CONTINUITY AND CHANGE
IN THE ORGANIZATION OF MANDAN CRAFT PRODUCTION, 1400-1750

by

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Continuity and Change in the Organization of Mandan Craft Production, 1400-1750

Thesis directed by Professor Douglas B. Bamforth

This study uses high-resolution data on the organization of stone tool and pottery production to write a precolonial and early colonial history of the Mandan towns at the confluence of the Heart and Missouri rivers. The dissertation begins by making a case for the crucial role archaeological methods and archaeological data can play in writing seamless "trans-Columbian" histories of Native communities spanning the advent of Europeans in North America. It then traces patterns of economic change in the Heart River region, especially the changing economic connections among contemporaneous communities. These patterns are woven together with ethnographic and historical data, as well as a new assessment of subsistence and settlement change, to support the dissertation's central claim that sociohistorical processes that began in the Heart region in the 1400s played a crucial role in structuring the regional political economy European fur traders encountered in the 1700s and 1800s.

Craft production data for the study derive from technological analyses of artifact assemblages from four Heart River communities the Mandans occupied between the late 1400s and the late 1700s. These data reveal the existence of both community- and household-level craft specialization, which in turn point to a web of economic connections among the Heart River towns. This evidence for specialized production is paralleled by evidence for subsistence intensification, an increase in local population density, an expansion of long-distance trade, and an increase in warfare. It was precisely under these conditions that Native groups in many parts of North America established inter-community political alliances known as confederacies. This study argues that the Mandans were no exception, and moreover that the Heart River confederacy of the sixteenth and seventeenth centuries was a keystone of the regional political economy.

This study fosters a more balanced view of colonial interaction by showing how Native history helped set the conditions for colonial engagement. In illustrating the value of archaeological research for writing trans-Columbian histories, it also helps forge theoretical and disciplinary links between archaeology and history. This dissertation is also the first modern synthesis of Heart River achaeology and the first multi-craft study carried out in the Plains.

For Stan, who led the way.

Acknowledgments

Stan Ahler kindled my interest in the archaeology of the Heart River region and so it is fitting that this dissertation builds directly on his lifetime of research on the Plains Village communities of the Middle Missouri. Stan pioneered the analytic methods I used to study stone tools and pottery. His thoughtful and meticulous work on more than a half-dozen Heart region sites forms the backbone of the project. Stan would not agree with everything I have written (and I have wished more than once that he was here to argue with me about it), but I am confident he would be pleased that the work he began continues.

Fern Swenson, the Director of the State Historical Society of North Dakota's Archaeology and Historic Preservation Division, has been—and continues to be—the driving force behind archaeological research in the Heart River region. Without her vision and tenacity we would know much less than we do about the region's complex archaeology. Fern generously made available the large collections I examined for this study and provided helpful comments on my analyses and interpretations.

This project, and Heart River research generally, rests on Ray Wood's many contributions to Middle Missouri archaeology, ethnohistory, and historical cartography. Indeed, anyone interested in learning about Plains Village archaeology can do no better than to begin by reading Ray's classic works on the subject. But Ray's contribution extends far beyond his exemplary scholarship. He also trained a generation of Plains archaeologists, Stan Ahler among them, who in turn have used what Ray taught them to make their own major contributions.

A truly remarkable group of scholars made up my dissertation committee. Doug Bamforth, who I first met on a spectacular quartzite quarry in Colorado's High Country 18 years ago, contributed in ways both large and small to every aspect of this study. Perhaps most importantly, he impressed on me the importance of clearly distinguishing what we reasonably know to be true from what we think might be true. Doug also did the readers of this dissertation

a great favor by kindly calling attention to (most of) my lapses into passive prose. I have had the pleasure of knowing Linda Cordell nearly as long. Linda served on my Master's thesis committee and both then and now she helped me refine my arguments and sharpen how I presented them. Interestingly, both Linda and Doug studied under Albert Spaulding, whose pioneering work at the Arzberger site continues to influence—more than 70 years on—how archaeologists think about the Middle Missouri. I must confess to taking a certain pride in thinking of myself as Spaulding's intellectual grandson, though it is probably just as well he is not here to offer his opinion on the subject. Art Joyce brought to the committee his nuanced understanding of current social theory and his broad knowledge of archaeological practice. I count myself fortunate to have participated in a series of stimulating graduate seminars Art led on archaeological method and theory. Finally, Steve Lekson and Brian DeLay helped me keep the bigger picture in view by encouraging me to put this study into wider frames of reference.

Throughout the project many people generously offered me their comments, counsel, expertise, and encouragement. Carl Falk's support was unwavering. Carl also shared with me his comprehensive knowledge of Middle Missouri archaeofauna and graciously allowed me to publish previously unreported data on bird remains from On-A-Slant Village. Dick Krause introduced me to the study of ceramic technology and shared with me his deep understanding of Middle Missouri systematics—along with one or two tall tales. Dick and I are both interested in the history of Plains archaeology, and I learned a great deal from him about the development of the scholarly community I now proudly call my own. My understanding of Middle Missouri pottery benefitted greatly from numerous discussions with Craig Johnson. Craig knows more about Middle Missouri ceramic traditions than anyone now working in the region. Craig also generously provided unpublished data on Extended Middle Missouri settlements and offered invaluable comments on several drafts of this study.

The project afforded me the pleasure of meeting Lil Fenn, a historian with a deep appreciation for the value of archaeological data. Lil's interest in the study affirmed my belief

that archaeology can and should contribute to wider discussions of Native North American's colonial experience. I found early inspiration for this study in Susan Vehik's thoughtful studies of Wichita lithic technology. Rich Wilshusen helped me refine many of the arguments I make here and provided insightful comments on an early draft of the first chapter. Curtis Nepstad-Thornberry and Dale Henning helped me understand the complexities of Initial Middle Missouri archaeology. Marvin Kay introduced me to the study of Plains warfare. Paul Picha taught me about Middle Missouri malacology. Michael Scullin and Wendy Munson-Scullin provided data on North Dakota chenopods and on Middle Missouri agriculture. Maxine McBrinn gave me a crash course on cordage production. Bill Billeck shared his encyclopedic knowledge of glass trade beads.

Most of these individuals are members of Paleocultural Research Group (PCRG), a non-profit organization devoted to archaeological and paleoecological research in the Plains and Rocky Mountains that Stan Ahler and his colleagues founded in 1996. Numerous PCRG members lent their time and talents to the organization's Heart River research. Many students from Northern Arizona University and the University of Colorado got their first taste of Plains Village archaeology in PCRG's lab. Stacey Bennett, PCRG's long-time Lab Supervisor, expertly managed the processing and quantification of collections from Double Ditch, Larson, and Boley villages. Stacey also carried out a laborious refitting study of the Double Ditch pottery assemblage that was a crucial prerequisite for my technological analysis. I am indebted to PCRG's Board of Directors for allowing me the time away from other projects to pursue this study.

I was ably assisted in the data collection phase of the project by Cassiope Sydoriak and Carolina Eichinger, both of whom received Undergraduate Research Opportunities Program grants from the University of Colorado to help fund their participation. Kelly Steckler, Director of the Mandan Public Library, graciously allowed me to open the library's display cases to examine artifacts from Scattered Village. Tim Reed, Research Archaeologist at the State

Historical Society of North Dakota, helped Fern manage the extensive artifact collections I studied. Val McBride, the Department of Anthropology's Graduate Program Assistant, and Lesa Morris, the Department's Office Manager/Program Assistant, cheerfully and expertly shepherded me through the graduate school experience.

I take special inspiration from the work of two remarkably versatile and prolific scholars. One is Bruce Trigger, whose book *A History of Archaeological Thought* should be on every archaeologist's bookshelf. In truth, I say very little in this dissertation that he has not already said with far more style than I can muster. The other is Kent Lightfoot. Kent's pioneering work at Fort Ross and elsewhere shows scholars interested in recent American Indian history what archaeology can really do.

Funding provided to PCRG and other institutions by the State Historical Society of North Dakota supported many of the field investigations and subsequent analyses that constitute the starting point for this project. The initial stages of my own work were supported by a three-year National Science Foundation Graduate Research Fellowship, supplemented by two Pre-Dissertation Research Grants awarded by the Department of Anthropology. A NSF Dissertation Improvement Grant (No. 0631295) funded the data collection phase of the study. I received a William H. Burt Award from the Museum of Natural History at the University of Colorado to visit the National Anthropological Archives to examine Alfred Bowers's ethnographic notes and to study artifacts curated by the Smithsonian's National Museum of Natural History. A Collections Study Grant from the American Museum of Natural History supported my study of artifacts and ethnographic data collected by Gilbert Wilson. Toward the end of the project, a Dissertation Completion Fellowship from the University of Colorado Graduate School allowed me to devote my full attention to writing. Of course, the opinions, findings, and conclusions expressed in this dissertation are my own, and do not necessarily reflect the views of the National Science Foundation or the other institutions supporting this project.

I would not have been able to complete this study without the love, encouragement, and

support of my partner, Cindy Souders, or my parents, Sue and George Mitchell. Cindy tolerated with good humor my all-too-frequent forays into the intellectual bushes. My parents instilled in me a passion for learning—a gift they received from their parents—and gave me the confidence and optimism to believe that anything can be achieved. To them, and to everyone who has helped me along the way, I offer my humble thanks.

Table of Contents

Chapter 1: Colonialism, Native History, and Archaeology 1
Into the Unknown 4
Archaeology and the Study of Colonial Engagement 12
Archaeological History and Indigenous History 18
Setting the Stage 20
Tribal Groups in the Middle Missouri 22
Research Themes 26

Chapter 2: Writing Archaeological History 29
Science and History 29
Indians, History, and Anthropology 31
Upstreaming into the Past 34
Colonial Narratives: Building the Cultural Baseline 35
From the Known to the Unknown: The Role of Direct Historical Research 38
Overcoming Obstacles to a Trans-Columbian Archaeological History 43
Confronting the Problem of History 43
History as a Genealogy of Skilled Performance 44
History and Materiality 48
Problem History 49
Tools for Writing Archaeological Histories 51
Downstreaming and the Supplementary Use of Documentary Sources 51
The Taphonomic Metaphysic 53
Archaeological Historical Data for the Heart Region 56
Measuring Variation in the Organization of Production 57
Craft Production as Skilled Performance 60

Chapter 3: Prior Models of Northern Middle Missouri Native History 64
The Ethnohistorical Model 64
Recent Revisions to the Ethnohistorical Model 71
The Northern Middle Missouri Model 74
Comparison 76
Research Questions 77

Chapter 4: Subsistence, Settlement, and Society in the Northern Middle Missouri, 1200-1750 80
The First Villages 80
Spatial and Temporal Distribution of Extended Middle Missouri Villages 86
The Middle Missouri Tradition Community 88
Extended Middle Missouri Settlements and Settlement Patterns 89
Post-1400 Settlement Change in the Heart Region 97

Northern Middle Missouri Society in the Nineteenth Century 102
The Changing Cultural Landscape of the Middle Missouri 105
Making a Living in the Northern Middle Missouri 107
Hunting and Fishing 108
Ethnographic Data on Hunting Practices and Comparisons with Archaeological Data 114
Farming and Harvesting 117
Ethnographic Data on Farming Practices and Comparisons with Archaeological Data 118
Hunting and Farming in the Northern Middle Missouri 122
Trading 123
Ethnographic Data on Trade Practices and Comparisons with Archaeological Data 128
Summary 130

Chapter 5: Building an Archive for Archaeological History in the Heart Region 132
Measuring Time in the Northern Middle Missouri 132
Depositional Context: Assessing Accumulation Duration 137
Heart Region Sites 138
The Four-Site Subsample 141
The Modified Stone Assemblage 143
The Pottery Vessel Assemblage 146

Chapter 6: Crafting History, Part I: Stone Tool Production in the Heart Region, 1400-1750 148
Previous Research on Northern Middle Missouri Lithic Technology 148
Raw Material Selection 159
Diversity within Temporal Groups 167
Tool Assemblage Diversity 171
Within-Site Variation in Stone Tool Technology 178
Production Errors and Product Uniformity 180
Metric Characteristics of Skill Groups 183
Skill in Small Patterned Biface Production 185
Skill in Large Patterned Biface Production 187
Production Sequences 189
Heat Treatment of Knife River Flint 189
Arrow Manufacturing Techniques 194
Discussion 196

Chapter 7: Crafting History, Part II: Pottery Production in the Heart Region, 1400-1750 202
Previous Research on Pottery Technology in the Northern Middle Missouri 202
Heart Region Pottery Types 205

S-Rim Wares 206
Straight-Rim Wares 210
The Fifteenth-Century Technological Transformation 212
Post-1500 Ceramic Diversity 215
Spatial Variation in Manufacturing Techniques 218
Associations between Style and Technology 222
The Sperry Horizon 224
Cordage Manufacture 230
Skill in Pottery Production 233
Discussion 238

Chapter 8: An Archaeological History of the Heart River Region 243
Creating Tradition 244
Transformation 253
Population Aggregation and Settlement Clustering 253
Expansion of Trade and Interaction 256
Forager-Farmer Interaction 257
Inter-village Interaction 259
Patterns of Economic Change 263
Subsistence Intensification 264
Changes in the Organization of Craft Production 268
Intra-regional Interaction 278
Warfare 281
An Emerging Heart River Confederacy 284
Sociohistorical Processes in the Heart Region 291
The Role of Climate Change 292
A First-Generation Narrative of Historical Change in the Heart Region 296
Problem History in the Heart Region 300
Comparisons with Prior Models of Heart Region History 302
Critical Junctures in Heart Region History 304
Into the Unknown 305

References Cited 307

Appendix 1: Time, Space, and Taxonomy in the Northern Middle Missouri 374
A Brief History of Research 374
Spatial Units 379
Temporal Units 382
Northern Middle Missouri Taxonomies 382
Summary of Northern Middle Missouri Systematics 383
Evaluating Northern Middle Missouri Taxonomic Systems 388

Appendix 2: Site Data **393**
Extended Middle Missouri Sites 393
Chronology 393
Site Data 395
Settlement Size 395
Number of Houses 397
Settlement Layout 397
Occupation Duration 398
Architectural Data 399
Extended Middle Missouri Sites Data Notes 400
Post-1400 Sites 408
Site Data 411
Settlement Size 411
Number of Houses 411
Settlement Layout 412
Architectural Data 413
Post-1400 Sites Data Notes 414

Appendix 3: Datasets and Analytic Methods **421**
The Study Sites 421
Analytic Unit Selection 423
Data Collection 426
Stone Tool Analysis 427
Methods and Variables 428
Modified Variables 435
Newly Defined Variables 437
Pottery Analysis 438
Methods and Variables 442
Pottery Types 443
Technological Variables 450

List of Tables

Table 1. Analytic dimensions and archaeological measures for studying the organization of craft production. 58
Table 2. Extended Middle Missouri community sizes. 90
Table 3. Sizes of Initial Middle Missouri (IMM) and Extended Middle Missouri (EMM) houses. 95
Table 4. Frequency of public plazas at Extended Middle Missouri settlements. 96
Table 5. Frequency of fortified Extended Middle Missouri settlements. 97
Table 6. Changes in residential density and site size over time in the northern Middle Missouri. 99
Table 7. Proportional distribution of identified faunal remains (NISP) in Late Woodland and Extended Middle Missouri assemblages. 110
Table 8. Proportional distribution of identified faunal remains (NISP) in two fifteenth-century Heart region assemblages. 111
Table 9. Proportional distribution of identified faunal remains (NISP) in seven post-1500 assemblages from the northern Middle Missouri. 112
Table 10. Estimated maize yields, calculated field sizes, and minimum distances to farthest fields over time 121
Table 11. Summary data on six Heart region study sites. 140
Table 12. Data on analytic units in the four-site subsample. 143
Table 13. Data on analytic units in the four-site subsample. 144
Table 14. Numbers of stone tools and waste flakes in the six-site Heart region sample. 144
Table 15. Number of bifacial stone tools in the four-site subsample 145
Table 16. Summary data on the ceramic assemblages from six Heart region sites. 146
Table 17. Number of pottery vessels in the four-site subsample. 147
Table 18. Stone tool technological class definitions. 149
Table 19. Heart region raw material groups and raw material types. 159
Table 20. Composition of flaking debris assemblages from six Heart region sites. 163
Table 21. Distribution of raw material groups across three artifact classes 164
Table 22. Frequencies of flakes assigned to five raw material groups in 58 analytic units from Double Ditch Village 168
Table 23. Distribution of tool technological classes according to site 173
Table 24. Frequency of recycled stone tools in the four-site subsample. 174
Table 25. Distribution of tool classes in the Heart region sample. 176
Table 26. Frequency of bifacial tool types in the four-site subsample, organized by site. 177
Table 27. Frequency of bifacial tool types in the four-site subsample, organized by regional time period. 178
Table 28. Frequencies of 11 tool classes in 36 pit features at Scattered Village 179
Table 29. Skill expression in small and large patterned bifaces. 183
Table 30. Metric data on arrowpoints organized by skill group. 184

Table 31. Skill expression in small patterned biface production, organized by site. 186
Table 32. Temporal trends in the skill of small patterned biface production. 186
Table 33. Skill expression in large patterned biface production, organized by site. 187
Table 34. Temporal trends in the skill of large patterned biface production. 188
Table 35. Comparison of heat treatment rates among three technological classes. 190
Table 36. Temporal trends in heat treatment rates in small and large patterned bifaces. 191
Table 37. Heat treatment rates for small patterned bifaces. 191
Table 38. Heat treatment rates in small patterned bifaces for two sites in the Knife region. 192
Table 39. Heat treatment rates in Knife River flint tools. 192
Table 40. Comparison of skill expression in small patterned bifaces made from heated and unheated KRF. 193
Table 41. Frequency of arrowpoint haft preparation techniques, organized by producer skill. 195
Table 42. Frequency of arrowpoint haft preparation techniques, organized by site. 195
Table 43. Frequencies of pottery wares in the four-site subsample. 213
Table 44. Frequencies of rim form classes in the four-site subsample. 214
Table 45. Frequencies of upper rim construction techniques used to produce pottery vessels in the four-site study sample 214
Table 46. Frequencies of eight interior color classes in size grade 1 vessel fragments in the four-site subsample. 215
Table 47. Frequencies of eight pottery wares in three post-1500 Heart region assemblages. 216
Table 48. Frequencies of Le Beau ware varieties within each post-1500 assemblage. 218
Table 49. Frequencies of rim forms used on Le Beau Classic variety vessels in three post-1500 Heart region assemblages. 219
Table 50. Frequencies of upper rim construction techniques used to produce Le Beau Classic variety vessels in three post-1500 Heart region assemblages. 219
Table 51. Frequencies of upper rim construction techniques used on Le Beau Recurved variety vessels 220
Table 52. Frequencies of lower rim construction techniques used on Le Beau Classic vessels. 220
Table 53. Frequencies of upper rim construction technique used on Knife River ware vessels at Scattered and Double Ditch villages. 221
Table 54. Temporal trends in upper and lower rim construction techniques at Double Ditch Village. 221
Table 55. Comparison of methods used to finish the lower rim on Le Beau and Knife River ware vessels. 224
Table 56. Condition and shape of the upper rim in Le Beau and Sperry ware vessels from Double Ditch Village. 225
Table 57. Upper rim surface treatment on Le Beau and Sperry ware vessels from Double Ditch Village. 225
Table 58. Matrix comparing interior and exterior surface colors on Sperry, Le Beau, and Knife River ware vessels. 226

Table 59. Interior paste colors in Sperry, Le Beau, and Knife River ware vessels. 226
Table 60. Frequencies of upper rim construction techniques in Le Beau and Sperry ware vessels from three post-1500 assemblages. 227
Table 61. Frequencies of lower rim construction techniques in Le Beau and Sperry ware vessels in three post-1500 assemblages. 227
Table 62. Frequencies of appendages on Le Beau and Sperry ware vessels from Double Ditch Village. 228
Table 63. Spatial distribution of major wares in three post-1700 analytic units at Double Ditch Village. 229
Table 64. Regional temporal trends in cordage final twist direction. 230
Table 65. Inter-site comparison of mean cord diameter. 231
Table 66. Inter-ware comparison of mean cord diameters. 232
Table 67. Between-site comparison of skill in pottery production. 235
Table 68. Inter-ware comparison of skill in pottery production. 236
Table 69. Inter-site comparison of skill in pottery production. 237
Table 70. Inter-site comparison of pottery production skill expressed in five varieties of Le Beau ware. 237
Table 71. Temporal trends in the skill of Heart region potters. 238
Table A1. Plains Village cultural-temporal units for the Middle Missouri subarea. 382
Table A2. Extended Middle Missouri sites in the study sample. 394
Table A3. Extended Middle Missouri site size, residential density, and layout. 396
Table A4. Extended Middle Missouri settlement occupation duration data. 399
Table A5. Mean sizes of Extended Middle Missouri houses. 400
Table A6. Sites in the post-1400 sample. 410
Table A7. Post-1400 site size, residential density, and layout. 412
Table A8. Mean sizes of post-1400 houses. 414
Table A9. Technical reports describing field and lab investigations carried out at six Heart region sites. 421
Table A10. Data on 80 analytic units included in the four-site sample. 424
Table A11. Synonymy between site-specific (TP) and regional time periods. 426
Table A12. Stone tool sample size data. 429
Table A13. Variables and attributes used in the stone tool study. 431
Table A14. Metric variables recorded on patterned bifaces. 436
Table A15. Stone tool production skill categories. 438
Table A16. Pottery vessel provenience and sample size data. 440
Table A17. Summary data on pottery vessel sample size by site. 442
Table A18. Summary data on pottery vessel sample size by regional time period. 442
Table A19. Pottery analysis variables and attributes. 446
Table A20. Pottery production skill categories. 454

List of Figures

Figure 1. Map of the Northern Plains and the Missouri River valley. 3
Figure 2. The Missouri River valley. 21
Figure 3. Archaeological regions of the Middle Missouri subarea. 22
Figure 4. John Ewers's map of Northern Plains trade relationships at the turn of the nineteenth century. 68
Figure 5. Map showing the locations of Initial Middle Missouri (IMM) and Extended Middle Missouri (EMM) settlements. 81
Figure 6. The floodplain gallery forest, cleared for fields of maize. 89
Figure 7. The Middle Missouri uplands. 90
Figure 8. Plan views of two Extended Middle Missouri settlements. 91
Figure 9. Two views of Middle Missouri tradition lodges. 93
Figure 10. Map of the Heart region showing major settlements occupied after about 1500. 101
Figure 11. A segment of the IntCal09 radiocarbon calibration curve 134
Figure 12. Changing frequencies of metal fragments and glass beads from four sites in the Heart region and two in the Knife region, plotted against estimated mean age. 135
Figure 13. Map of the central Heart region showing the locations of sites included in the study. 139
Figure 14. Double Ditch Village, looking to the southeast. 140
Figure 15. Larson Village, looking to the northwest 141
Figure 16. Temporal structure of the excavated samples from six Heart Region sites. 142
Figure 17. Small patterned bifaces 150
Figure 18. Large patterned bifaces 151
Figure 19. Stone tools. 153
Figure 20. Stone tools. 156
Figure 21. General locations of chipped stone raw materials used by Heart region flintknappers 160
Figure 22. S-rim wares from the Heart region. 207
Figure 23. S-rim wares from the Heart region. 209
Figure 24. Straight rim and S-rim wares from the Heart region. 211
Figure 25. Comparison of surface and core colors in Knife River ware and Le Beau ware vessels in three post-1500 Heart region assemblages. 223
Figure 26. Scatterplot showing the relationship between cord spacing and cord diameter on Le Beau ware vessels from three post-1500 Heart region assemblages. 234
Figure A1. Archaeological regions of the Middle Missouri subarea. 381
Figure A2. Generalized drawing of a Plains side-notched arrowpoint showing measurement locations. 436
Figure A3. Examples of northern Middle Missouri rim profiles. 444
Figure A4. Drawings of rim sherd cross-sections for each rim form class. 445

Chapter 1:

Colonialism, Native History, and Archaeology

For the better part of the twentieth century, archaeologists and anthropologists structured their studies of Native culture change since 1500 around a seemingly straightforward question: how were indigenous societies affected by the advent of Europeans? But as the century drew to a close many began to recognize that this keystone question grows from a complex web of colonial-era beliefs about American Indians and First Nations Peoples. Reflecting on the political and social controversies surrounding the 1992 Quincentennial of Columbus's landfall, and spurred on by the passage in 1989 of the Native American Graves Protection and Repatriation Act, they set about untangling that web, in the process building a new conceptual framework that sees indigenous peoples as active, knowledgeable participants in colonial projects. Now, armed with a new appreciation of Native North Americans as historical actors, many archaeologists aim for a deeper understanding by turning their long-favored question on its head, asking instead how the precolonial histories of Native North Americans affected their subsequent engagement with the colonists.

And yet, despite these conceptual strides, I believe two interconnected obstacles stand in the way of truly satisfying answers to this new question. The first is substantive: archaeologists have written about Native lifeways but few empirical histories of Native communities exist for the centuries prior to the advent of literate Europeans. Archaeological research can provide the raw data necessary for writing precolonial Native histories, but archaeologists only recently have begun doing so. Their reluctance to enter the historical fray stems largely from the second obstacle. Since the late nineteenth century, the production of recent Native histories has been tightly bound to the study of colonial documents. Writing precolonial histories requires archaeologists to confront that disciplinary legacy and, more importantly, devise new research strategies that privilege archaeological data.

This dissertation tackles both of these obstacles. Most importantly, it aims to write an archaeological history of the Native farming towns clustered around the confluence of the Heart and Missouri rivers (figure 1). In the eighteenth century, these towns, home to the Mandan people, became hubs of the Northern Plains fur trade, one of the principal modes of early colonial engagement across much of North America. Later, in the early nineteenth century, the Mandans, who by then were living upstream at the mouth of the Knife River, hosted a succession of explorers and fur traders. These visitors' vivid and sympathetic accounts paint an intimate portrait of colonial-period Native life on the Missouri. But they say nothing about how the Mandan's communities changed and developed during the centuries before the appearance of Europeans and European trade goods.

This history relies on new, high-resolution data on the organization of pottery and stone tool production. Thanks to a state-of-the-art research program that began in the Heart River region in the late 1990s, it is now possible to describe in detail how craft production changed there over a three century period, from the mid-1400s to the mid-1700s. Accordingly, this account of Heart region history focuses on patterns of economic change, especially the changing economic connections among contemporaneous communities, along with the political implications of those connections. Combined with a new assessment of subsistence and settlement change, it marshals these craft production data in support of the dissertation's central claim that historical developments in the Heart region, beginning in the 1400s and accelerating in the 1500s and 1600s, played a crucial role in structuring the economic and political landscape that European traders confronted when they entered the Northern Plains in the 1700s and early 1800s.

As a crucial first step, I begin by surveying conceptual and methodological barriers to the production of archaeological histories. I then offer a series of proposals for overcoming them. The first, and most important, is to apply the principles of an emerging theoretical approach in archaeology known as "historical processualism" to the study of Native culture change spanning

the advent of Europeans. The second is to reconfigure the ways archaeologists use documentary evidence in their research on recent indigenous culture change.

This history is a necessary building block for a more comprehensive understanding of

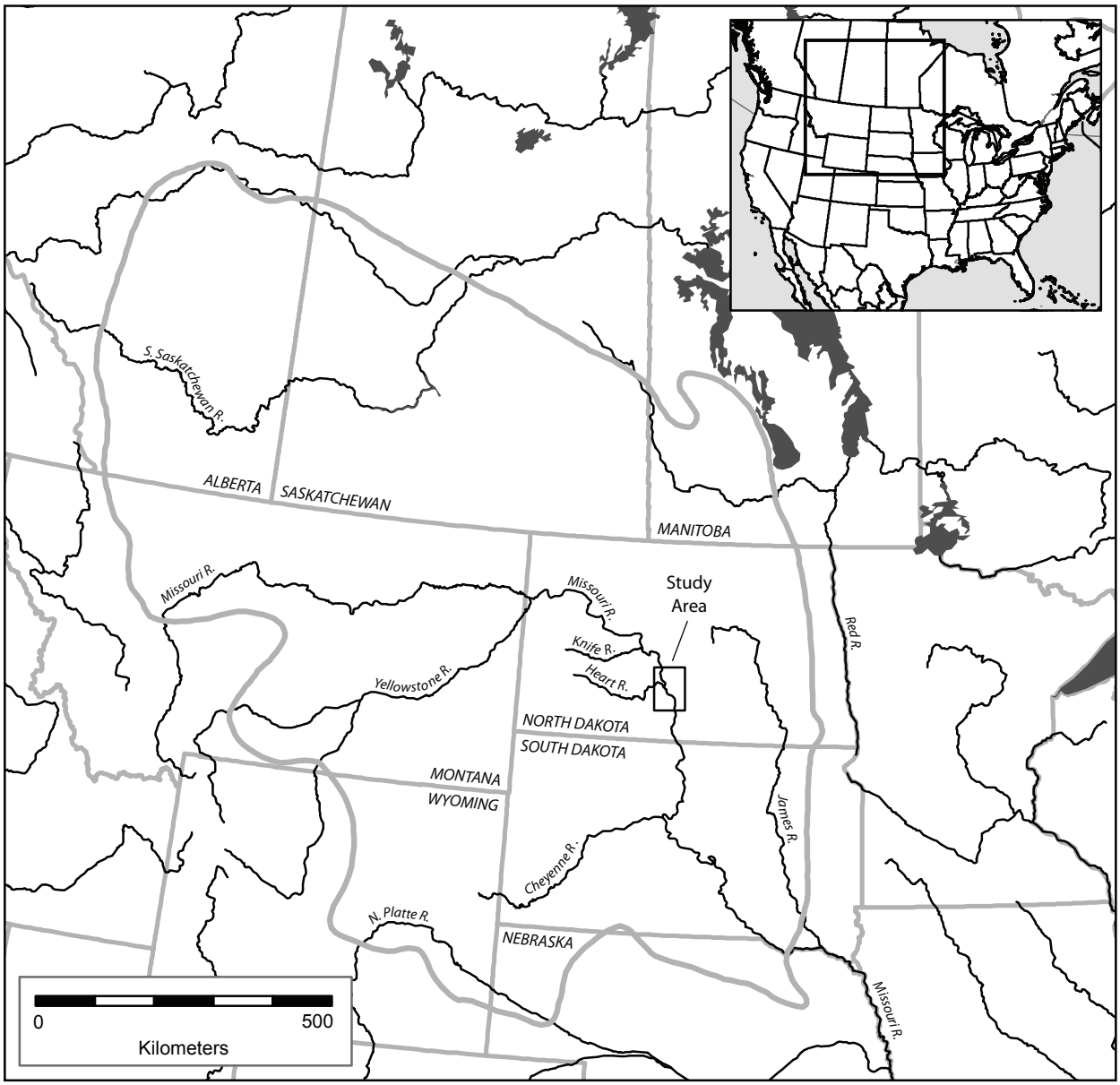

Figure 1. Map of the Northern Plains and the Missouri River valley. From the Niobrara River to the North Saskatchewan River and from the James River to the Rocky Mountain Front, the Northern Plains encompasses nearly 650,000 sq. km spread across five U. S. states and three Canadian provinces.

the Northern Plains fur trade. But it also satisfies a more immediate goal. Long-term Native histories written from archaeological data add to the "consultable record," as the anthropologist Clifford Geertz (1973:30) puts it, of what people have done in the past. The value of this record transcends the aims to which historians or anthropologists might put it. This may be the most important lesson gleaned from reflections on the Quincentennial: histories matter in their own right, not simply as exemplars of the steps and stages of human cultural evolution.

Into the Unknown

During the first week of April 1805, Meriwether Lewis, William Clark, and the men of the Corps of Discovery were making arrangements to leave their winter quarters near the Mandan and Hidatsa towns at the confluence of the Knife and Missouri rivers. Lewis, writing in his journal for the first time in nearly two months, expressed their eagerness to be underway: the men, he said, are "in excellent health and sperits, zealously attatched to the enterprise, and anxious to proceed, not a whisper of murmur or discontent to be heard among them, but all act in unison, and with the most perfect harmony" (Ambrose 1996; Lewis 2002a). To be sure, they kept themselves busy throughout the long northern winter, visiting and trading with their Native neighbors, learning what they could about the complex politics of the region, about opportunities for commerce, and about what lay ahead. But by April the cramped confines of the simple log structure they dubbed Fort Mandan must have become unbearable for men used to frontier travel. Now, late in the afternoon of April 7, with the spring thaw underway, they eased their boats into the cold current of the Missouri, pulling confidently upstream, bound for the Rockies.

And yet, for all their outward self-assurance, many of men must have felt the same uneasiness Lewis confessed in his journal that night:

> Our vessels consisted of six small canoes, and two large perogues. This little fleet altho' not quite so rispectable as those of Columbus or Capt. Cook were

> still viewed by us with as much pleasure as those deservedly famed adventurers ever beheld theirs; and I dare say with quite as much anxiety for their safety and preservation. we were now about to penetrate a country at least two thousand miles in width, on which the foot of civillized man had never trodden; the good or evil it had in store for us was for experiment yet to determine, and these little vessells contained every article by which we were to expect to subsist or defend ourselves [Lewis 2002a].

After all, the settlements on the Knife were perched on the brink of the world then known to Europeans. Traders and explorers first came to the Native towns strung along the Missouri in the early eighteenth or, perhaps, late seventeenth century (Jantz and Owsley 1994). Beginning in the 1780s, French, English, and Spanish fur traders visited regularly (Wood 2003; Wood and Thiessen 1985). But only a handful traveled farther west. In 1793, Alexander Mackenzie, exploring for the North West Company, became the first European to cross the continent north of Mexico (Gough 1997). Lewis and Clark read Mackenzie's account, but the map produced for their journey lacks cartographic details west of the Knife (Gilman 2003). The captains knew the width of the continent but almost nothing about the geography of the Northwest. Logic dictated that there must be a "height of land" separating the headwaters of the Missouri from those of the Columbia (Allen 1975), but on their map the Northern Rockies are shown simply as a single, sinuous range, not the complex succession of peaks and valleys they proved to be. The region's major rivers are indecisively depicted by dash lines.

Even more ominously for the fate of the expedition, the captains knew almost nothing about the Native peoples of the Northwest. They recognized that the blank spot on their map was "a crowded wilderness," as the historian James Ronda (2002:1) puts it, though scholars now know that epidemic disease already had taken a terrible toll (Fenn 2001). But they were dangerously ignorant of the people they would encounter there, people on whom their lives would depend. Indeed, President Jefferson's instructions to Lewis expose the captain's profound

lack of knowledge about their Indian hosts. He charged them to learn:

> the names of the nations & their numbers; the extent & limits of their possessions; their relations with other tribes or nations; their language, traditions, monuments; their ordinary occupations in agriculture, fishing, hunting, war, arts, & the implements for these; their food, clothing, & domestic accommodations; the diseases prevalent among them, & the remedies they use; moral and physical circumstance which distinguish them from the tribes they know; peculiarities in their laws, customs & dispositions; and articles of commerce they may need or furnish, & to what extent [Jackson, ed. 1978:62].

Leaving Louisiana, they soon discovered that Native groups in the Northwest, like the Mandans and Hidatsas with whom they spent the winter, had been participants in the developing world economy for some time and in fact knew quite a lot about European material culture. Crossing the Continental Divide at Lehmi Pass in present-day Montana, Lewis was able to draw the attention of the Shoshones, from whom he hoped to purchase horses. They did not disappoint: the band Lewis stumbled on owned at least 400, obtained from Spanish merchants or Native brokers living on the fringes of New Spain far to the south. From these same sources they bought cloth, beads, metal tools, and marine shell ornaments. Some of the Shoshones carried Northwest guns that likely came to them from the Missouri River towns by way of the Crows, along with metal arrow points and other items (Lewis 2002b).

Probing to fill in the blank spots on his map, Lewis discovered that, in addition to their horse wealth, the Shoshones possessed a remarkable stock of geographical knowledge. From their annual visits to the Plains and from their interactions with the Crows they knew of the Mandan and Hidatsa towns on the Missouri. From their Nez Perce neighbors to the west they knew too that European traders operated on the lower reaches of the Columbia. They even knew something of the geopolitical jostling among European powers for control of the Northwest, telling Lewis that the firearms embargo the Spanish imposed put the Shoshones at a strategic

disadvantage relative to the Native clients of British and French traders with whom they competed (Lewis 2002c). In the end, Lewis discovered to his dismay that the Shoshones were well versed in the principles of a market economy, finding that the prices they charged for their horses increased in proportion to their perception of his need (Ronda 2002:154).

Pushing on, the Corps observed European trade goods in nearly every community they visited. Among the Nez Perce they saw glass beads, brass ornaments, copper kettles, and, of course, horses. On their return trip in 1806, members of the expedition would see Spanish coins and even an iron axe their own blacksmith made at Fort Mandan the previous winter (Ewers 1954:444-445; Ronda 1991:177). When they reached the Columbia in late October 1805, they spotted European clothing, blankets, glass beads, and countless metal tools and containers. They even heard their Native hosts use salty phrases borrowed from English-speaking sailors. At The Dalles, they encountered a cluster of Native towns they called the "great mart of trade," which turned out to be the hub of a vast network comparable in scale to the system centered on the Missouri with which Europeans of the day were more familiar (Ronda 2002:170). The Native merchants on the Columbia bought and sold manufactured goods, food stuffs, raw materials, cultural knowledge, even people, fueling their transactions with colossal quantities of dried salmon (Ronda 2002; Wood 1980).

Lewis and Clark's testimony shows that the effects of European colonization began rippling through the Native societies of Louisiana and the Northwest long before their arrival. In a real sense the world they encountered there was a colonial world, affected in crucial ways by the advent of Europeans. Certainly, some of the impacts of colonization had begun only recently. Spanish and British ships had been visiting the Pacific coast regularly for just 30 years (Cook 1973; Walker and Sprague 1998). In the 1780s and 1790s, they were joined by Russian and American traders. Northwest guns may have reached the Shoshones at about the same time. But other effects had been felt for generations. The horses Lewis so eagerly sought had come to the Columbia Plateau more than a century earlier. Metal tools first appeared in the Missouri River

towns 150 years before Lewis and Clark (Ahler and Drybred 1993). Thus, no single temporal or spatial scale adequately frames the varied processes European colonization set in motion.

But the world Lewis and Clark witnessed was equally a product of more ancient forces. The great extent and complexity of the Pacific-Plateau trade system signify the fact that it had begun operating long before European merchants appeared at the mouth of the Columbia. In fact, data on the age and distribution of the most archaeologically visible trade goods—stone tools made from obsidian and ornaments made from marine shell—indicate that a massive trade network centered on the settlements at The Dalles had existed there for centuries (French and French 1998; Galm 1994). Steatite, native copper, and other minerals circulated as well, but it was an abundant and renewable resource—salmon—on which the Native merchants on the Columbia built their system, just as their Mandan and Hidatsa counterparts on the Missouri had built a trade system on the twin pillars of maize and bison.

The Corps of Discovery's experiences and observations in Louisiana and the Northwest convey a truth about European colonialism in North America that anthropologists, archaeologists, and historians only recently have come to appreciate: that the impacts of the novelties the colonists introduced only can be fully understood in the context of local history and local culture (Sahlins 1981, 1985, 2004; Trigger 1982). Indian people drawn into the emerging colonial world—like the colonists themselves—engaged the changes sparked by European settlement "facing backwards, interpreting and dealing with new exigencies as they arose in terms of relationships and ideas they had already known" (Chanock 1985:15). Their history and traditions shaped their perception of, and creative entanglement with, the challenges and opportunities presented by the advent of Europeans.

Karl Marx (1978:595) expresses this idea in more abstract terms: "Men make their own history, but they do not make it as they please; they do not make it under self-selected circumstances, but under circumstances existing already, given and transmitted from the past." Some of those circumstances are material. The resources available to individuals, households,

and communities are dictated by their long-term engagement with the places they live and by technologies and extractive practices that developed over time (Brumfiel 2003; Fisher and Feinman 2005; Ingold 1993). Other circumstances are cultural and social. People justify their actions and frame their experiences, no matter how novel, in terms of previously established cultural schema (Brumfiel 2003). Identities, too, are built on history. Sometimes, people use their traditions to build communities and alliances, to assert privileges for themselves or deny them to others. But just as often, the historical constitution of identity goes unrecognized, built as it is on everyday activities and taken-for-granted relationships. Of course, neither histories nor identities are static because the conditions under which people enact their traditions are constantly in flux. Put another way, history is continuously calibrated—remembered and forgotten—to the changing social and material circumstances of the moment.

For these reasons, the lives of the people Lewis and Clark met in Louisiana and the Northwest—or those of indigenous people living anywhere else in colonial North America—need to be understood not simply as a reaction to the coming of the colonists, but rather as a conjunction or intersection of multiple histories, both Native and European. The social structures, economic practices, and symbolic systems of post-1500 Native societies reflect a dynamic interplay of forces operating at a variety of scales. Europeans introduced new technologies, new economic practices, and new social forms, but those novelties were appropriated, resisted, modified, or ignored according to indigenous meanings, indigenous relationships, and indigenous practices, the origins of which lie in the 1400s, 1300s, or earlier. A comprehensive understanding of colonial-period American Indian culture change—and, ultimately, of colonialism itself—must therefore rest on historical analyses that consider both European and Indian conduct from a variety of temporal and spatial perspectives.

Until quite recently, though, anthropologists paid scant attention to the role pre-1500 Native histories played in the historical constitution of Native (or European) action in the colonial period. In keeping with the assumptions of their keystone question, in the past most

emphasized the motivations and actions of the colonists, as well as the seemingly unprecedented effects of the new technologies, diseases, plants, and animals they brought with them. For instance, anthropologists and archaeologists working in the Northern Plains have seen the advent of horses and European trade goods as cultural, social, and economic watersheds. A byproduct of this emphasis on European agency was the cognate, if tacit, view that American Indians and First Nations peoples were passive recipients, rather than authors, of history (Rubertone 2000). Fortunately, this approach has steadily receded in recent decades, thanks in large measure to the interest anthropologists have taken in Native histories. Beginning in a limited way with acculturation research in the 1950s, and accelerating greatly with the maturation of ethnohistory and especially historical anthropology in the 1960s and 1970s, anthropologists have shown that Native beliefs, Native experiences, and Native actions shaped the course of colonial interaction (Cusick 1998; Sahlins 1981, 1985; Trigger 1991).

But a second reason for a lack of attention to long-term Native histories lingers. Most scholars continue to make extensive use of documents written by the colonists themselves, along with ethnographies produced long after the first appearance of Europeans, to tell the story of colonial-period indigenous culture change. To be sure, these scholars have long recognized, and grappled with, the biases, preconceptions, and misunderstandings that the colonists brought to their chronicles (Galloway 2006; Wood 1990). As the archaeologist Bruce Trigger (1986:264) quips, "ethnohistory has mainly been valuable for what it has told Euroamericans about themselves." But other, more intractable problems flow from a reliance on documentary sources. One is the things colonial texts fail to mention, their silences and omissions (Stahl 2001). As the geographer John Allen (2002) shows, current views of the early nineteenth-century landscape of Louisiana and the Northwest owe a great deal to Lewis's ideas about the relationship between Indians and the environment, ideas he inherited from Thomas Jefferson, Benjamin Rush, and other leaders of the American Enlightenment. Lewis, Allen (2002:4) concludes, "simply did not have an intellectual construct that permitted [him] to view Indian populations a shapers and

modifiers of the environment."

Beyond their misunderstandings and omissions, though, is the inescapable fact that no matter how keen their observations, no matter how much sympathy they may have felt for their subjects, the colonists simply lacked an understanding of the sociohistorical processes at work during the centuries before they arrived. Certainly, they report on practices they believed reflected precolonial indigenous traditions, but the truth is that their grasp of pre-1500 Native histories was based at least as much on their own beliefs about the differences between Natives and themselves—especially on the assumption that Native societies inevitably changed when they came in contact with European societies—as it was on evidence they gathered about specific patterns of development (Mitchell and Scheiber 2010). Careful historical vetting, necessary as it is, cannot entirely winnow their assumptions from their observations and so, while colonial descriptions will remain crucial for understanding post-1500 events and processes (not coincidentally the period of greatest interest to ethnohistorians), other sources are needed to investigate longer-term Native histories (Galloway 1997).

Archaeological research, though by no means the only other source, offers the most abundant data for writing precolonial histories of Native peoples (Trigger 1983). Of course, archaeology has long been afforded a supplementary role. For one thing, archaeological research offers unparalleled spatial and temporal coverage. Archaeological data are not limited to the places literate Europeans visited, but also reveal the forces shaping Native communities located well away from European settlements or trade routes. For another, archaeological data can fill some of the silences in the documentary record. Men wrote most historical narratives and they commonly emphasize public ceremonies and fateful meetings; information about everyday domestic activities, especially those of women or children, is far less abundant. Archaeological data, by contrast, mostly record the intimate rhythms of daily life and therefore can be used to study all members of society, not simply those with whom Europeans interacted.

But archaeology can do much more. Apart from its capacity to fill gaps in the written

record, archaeological methods and data offer a congruent observational standpoint spanning the advent of Europeans, from which longer-term patterns of continuity and transformation can be seen. Archaeological research, though by no means unencumbered by the intellectual legacy of colonialism, has the potential to produce a seamless "trans-Columbian" account that puts Native histories before and after 1500 on equal methodological footing. And yet, despite the obvious strengths of their data for investigating the impact of pre-1500 Native histories on post-1500 colonial engagement, archaeologists seldom have pursued this line of research.

Archaeology and the Study of Colonial Engagement

I am not suggesting that archaeologists have failed to contribute to the study of colonial interaction. Just the opposite is true: over the last 20 years archaeologists have mounted increasingly sophisticated challenges to conventional views of colonial-period indigenous communities, in the process bringing the experiences of American Indians and First Nations peoples to the fore in broader discussions on the course of colonialism (Lightfoot 1995; Scheiber and Mitchell, eds. 2010). It is no exaggeration to say that archaeologists are now making substantial contributions to a more comprehensive understanding of European colonialism in the Americas.

Their success rests on a series of interconnected theoretical innovations (Stein 2002). The most crucial is a shift toward smaller-scale analyses. Archaeologists now recognize that colonialism needs to be understood not only as a macro-scale political and economic phenomenon but also as a micro-scale social phenomenon, one directly affecting the life chances of individuals, families, and communities (Deagan 1983, 1996; Lightfoot et al. 1998; Trigg 2005). Quotidian connections among people shed light on colonial interaction for at least two reasons. On the one hand, many everyday tasks—food preparation, tool making, or house building—are charged with social and symbolic meanings in plural communities and therefore

can become flash points for social and political negotiation (Silliman 2001). On the other hand, and perhaps more importantly, social identities are both maintained and transformed in the performance of everyday activities (Lightfoot and Martinez 1995; Lightfoot et al. 1998).

This focus on everyday practice leads to a second innovation. Archaeologists have shown that colonialism was not a "bipolar confrontation" between monolithic cultural entities, but rather a complex conjunction of socially heterogeneous communities (Gosden 2004; Stein 2002:906; Stoler 1989). Both European settlements and contemporaneous indigenous communities were complex constellations of individuals, who spoke different languages, who had different interests, and whose access to social and material resources varied. They experienced and participated in colonial interaction in different ways, depending on their class, gender, age, faction, or ethnicity (Frink 2010; Vehik et al. 2010; Voss 2008). In turn, the recognition that people's experiences differed has encouraged archaeologists to consider how the actions of people rarely mentioned in historical documents, including women, children, and slaves, affected the course of colonial interaction.

Attention to differential experience drives home the point that Indians were active participants in colonial engagement, not simply witnesses to an unfolding colonial drama (Gosden 2004; Rubertone 2000; Williamson 2004). The inability of Native people (or their European counterparts for that matter) to fully anticipate the ultimately catastrophic effects of their involvement does not mean they were powerless to affect its structure (Mitchell and Scheiber 2010). On the contrary, Native people exploited opportunities presented by the colonial economy to further their own social, political, and economic ends. They could be, for instance, "aggressive, discriminating consumers," whose preferences expressed local tastes and local symbolic systems (Anderson 1994:94; Miller and Hamel 1986; Stahl 2002). For this reason, Indians as well as Europeans need to be understood as "culturally produced and culturally producing, historically contingent social agents," with their own standpoints grounded in their experiences and their identities (Sahlins 1996; Silliman 2005:66).

Together, the attention paid to local interaction and Native agency has helped archaeologists move beyond the "culture contact" approach taken by anthropological acculturation researchers and by generations of their predecessors (Rubertone 2000; Silliman 2005). In part, the move away from the acculturation framework was compelled by empirical data showing that culture change and the initiation of face-to-face interaction seldom occurred at the same time. Perhaps the clearest example of the lack of synchrony between the initial appearance of Europeans and the effects of European colonialism is the spread of epidemic diseases, perhaps as early as the sixteenth century (Dobyns 1983; Ramenofsky 1987). In other cases, though, Native cultures changed in significant ways only after long experience with Europeans (Kulisheck 2010).

There also are theoretical challenges to the concept of culture contact (Rothschild 2003; Silliman 2005). The acculturation model makes too much of trait lists. It treats Native cultures as if they were isolated, organic systems. Instead of viewing colonialism as a long-term process, the acculturation perspective conceives "contact" as an event, and this has overemphasized the stability of precolonial Native communities as well as the instability of their colonial-era successors. And it downplays the violence of colonialism, embodied in slavery, warfare, and displacement.

It should be said that historians have taken up many of these same theoretical innovations. Building on the pioneering work of James Axtell (1981), Arthur Ray (1978), Bruce Trigger (1976), Richard White (1991), and others, many now promote the need to incorporate what Neal Salisbury (1996) calls the "American background" to European colonialism (Binnema 2001; Calloway 2003, DuVal 2006; Hämäläinen 2008; Richter 2001; West 1998). These scholars recognize the importance of understanding their Native subjects on their own terms. They recognize the need for longer-term perspectives and embrace the view that Native histories cannot be written from documents alone. Many have waded into the sometimes murky literature archaeologists produce to supply the missing pieces. And just as these innovations

have encouraged archaeologists to investigate previously neglected topics, so too have they encouraged historians to consider new dimensions of the colonist's engagement with Indians.

All of these innovations—the shift in analytic scale, the recognition of Native agency, and the reconceptualization of colonization as a protracted, nonlinear process—have gone a long way toward transforming archaeology into what the ethnohistorian Patricia Galloway (2006:11) calls a "positive method" that can carry research on recent Native communities well beyond the spatial, temporal, and experiential limits of the colonist's observations. Nevertheless, I believe archaeologists have yet to fully exploit the potential of their methods and their data to produce accounts that reveal the forces shaping the world the colonists entered and that, ultimately, will contribute to a broader, more balanced understanding colonial engagement.

Perhaps the clearest signals that archaeologists can contribute more than they so far have are the temporal and spatial disjunctions characteristic of many accounts of Native history, even those professing the importance of Native agency and aiming to tell the story of the Native past in its own terms. Pre-1500 contexts commonly are covered at broad geographical and temporal scales, often beginning, ironically enough, with the late Pleistocene colonization of North America. Post-1500 contexts, by contrast, are conceived far more narrowly, with change and development framed in terms of localized ethnic groups at time scales ranging from a century or two down to a few decades. The result is a kind of "telescoping," in which the last five centuries are afforded an immediacy and a specificity not granted earlier periods.

Different themes or topics are tied to these scale differences. Cultural ecology, for instance, so prominent in discussions of precolonial processes, is scarcely mentioned after the arrival of Europeans. By contrast, political institutions, symbolic systems, or demographic changes are less commonly considered for earlier periods. Together these scalar and topical disjunctions impart a patchwork feeling to many treatments of Native history, whether written by archaeologists or historians (Stahl 2001:34; see also Wilson and Rogers 1993:7). Put another way, these disjunctions reflect the lack of a truley trans-Columbian perspective.

The problem usually is chalked up to the differences between archaeological data and written documents: it is a commonplace to say that archaeological data are best suited to long temporal and broad geographical scales, whereas documents are better suited to shorter, narrower scales. But in my view the schism between pre- and post-1500 Native histories is not mainly due to the scope or content of the data per se, but rather to the differing conceptual frameworks used to make sense of them. That is, the issue at stake is how anthropologists think about time and space, not the specific temporal and spatial scales they choose. Johannes Fabian's (2002) provocative essay on the modes of time in anthropological research offers a vocabulary for talking about the temporal dimension. Fabian distinguishes three different modes. The first, which he calls "physical time," measures the passage of years in relative or absolute terms. Though grounded in physical time, archaeological research is framed primarily in terms of Fabian's second mode, "typological time," the periodization of change based on the intervals between "socioculturally meaningful events" (Fabian 2002:23). Typological time is the time of cultural evolution, a teleology that progresses by discrete steps from one essentially synchronic state to the next. By contrast, historical accounts rely mainly on what Fabian (2002:24) calls "intersubjective time," which recognizes that time is not merely an external yardstick of change, but also a dimension of social relations. Intersubjective time is the time of human experience and interaction: culture, conceived in intersubjective time, is not simply an abstract framework for behavior but rather the "specific way in which actors create and produce beliefs, values, and other means of social life" (Fabian 2002:24). Archaeologists can move toward an intersubjective concept of time by making use of explanatory models that frame the processes of demographic, social, or economic change in terms of human experience and interaction.

Stephen Lekson (2009; see also Jordan 2010) argues that archaeologists badly underestimate the extent of the interconnections among Native communities and therefore are apt to work in geographical scales that are too small. Indigenous people knew what their contemporaries were doing and the simple fact of distance did not necessarily inhibit the scope

of their interactions. Put another way, the geography of human experience and interaction is far bigger than a single community or region. The appropriate spatial scale should not, therefore, be measured by distance alone, but rather by the fit it affords between the available empirical data on what people did in the past and the models and concepts that make those data intelligible as history. In this study, I adopt a scale Kurt Jordan (2008:27) calls the "local political economy," which he defines as a focus on the social and economic organization of a defined locality, comprised of several settlements or groups of settlements, over periods of time ranging from a few decades to a century or two. This scale reveals variations among households and communities without losing sight of larger-scale processes, and emphasizes dynamic processes of change without neglecting long-term continuities. It also strikes me as a workable compromise between the large datasets demanded by micro-scale historical analysis grounded in archaeological data and the need to put those data into a conceptual framework. Not surprisingly, it is a scale familiar to many social historians.

Together, an intersubjective view of time and an analytic scale that links empirical data on past practices with explanatory models and concepts that foreground the knowledgeability and experiences of individuals, households and communities are what, in my view, make archaeological interpretations fundamentally historical. It should be said, though, that this approach to archaeological history is only partly congruent with those taken by other archaeologists interested in history. The move towards history is one of the most significant trends in archaeology today, but the proponents of historical analysis are a diverse lot, whose projects vary greatly in scope, scale, and theoretical orientation (Cameron and Duff 2008; Duke 1991; Kirch 2000; Lekson 2009; Pauketat 2001a, 2003a, 2003b; Sassaman and Holly, eds. 2011, Shennan 1993, 2000). The approach I pursue here is geared to the special analytical challenges presented by colonial engagement in North America. For research on the centuries before and after 1500, the paired distinctions between "prehistory" and "history" on the one hand and "Indian" and "European" on the other are especially potent, both conceptually and

methodologically. For this reason, I believe the surest route to a seamless trans-Columbian perspective lies in a move toward archaeological analysis that emphasizes local experience, permitting a view of American Indians and First Nations peoples as historical actors. But does such a move bar a role for comparison or for macro-historical syntheses—for "Big Archaeology," as Lekson (2009:257) puts it? Not at all: a balanced view of colonial-era Native culture change, or of colonialism itself, demands such an integrative approach. But research by archaeologists, anthropologists, and historians has shown that Natives people's engagement with Europeans and Americans varied from place to place and over time. Synthetic approaches to colonialism in the Americas should integrate that variation. For that reason, I believe the building blocks needed for a larger synthesis should be richly drawn local or regional histories that credit the varying experiences of different groups.

Archaeological History and Indigenous History

At this point I want to pause briefly to consider the articulation between archaeological histories and indigenous oral histories that are embodied in myths, rituals, folk tales, creation stories, and other forms of social memory (Nabokov 1996). While it would be a mistake to draw the distinctions between them too sharply (Echo-Hawk 2000; Galloway 2006:26), the existence of separate historiographies certainly invites comparison and critical evaluation. But does opening the door to this diversity admit a debilitating relativity? For several reasons, I think that the threat is less dire than many imagine. To begin with, different modes of historical production tackle different topics and therefore ask different questions of the past. Those questions reflect the distinctive attributes of their source materials as well as shared, if usually implicit, ideas about which topics count. Questions appropriate to one mode may be unsuitable, even "disabling," to another (Stahl 2001:36). Not every question is equally relevant to the producers or consumers of different accounts; Native peoples may deem as beside the point subjects of

habitual interest to archaeologists.

A somewhat similar relationship exists between social histories and traditional political and military histories. Even though they may cover similar periods they nevertheless differ in scope, in subject matter, and in sources. Historians certainly debate the merits of different approaches, but do not necessarily feel compelled to harmonize different accounts. In fact, debates about the merits of particular approaches turn not only on the representativeness or relevance of the data but also on the aims of history and the context of its production in the present.

Beyond differences in the kinds of questions they ask and the sources they use, archaeological history and indigenous history are underwritten by different modes of historical consciousness (Nabokov 1996). Archaeological history's conceptual framework is fundamentally Western, part and parcel of European colonial experiences in the Americas and elsewhere (Dirks 1990; Thomas 2004).

Because of these differences, opportunities to directly compare accounts produced by different historical modes turn out in practice to be fairly rare. Nevertheless, when such opportunities present themselves, scholars should weigh their differences and similarities, recognizing that productive insights may be gleaned from both (Paynter 2000; Stahl 2001). For instance, the archaeological history developed here converges in a number of revealing ways with Mandan oral history as expressed in creation stories.

The materiality of the past also mitigates the threat of relativity. Archaeological histories in particular call attention to the material and spatial dimensions of historical production, a topic chapter 2 explores in more detail, but spaces and things are no less important to indigenous history. Indigenous histories invest landscape features and settled places with sacred and secular significance. They highlight the catalytic functions objects of cultural patrimony and personal heirlooms play in the production of social memory. Thus, for both historiographies, the materiality of the past, "created independently of the observer's will," constrains what can be

said about it (Trigger 2003:199; Wylie 1992).

If the epistemological problems are less daunting than some have thought, the existence of multiple historiographies nevertheless raises thorny political questions. Who has the right to tell the story of Native peoples? Who decides how histories matter? Galloway (2006:19) is not alone in wondering whether Native histories ever can be written by the descendents of the colonists "without power relations coming into play." The answer, I think, is quite simply "no," if only because the production of history always invokes power. The violence of European colonialism, and its legacy of poverty and disenfranchisement, ensures that the production of Native histories will always occur in a politically charged atmosphere. But I believe that the fact that power differences continue to shape the relationship between academics and Indians does not in itself constitute grounds to reject good faith efforts to tell the story of the Native past. Archaeologists need to recognize that their long-standing interests in cultural evolution and in cross-cultural generalization remind many Indian people of the justifications the colonists offered for the injuries they inflicted (Echo-Hawk 2000; Trigger 1980). But archaeologists can go a long way toward demonstrating their good faith by actively confronting their discipline's colonial patrimony (Smith and Wobst 2005). This means closely examining their analytic categories, looking for ways to test their assumptions. It means cultivating an awareness of the contemporary influences on their work. It means recognizing that archaeological methods do not necessarily unearth a singular truth about the past, exempt from challenge or modification. Above all, it means accepting the fact that it is not up to archaeologists to decide whether or how the histories they produce are relevant to Native peoples (Zimmerman 1995).

Setting the Stage

This history is set at the confluence of the Heart and Missouri rivers, some 90 km below the Corps of Discovery's winter quarters at Fort Mandan (figure 2). The area above and below

Figure 2. The Missouri River valley. Square Buttes, the northern limit of the Heart region, can be seen in the upper left. (Photo by Michael D. Frohlich, reproduced with the permission of the State Historical Soceity of North Dakota).

the confluence, known to archaeologists as the Heart region, is a part of the Middle Missouri subarea of the Plains, a 1,100-km stretch of the Missouri River valley running from just above the mouth of the Yellowstone River in western North Dakota downstream nearly to the South Dakota-Nebraska state line. In the nineteenth century, this part of the Plains was known to European explorers and traders as the Upper Missouri. Archaeologists currently partition the Middle Missouri into eight archaeological regions, bounded and named mainly by the Missouri's major western tributaries (figure 3) (Ahler 1993a:58; Johnson 2007a:3-4; Lehmer 1971; Lehmer and Caldwell 1966). Here I make a distinction between the northern half of the Middle Missouri, consisting of the Garrison, Knife, Heart, and Cannonball regions, and the southern half, consisting of the Grand-Moreau, Bad-Cheyenne, Big Bend, and Fort Randall regions. Appendix 1 provides additional details on the spatial units used in this study.

Tribal Groups in the Middle Missouri

When Europeans began visiting and writing about the Missouri River valley in the eighteenth century, three different groups of Native farmers lived there. Two of those groups claimed adjacent regions of the northern Middle Missouri. The Siouan-speaking Mandans, or Numakaki as they called themselves in the early nineteenth century (Wood and Irwin 2001), were living in the Heart region when the French fur trader Pierre Gaultier de Varennes, sieur de La Verendrye, visited in 1738 (Smith 1980). The Mandans told Verendrye that they occupied six

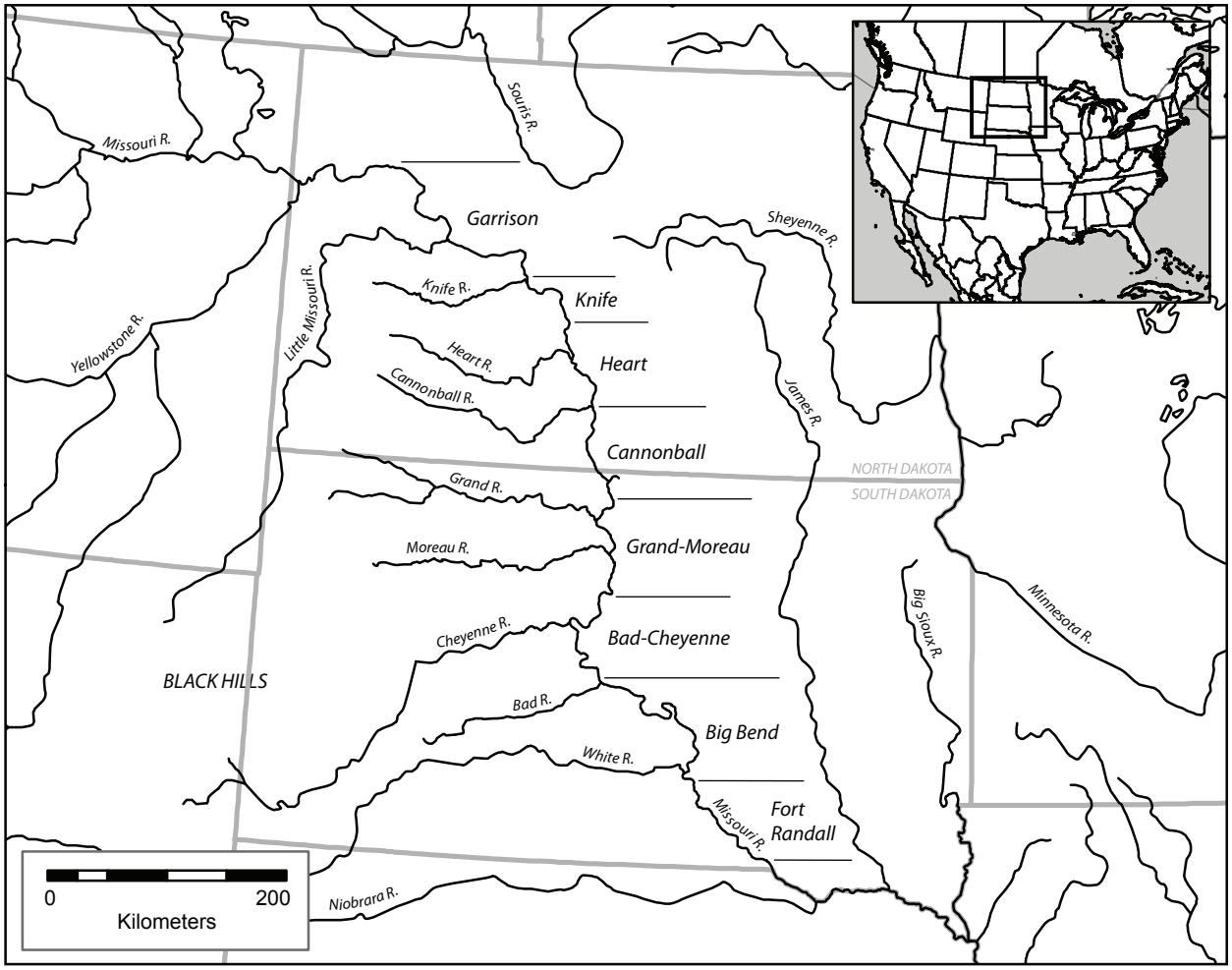

Figure 3. Archaeological regions of the Middle Missouri subarea.

large villages on both sides of the Missouri; some 75 years later, Lewis and Clark's informants reported that they lived in nine Heart-region settlements prior to the smallpox epidemic of the early 1780s, seven on the right bank and two on the left.

After the epidemic, the Mandans moved north to the mouth of the Knife River where they settled alongside their long-time neighbors and distant linguistic cousins, the Hidatsas. Unlike the Mandans, who had been known to Europeans since the early 1700s, the Hidatsas were first recognized as a distinct group only in the late 1780s. According to David Thompson's rough census, taken in 1797, the Hidatsas and the Mandans lived together in five settlements (Wood 1977). Two were comprised solely of Hidatsa families. Mandans and Hidatsas lived together in two others, with the Hidatsas in the minority. Mandans occupied the fifth. In 1845, the Hidatsas and many of the Mandans jointly founded Like-A-Fishhook Village, a settlement that would in time become the last earthlodge village in the Plains (Smith 1972).

Second-hand reports from the first half of the 1700s put the third farming group, the Caddoan-speaking Arikaras, in a large number of villages scattered throughout the southern half of the Middle Missouri (Johnson 1998; Krause 1972; Lehmer 1971; Parks 2001a). In the 1790s, following an undoubtedly traumatic period of consolidation and reorganization, the Arikaras were living in just two villages near the mouth of the Cheyenne River and one below the mouth of the Knife. Between 1802 and 1837 they moved repeatedly, first to the mouth of the Grand River, then to the Loup River in eastern Nebraska, and finally to the Knife region. They moved again in 1861, this time to the Garrison region where they eventually joined the Mandans and Hidatsas at Like-A-Fishhook Village (Metcalf 1953; Smith 1972).

Archaeological data and oral traditions leave little doubt that the Mandans were the first farmers to settle in the Middle Missouri. An unbroken decorative tradition links the pottery made by Mandans living in the towns Europeans visited in the 1700s to pottery made in the 1200s (Wood 1967, 2001). One of the two Mandan creation stories puts the place of emergence of a portion of the tribe, known as the Buffalo People, near the Heart River (Bowers 1950:117). In

the second creation story, another group, the Corn People, travel up the Missouri from the ocean, learning farming and craft production along the way. Eventually they arrive at the Heart, where they joine with the Buffalo People.

Many of the Hidatsas, by contrast, were comparative newcomers, having migrated to the Middle Missouri from the northeastern Plains about 1600 (Hanson 1993; Wood 1993a). Both Mandan and Hidatsa oral traditions locate the Hidatsa's arrival on the Missouri close to its confluence with the Heart. Shortly afterward they moved north of Square Buttes, a prominent feature marking the northern limits of Mandan settlement in the seventeenth century. The balance of the Hidatsas appears to have lived near the Mandans on the Missouri for a lengthy period; by their own account they always lived on the river.

The origins and early history of the Arikaras are less clear. At least some of their ancestors likely arrived on the Missouri in the 1300s, but little is definitely known about the relationships between those early communities and either contemporaneous or later Caddoan-speaking groups (Johnson 1998, 2007a; Steinacher 1983; Steinacher and Carlson 1998). Nevertheless, oral history, historical linguistics, and archaeological research—though certainly not entirely in agreement—together suggest there were complex and on-going connections between communities in the southern Middle Missouri and communities farther south, in central Nebraska. It also seems clear that fourteenth-century settlements on the river figured prominently, in one way or another, in the histories of the Arikara communities Europeans encountered in the 1700s.

Archaeologists commonly treat these three tribal identities as stable and unproblematic, but in truth there are few empirical data bearing on their long-term social and political significance. On the contrary, historical accounts make it clear that many of the tribal groups Europeans recognized in the nineteenth century only had just begun to coalesce at the end of the eighteenth (Blakeslee 1975:219-220). The Hidatsas offer the clearest example of this: in the eighteenth century they were divided into three related but nevertheless culturally and

dialectically distinct subgroups, the Hidatsas proper, the Awatixa, and Awaxawi. Only later, after their move to Like-A-Fishhook Village, did they take up the common tribal designation (Stewart 2001). Similarly, before they left the Heart region in the 1780s, the Mandans were organized into four or perhaps five subgroups or divisions, each of which occupied one or more settlements (Bowers 1950; Wood and Irwin 2001). Like the three Hidatsa divisions, significant linguistic and cultural differences existed among them, some of which persisted into the twentieth century.

In addition, many of the horticultural villages and towns Europeans and Americans visited in the eighteenth and nineteenth centuries were ethnically heterogeneous (Blakeslee 1975:227; Wood 1977). Besides the composite communities on the Knife I mentioned previously, Mandans and Arikaras may have lived together, as did Arikaras and several Sioux bands. Moreover, individual aliens lived in many communities, a consequence of diplomatic exogamy, warfare, slavery, and intertribal trade. Still, scholars continue to debate whether multiethnic communities existed before the dislocations of the eighteenth century. Genealogies Alfred Bowers (1992:6) collected, for instance, indicate that interethnic marriages between Mandans and Hidatsas were rare before 1845. However, archaeological data presented in chapter 4 suggests that regional interaction in the 1400s may have given rise to ethnically diverse communities at that time.

Social formations extending beyond the tribe or division were equally heterogeneous. In the Plains, inter-tribal trade relationships and political alliances were based largely on kinship, real or fictive, rather than ethnicity. Such relationships led to interethnic political and economic cooperation and pluralistic land use (Albers 1993, 1996; Binnema 2001; Duke 1991; Sharrock 1974). Multiethnic coalitions took on many forms. In some cases, cooperation led to merger or ethnogenesis, but in others separate tribal identities were maintained within political alliances.

Thus, while tribal identities undoubtedly constituted one dimension of the Middle Missouri's social landscape, it is by no means clear that they dictated patterns of interaction. Rather, it seems more likely that other institutions, such as the clan, the society, the community,

or the division, were more important politically and economically. For this reason the evident clarity of the material connections between the settlements of the 1200s and 1300s and those of the 1700s and 1800s should not be taken as a sign that the political and economic relationships among contemporaneous communities remained stable throughout that long period. Rather, the changing nature and strength of the connections among Heart region communities is an empirical question addressed in the final chapter.

Research Themes

When Lewis and Clark passed by in October 1804, the Mandan's Heart River towns stood empty. Only a few decades earlier, though, these communities had been vital links in a continent-spanning trade network. From the south and west, Native entrepreneurs brought bison hides and meat, Spanish horses and riding gear, and Navajo blankets. From the north and east came English and French cloth, guns, axes, and glass beads. These great streams of commerce, joined by lesser currents from every direction, converged in the cosmopolitan village bazaars at the Heart.

Judging by the abundance and variety of trade goods in the region's earliest villages trading had long been an important part of the Heart River economy. But little is known about its historical development prior to the eighteenth century or how it was integrated with other economic practices. As I show in chapter 3, the models currently used to describe the economy of northern Middle Missouri communities before the advent of Europeans, as well as the changes that accompanied the development of the fur trade, are based mainly on narratives written by European travelers and traders who visited the Plains in the nineteenth century. By and large, these models have not been systematically tested against archaeological data. In this study, I focus mainly on two interrelated questions. First, I ask whether the fur trade, marked by an infusion of glass and metal trade items into the Northern Plains economy and a purported

commoditization of exchange, can be held responsible for the political economy of the region European explorers and traders documented. Second, I consider in detail the relationships among Heart region communities on the eve of European colonial expansion to evaluate how the local history of the region informs larger patterns of development. Chapter 3 puts these research questions in context by reviewing prior models of Heart region Native history.

I use several kinds of archaeological data to answer these questions. In chapter 4, I consider how Mandan communities changed from the 1200s to the 1700s. The chapter first describes their distinctive features and then examines how those features changed over time, focusing particularly on shifts in community size and intercommunity distance. The balance of the chapter is taken up with a discussion of what currently is known about subsistence practices during this 500-year period.

In chapters 6 and 7, I use data on the organization of craft production to zero in on the specific social and economic changes taking place in the Heart region from the middle of the 1400s to the middle of the 1700s. Archaeological data supporting inferences about the organization of craft production are especially abundant in the Heart River towns. Their deep, well-stratified middens and numerous trash-filled storage pits preserve a detailed record of the methods used to manufacture pottery, stone tools, bone tools, and other craft items. In addition, two other features of the Heart River towns make them ideal settings for studing economic change and continuity. Many were occupied continuously from the late 1400s to the late 1700s, permitting detailed diachronic comparisons spanning the seventeenth-century introduction of European trade goods. They also are clustered close together, making it possible to compare communities while holding constant the effects of differential access to critical resources, including arable land, toolstone, timber, and suitable bison habitat. Finally, the state-of-the-art field methods used to investigate them, which I summarize in appendix 1, feature complete, systematic recovery of artifacts and other items, representing the full range of production debris. Subsequent laboratory analysis was designed to maximize the temporal resolution of

the resulting assemblages, making possible the high-resolution data on the steps and stages of craft production collected for this study possible. Chapter 6 presents data on changes in the organization of stone tool production, emphasizing patterns of raw material selection, tool assemblage diversity, manufacturing techniques, and production skill. Chapter 7 compares these patterns with comparable data on the organization of pottery production.

The final chapter pulls together these lines of evidence, arguing that the fifteenth century marked the beginning of a period of sustained economic intensification, the political consequences of which structured the opportunities available to European traders in the 1700s and 1800s.

Before examining the role of Mandan history in the development of colonial-period trade, though, I first tackle a series of theoretical and methodological questions about the relationship between history and archaeology. What barriers have kept archaeologists from producing historical narratives? What special problems might archaeologists encounter when writing histories from archaeological data?

Chapter 2:

Writing Archaeological History

Three main hurdles have kept archaeologists from writing trans-Columbian Native histories. The first is a lingering ambivalence many feel about taking up history as a disciplinary goal. While archaeologists' attention to history is now rapidly growing, many remain unsure how to integrate explicitly historical objectives with the important theoretical and methodological advances made since the 1960s, advances predicated on behavioral or neoevolutionary research objectives. A second hurdle stems from the role research on Indian peoples played in the differentiation of history and anthropology as academic disciplines. In the U. S., questions about the origins of indigenous peoples were bound up with emergence of anthropology as a distinct field of study. Both archaeologists and historians have sought to break down the partition separating their respective disciplines, but that partition has proven to be deeply rooted. A third hurdle is the persistence of unexamined ideas Europeans and Americans have held about Indian people and Indian culture. Despite recent challenges to them, assumptions about Native people forged in the Western experience of colonialism continue to influence how scholars think about the Native past.

Science and History

An obvious place to begin the search for obstacles is the programmatic statements made more than forty years ago by the first generation of processual archaeologists. The "New Archaeologists," as they came to call themselves, emphasized the novelty of their approach by drawing a bright line between the methods and goals of history and those of science. History, they argued, is concerned with describing particular, contingent events. Science, by contrast, seeks general propositions about human behavior applicable to a wide range of cultural settings.

Explanation in history, many New Archaeologists believed, entails an empathetic understanding of cultural context, whereas scientific explanation is achieved by deduction from behavioral laws (Binford 1968). If archaeology was to contribute to anthropology, and the New Archaeologists felt strongly that it should, then it would need to become more scientific and that meant making it less like history.

It would be easy enough to take the New Archaeologist's anti-historical rhetoric at face value as a contemporary expression of a persistent distinction Westerners make between idiographic and nomothetic forms of knowledge (Collingwood 1965). But while the distinction was critical for some New Archaeologists, overall the particular brand of history they decried, the history against which they built their program, was not the history practiced by contemporary historians, but rather by their own anthropological ancestors, the culture historians inspired by Franz Boas (Trigger 1983:414). Even a cursory survey of historical scholarship shows that what many historians were doing at the time bore little resemblance to Boasian culture history. As early as the 1920s, for instance, Annales historians were pursuing a research program that anticipated much of what the New Archaeologists later promoted (Bintliff 1991; Braudel 1980; Burke 1992). And at the very moment the New Archaeologists were crafting their program, social historians were advocating comparable theoretical standpoints and methodological innovations (Sewell 2005:25-29). Thus, the processual program is best seen as a consolidation of the wide-ranging critique of culture history begun in the 1940s by Julian Steward, John Bennett, Clyde Kluckhohn, and others. While epistemic issues were always an aspect of this critique, other elements—particularly a functional, materialist definition of culture—were probably more important.

Nevertheless, the New Archaeologists' strong stance against history set the stage for an acrimonious debate in the 1980s, in which the distinction between history and science took on exaggerated and unwarranted importance. The result was a hardening of epistemic positions that forced both processual archaeologists and their critics into unproductive intellectual corners.

The processual camp found itself defending a brand of positivism made especially problematic by their simultaneous commitment to Thomas Kuhn's ideas about the incommensurability of research paradigms (Wylie 2002:117-126). For their part, some postprocessual archaeologists wound up flirting with what could be called neoparticularism (Trigger 1989).

In the end, this debate proved to be a distraction. I do not mean to unduly downplay epistemic issues, but most archaeologists now recognize that a rigid distinction between science and history is unproductive. Rather, there is an emerging agreement that social scientists cannot avoid history any more than historians can avoid social theory (Bamforth and Spaulding 1982; Burke 1992). But I do think that the sound and fury around epistemology drew attention away from efforts to find new ways to explain the past in historical terms (Pauketat 2003a). The remedy is to rethink how events and processes fit together, how culture and history are mutually produced. Such a reconceptualization has been underway in anthropology for some time but is comparatively new to archaeology.

Indians, History, and Anthropology

Simply labeling the segregation of science from history a distraction risks missing another, equally consequential hurdle. As the historian of American intellectual life Steven Conn (2004) adeptly demonstrates, the study of the Indian past, especially research on the ultimate origins of Native peoples, was crucial to the disciplinary differentiation of history and anthropology in the nineteenth century. That is, the sustained effort of academics to account for the indigenous past was a part of the processes by which certain subjects and methodologies came to be called history, while others came to be called anthropology. This disciplinary partition has, I think, done at least as much to inhibit the use of archaeological data for the study of Native history as have disputes about the nature of explanation in archaeology.

Conn shows that, from the beginning, European colonists struggled to explain Indian

origins. Initially, they drew on the Bible and on classical texts, but by the turn of the nineteenth century these explanations were breaking down and scholars increasingly turned to natural historical accounts, which, their name notwithstanding, were largely ahistorical. At the same time, historians began defining their work in terms of the careful study of documents. As the nineteenth century wore on, these two trends converged, pushing Indians out of the "flow of historical time" (Conn 2004:214). The seemingly paradoxical conclusion that Indians had a past but not a history was mitigated in part by what Conn (2004:211-216) calls the "prehistoric revolution." Invented by archaeologists in the middle of the nineteenth century, the concept of prehistory achieved two academic goals. The notion of a time before history effectively freed historians to focus on documentary history. At the same time, it made non-literate people suitable subjects for the emerging field of anthropology, which in the late nineteenth century meant the study of cultural evolution. These processes were intertwined: their illiteracy reinforced the notion that Native peoples were best understood as exemplars of the stages of cultural evolution, stages through which Europeans already had passed, which in turn meant that they need not exhibit progressive history, a characteristic along with writing, state-level bureaucracies, and iron metallurgy, of civilization.

Conn goes on to show that the gradual erasure of Indians from academic history was reinforced by the concurrent rise of a new historical consciousness in the U. S. While historians and anthropologists were staking disciplinary claims, Americans at large were adopting a new sense of the nation's history. In the middle of the nineteenth century, just as the fledgling nation began its aggressive expansion westward into Native-occupied lands, the old cyclical view of history began giving way to a new progressive vision. Americans began to believe that their society was exempted from the historical cycle of rise and fall. Indian societies, by contrast, seemed to Americans of the day to be trapped in the old pattern, destined to inexorable decline. Thus, beyond their lack of written records, the Indian's apparent lack of social, economic, and cultural progress made them unfit subjects for history as it came to be understood. By the end of

the nineteenth century, these interconnected trends led to a firm if implicit association between progressive history, literacy, and civilization on the one hand and cultural evolution, illiteracy, and savagery on the other. This dyad also marked the disciplinary boundaries of history and anthropology, respectively.

Even when the disciplinary partition began breaking down in the twentieth century, the link between historicity and documents remained largely intact. When anthropologists took up Indian history under the banner of acculturation in the 1930s they turned first and foremost to the study of written records. While they drew on multiple lines of evidence, including ethnographic observations and interviews (Redfield et al. 1936), most acculturation researchers gave the greatest evidentiary weight to written records, especially narrative accounts penned by the first wave of explorers and traders. They justified their preference for documents largely on methodological grounds: without the "controls" provided by the written record, explains Melville Herskovits (1937:260), the validity of "unrecorded history" cannot be determined. Tellingly, their view of history echoes Henry Schoolcraft's dictum, expressed more than a century earlier, that "unwritten tradition, extending beyond the era of Columbus, may be considered as entitled to little credit" (cited in Conn 2004:21). Thus, despite their avowed interest in Native history, acculturation researchers never effectively challenged the linkage between histories and texts.

In the 1950s, acculturation researchers began developing a more sophisticated and more explicitly historical approach they called "ethnohistory" (Trigger 1986). Still, ethnohistorians continued to emphasize documentary evidence, defining their work initially as "the study of identities, locations, contacts, movements, numbers, and cultural activities of primitive peoples from the earliest written records concerning them" (Lurie 1961; Voegelin 1954:168). Shepard Krech (1991) argues that the preference for documentary evidence was authorized in part by the central role ethnohistorians played in the adjudication of land claim cases brought before the Indian Claims Commission, the establishment of which in 1946 was an important catalyst for the development of the field. To be sure, ethnohistorians now draw on an eclectic mix of

sources, including oral history, archaeology, historical linguistics, and ethnography in addition to maps, pictures, diaries, and ledgers produced by Europeans (Axtell 1997; Trigger 1986; Wood 1990). Such eclecticism has been encouraged by the fact that scholars trained in a wide variety of disciplines, including geography and economics, began contributing to ethnohistory in the 1970s and 1980s (Peterson and Anfinson 1984; Trigger 1982). Still, written documents remain the field's evidentiary backbone, a fact reflected in W. Raymond Wood's (1990:81) definition of ethnohistory as "the use of historical documents and historical method in anthropological research."

Even recent advocates of a historicized archaeology of recent Native societies continue to reserve a central role for documents. Many promote a "conjunctive" or integrative approach in which archaeological data are combined with data derived from documentary sources (Wilson and Rogers 1993:8; see also Lightfoot 1995). Without question, such interdisciplinary research has yielded substantive results. But to really use archaeological data to write Native histories reaching back into the centuries before the advent of Europeans, archaeologists need to think more about how histories written primarily from archaeological data might differ from those written from documents. In my view it is not enough simply to add material and spatial muscle to a skeleton built from the written record. Instead, archaeologists need to envision history differently. Apart from rethinking the relationship between history and culture, doing so requires archaeologists to use methods that make ample room for the possibility that longer-term transformations of Native societies are not reflected in the documents produced by Europeans.

Upstreaming into the Past

The methodological trouble, though, is even deeper than Conn's thoughtful analysis suggests. The emphasis on documentary sources underwrites two key research methods archaeologists have used since the 1930s to study recent indigenous societies of the last few

centuries. One is the concept of a cultural "baseline," a synchronic description of Native societies on the cusp of their interactions with Europeans. The other is a particular brand of interpretive analogy commonly known the direct historical approach.

Colonial Narratives: Building the Cultural Baseline

The oddly incongruent notions that Indians existed outside history, but were destined inevitably to disappear are not only products of the late nineteenth-century academic differentiation Conn analyzes. They also represent two of the many assumptions European colonists and their descendants have held about Native peoples. In fact, nineteenth and early twentieth century scholarship on American Indians and First Nations peoples was built up around a whole series of colonial "narratives" or schema concerning indigenous character, indigenous conduct, and indigenous culture (Ferris 2009; Jordan 2008; Mitchell and Scheiber 2010; Stahl 2001; Trigger 1980; Trouillot 1991; Wilcox 2009).

These narratives originated in the attitudes and preconceptions European colonists brought with them, mingled with their interpretations of what they saw after they arrived. Scholarly appropriation and systematization of these raw colonial descriptions dates mostly to the nineteenth century, when Europeans were increasing their control over the North American landscape and when anthropologists and historians were defining their disciplinary domains (Mitchell and Scheiber 2010). Each narrative, reduced to its basic elements, sets up an opposition between Europeans and Natives (Ohnuki-Tierney 2001). One well-known schema, for instance, asserts that European technologies are superior to Native technologies and therefore that the replacement of the latter by the former was inevitable. Another juxtaposes the progressive character of European societies with the static character of Native societies. It is worth noting, however, that the moral content of colonial narratives was complex and often contradictory; in some, Europeans are branded as bloodthirsty, in contrast to the inherent peacefulness of

Indian society, but in others the polarity of that relation is reversed (Berkhofer 1978). Colonial Europeans put these oppositions, along with many others, to a variety of uses. At one level they simply constitute descriptions of the differences between Indians and Europeans as the colonists saw them. But in the context of emerging ideas about cultural evolution they also became explanations of the processes of culture change initiated by the arrival of Europeans.

In the 20 years since the Quincentennial archaeologists have successfully exposed the fallacies of many such narratives. Charles Cobb (2005:563), for instance, argues that the colonist's interpretation of precolonial cultural stasis, which is now built into current ideas about the history of modernity, is not supported by archaeological data on patterns of Native mobility before 1500. Similarly, Enrique Rodriguez-Alegria (2008) demonstrates that the transition in central Mexico from stone to metal tools was neither linear nor adequately explained by each technology's functional merits. Yet, despite challenges, some of the most potent narratives continue to influence, in powerful if not overt ways, how archaeologists and other scholars study Native history. For instance, reflecting on the relative dearth of archaeological data on post-1492 Taíno social dynamics in Hispaniola, Kathleen Deagan (2004) makes the case that long-held assumptions about Native cultural collapse have kept archaeologists from searching for and investigating Native communities dating to the aftermath of Columbus's arrival. Similarly, I believe that the taken-for-granted research methods archaeologists and historians commonly use to investigate the histories of American Indians and First Nations peoples are thoroughly intertwined with untested colonial assumptions and colonial schema.

Archaeologists often begin their research by using historical sources and ethnographic data to establish a precolonial cultural baseline, against which to measure subsequent changes (Stahl 2001). This baseline usually takes the form of an ethnographic sketch purporting to describe elements of Native culture and society as they existed prior to (or immediately after) the arrival of Europeans. As the ethnographer and ethnohistorian John Chance (1996) sees it, the cultural baseline is a projection of structural-functional anthropology's "ethnographic present"

into the past, an "ethnographic past" that emphasizes structure and continuity over process and transformation.

Colonial narratives enter into the construction of the ethnographic past at several points. The very idea of a cultural baseline rests on three of the most basic assumptions Europeans have held about Native peoples: that before contact Native societies changed only gradually, that afterward change was largely a reaction to the coming of the colonists, and that, for Indians, interaction inevitably led to cultural decline. Put another way, efforts to establish a comparative precolonial frame of reference from historical and ethnographic sources assume a kind of law of cultural conservation which views continuity as the norm for Indian societies and modernity as little more than an ill-fitting veneer, beneath which a stable, authentic indigeneity persists (Stahl 1993:243, 2001:22).

Apart from this basic assumption, colonial schemas affect the construction of the baseline in other ways. Researchers typically combine data from several sources produced at different times into a "composite image" of Native culture (Stahl 2001:24, 28). Such composite reconstructions are deemed necessary because the early written accounts thought to best represent precolonial indigenous practices are comparatively rare (and are maddeningly silent on issues of anthropological interest), but more comprehensive ethnographic accounts mostly were collected long after Europeans began interacting with Native peoples. The composite image of the ethnographic past is formed by peeling away alterations believed to have been imposed by colonial interaction to expose an independent core of Native culture. But doing so invokes colonial schemas. Confronted with what they believed to be admixtures of traditional and modern practices, anthropologists and historians interested in reconstructing authentic Native culture make decisions about what to emphasize and what to downplay based on principles adapted from colonial narratives (Stahl 1993:241, 243), just as the colonists themselves drew on axioms differentiating modern from traditional to winnow their own observations.

Thus, ethnographic pasts produced from documents written by Europeans are based

on a convenient but ultimately unstable fiction because their evidentiary basis post-dates the events and processes in question. The problem is sometimes lessened by shifting the idea of "precolonial" forward in time as far as possible, but this move is based largely on untested ideas about the rate or character of Native cultural transformation. It is easy enough to see that such a procedure is apt to introduce anachronisms to the interpretation of indigenous culture change. But the cultural baseline also strips indigenous societies of their historicity, substituting the "ideal-type" oppositions of colonial schema for empirical data on historical change (Chance 1996:394-395). At best, then, the baseline inhibits the recognition of change and development; at worst it infuses the study of Native history with the assumptions and stereotypes Europeans have held about Indian peoples.

Building archaeological histories sufficiently robust to challenge colonialist narratives requires archaeologists to abandon the notion of a precolonial cultural baseline and recognize instead that Native societies were in flux before, during, and after the advent of the colonists. There is, as Chance (1996:394) puts it, "no primordial point of departure" for historical analysis. This, of course, is not a radical idea: archaeologists, in fact, now recognize that the assumption of cultural conservatism short-circuits historical investigation. But it is not enough simply to affirm this as true on theoretical grounds; it must also be reflected in archaeological research methods.

From the Known to the Unknown: The Role of Direct Historical Research

The concept of a cultural baseline is allied with a general research method known as the direct historical approach (Wedel 1938). Sometimes described as "upstreaming" (Fenton 1952), the method involves reconstructing history in reverse order, moving backward in time, often beginning with ethnographic data, then progressing to early historical narratives, and finally to archaeological data. The method assumes that ethnographies, by their nature, provide the most secure knowledge about Native cultures. These data can then be used to fill gaps in the

historic record and, ultimately, the seemingly fragmented archaeological record. Initially, much of the impetus for direct historical research was simply a desire on the part of archaeologists to build reliable local chronologies by identifying the locations of Native settlements mentioned in historical documents. But as they became more familiar with the content of the documents, their significance for reconstructing Native history became apparent (Steward 1942; Wedel and DeMallie 1980:111-112).

Interestingly, the Heart River region played an early and leading role in the development of direct historical research. Harvard University's Roland B. Dixon, an early proponent, sponsored George Will and Herbert Spinden's excavations at Double Ditch Village. Their published report became an exemplar of the method (Will and Spinden 1906). Later, Duncan Strong's excavations at nearby On-A-Slant Village figured prominently in another influential contribution titled, appropriately enough, *From History to Prehistory in the Northern Great Plains*, which appeared in a volume honoring John R. Swanton, a dean of direct historical research (Strong 1940).

Will and Spinden devote the first half of *The Mandans: A Study of their Culture, Archaeology, and Language* to a review of the historical literature then available. In the introduction, they sift accounts left by the traders and explorers who visited the region in the 1700s and 1800s for information about the number and locations of Mandan settlements. The next section consists of a summary of Mandan culture and society, again drawn from historic sources, especially the detailed account written by Prince Alexander Philipp Maximilian describing his visit to the Knife region in the winter of 1833-1834. (They would certainly have made use of ethnographies produced by anthropologists, but at the time none were available.) The discussion ranges widely, from the Mandan's "physical characteristics," to their social organization, "manufactures," residential structures, ceremonial practices, subsistence practices, and origin narratives. The final section of the report is a description of their field investigation at Double Ditch. They describe the major features of the settlement, give an account of their

excavation, and summarize data on the artifacts they recovered. In Strong's (1940:354) view, Will and Spinden's work set a benchmark for archaeological research on the Native farmers of the Northern Plains and his presentation of data from On-A-Slant Village follows a similar, though comparatively abbreviated, outline.

Will and Spinden sprinkle their treatment of the archaeology of Double Ditch Village with brief references to historical data, but overall there are few connections between the two sections of their report. Both are synchronic, though to be fair the dearth of archaeological research at the time made a diachronic analysis of their Double Ditch data difficult. Strong's treatment is somewhat more historical, because more archaeological data were available by the late 1930s when he was working. His essay partitions the discussion of archaeological data into "historic," "protohistoric," and "prehistoric" sections. Still, for Strong, like Will and Spinden before him, the documentary and archaeological data are not well integrated. The effect is that data bearing on social and cultural processes come almost exclusively from the documentary sources. For practical purposes, then, those sources are the basis of what Ann Stahl (1993:236) calls "illustrative analogies," which establish an interpretive context for the archaeological data.

One might object that Will and Spinden's and Strong's work is now badly out-of-date and that their approach has been superseded. However, many investigations of so-called "protohistoric" archaeology, in the Northern Plains and elsewhere in North America, continue to feature essentially parallel treatments of historical and archaeological data. Many continue to rely on illustrative analogies supplied by historical research to guide investigation of recent indigenous archaeological sites and assemblages.

As a class, illustrative analogies involve translocating cultural details from an ethnographic or historic context to an archaeological context. The perceived strength of an illustrative analogy depends on an assessment of the connection between the specific ethnographic and archaeological cases (Stahl 1993:236). A number of types of connecting principles are possible, but for Will and Spinden and Strong, and indeed for most practitioners

of direct historical research, the most important is tribal identity. Thus, the warrant for the use of historical documents to illuminate archaeological data involves the same assumption of conservation that underwrites the cultural baseline: pottery styles may change, people may move, but the core elements of identity—social organization, religious practices, worldview, and so forth—possess a kind of inertia. But the method does more than simply emphasize similarity and continuity at the expense of difference and transformation. It also subtly injects elements of the colonial assumptions about indigenous culture I mentioned previously into archaeological accounts of Native history.

It is worth pausing here to provide some context for the use of specific historical analogies—those warranted by the assumption of direct cultural continuity—in archaeological research. In fact, archaeologists have long cast a skeptical eye on analogical interpretations (Wylie 2002:136). Reacting to what Alison Wylie (2002:139) dubs the "evolutionist debacle," archaeological practice for much of the twentieth century was haunted by a suspicion that cross-cultural analogy, as a general procedure, was fatally flawed. Many archaeologists feared that the circularity evident in the evolutionist's use of analogical inference never could be avoided, because no independent verification of analogical claims was possible.

Oddly, though, the use of specific historic analogy came into its own just as critiques of ethnographic analogy began to solidify in the early twentieth century. Why did the practitioners of the direct historical approach only infrequently suffer from the doubts afflicting their colleagues working in more remote time periods? It is not as though the interpretive problems went unrecognized. William Fenton, an early proponent, observes that direct historical research needs to be approached cautiously, "because it contains a built-in fallacy which historians will recognize as the doctrine of uniformitarianism, which infers the past from the present" (Fenton 1957:22). But archaeologists interested in the indigenous societies present in North America when Europeans arrived usually have seen illustrative analogies drawn from historical sources as less problematic than cross-cultural analogies. As Kent Lightfoot (1995:205) points out,

"historical narratives often take the place of archaeological analyses at the point in time when descriptions of [N]ative peoples were first recorded." For the Plains in particular, Donna Roper (2007a:787) argues that the comparatively rich ethnographic and historical records of the region have led archaeologists to substitute the "ready-made" interpretations provided by direct historical research for a broader array of carefully warranted analogies or models.

There are a couple of reasons why archaeologists have been willing to accept historic analogy while rejecting ethnographic analogy. The most potent was probably Franz Boas's critique of comparative research. Boas argued that societies need to be understood on their own terms, as products of their own history and of their interactions with other societies and with the local landscape. In effect, Boasian culture history made the direct historic approach "safe" from the doubts inspired by evolutionism (Stahl 1993:242). Ann Stahl (1993:243) also points to the use of Fabian's concept of "typological time," discussed in the last chapter, to sort "traditional" from "nontraditional" practices. Yet, even with the waning of culture historical research, archaeologists have continued to view direct historical analogs as relatively straightforward. For instance, in working to rehabilitate analogical inference in the 1950s and 1960s, archaeologists began by affirming the relative strength of those that took "historical context" into account (Wylie 2002:139).

As an aside, it is interesting to note the ironic role Plains research plays in all this. As Wylie (1988:142) observes, Waldo Wedel's (1938) and Strong's (1935) early work in the Plains showed precisely why historical analogs need to be vetted against archaeological data. Both scholars show that interpretations drawn from data on the nineteenth century equestrian bison hunting cultures so prominently featured in the historic record of the Plains cannot be applied to earlier periods, when swaths of the region were occupied by farmers. But while their accounts are commonly held up as models of direct historical research, the methodological implications of their work have not always been fully appreciated.

Overcoming Obstacles to a Trans-Columbian Archaeological History

Tackling these challenges requires a series of coordinated theoretical and methodological shifts. Most centrally, archaeologists need to rethink what is meant by "history." An emerging approach in archaeology known as historical processualism now provides firm footing for doing just that. Archaeologists also need to work toward reversing the longstanding priority given to documentary evidence by regularly vetting ethnographic and historic data against archaeological data.

Confronting the Problem of History

The interest archaeologists now have in history is connected to a more general historicization of the social sciences that began in the 1970s. Cultural anthropologists studying the Native experience of European colonialism—early proponents of historicization—followed two main tracks in their turn toward history (Dirks 1996). Some, like Eric Wolf and William Roseberry, emphasize the constraints placed on culture by large-scale social and economic processes. In his influential book *Europe and the People Without History,* Wolf (1982:21) argues that "the social relations into which humans enter in the course of transforming nature," what Marx calls the "mode of production," were the primary instruments structuring colonial interactions between Europeans and Native peoples. Marx famously focuses on the capitalist mode of production, but Wolf (1982:88-99) extends Marx's general approach by defining a "kin-ordered" mode of production that recognizes the political and economic processes latent in kinship.

Wolf also draws on world-systems theory to describe and explain the interactions between Europeans and indigenous peoples. Formulated initially by the Annales historian Immanuel Wallerstein, as well as by the economist Andre Gunder Frank, world-systems theory

is at once a way of characterizing the social and economic connections between societies and a method for analyzing those connections. Wallerstein describes a world system as a "multicultural territorial division of labor in which the production and exchange of basic goods and raw materials is necessary for the everyday life of its inhabitants" (Chase-Dunn and Grimes 1995:389). The division of labor at the heart of a world system is hierarchical: peripheral areas, like North America, are dependent on and dominated by core areas such as Europe. Thus, Wolf's approach to colonial interaction is structural: economic forces, in his view, precede and shape culture.

A second group of scholars, Marshall Sahlins and Sherry Ortner among them, emphasize instead the interplay between socioeconomic processes and people's understanding and experience of the world. In their view, people ground their actions in their traditions, their "existing understandings of the cultural order," but at the same time are able to "creatively reconsider their conventional schemes" when confronted with the exigencies of the moment (Sahlins 1985:vii). For these poststructuralists, action flows from cultural traditions, reproducing them, but those traditions, having been realized in a particular moment under particular conditions, are thereby exposed to the possibility of transformation. History orders, and simultaneously is ordered by, culture. Put in more analytical terms, it is in the meaningful actions of historical subjects that "diachrony and synchrony coexist in an indissoluble synthesis" (Sahlins 1985:151). This position is sometimes billed as a simple inversion of Wolf's materialism, but in fact it aims not for an idealist alternative, but rather for closure of the oppositions between culture and history, structure and event, and stability and change that are fundamental features of structural analyses like Wolf's.

History as a Genealogy of Skilled Performance

Archaeologists tread both tracks pioneered by cultural anthropologists. But the

discipline's most comprehensive move toward history, an approach Timothy Pauketat (2001a, 2001b, 2003a, 2003b) calls "historical processualism," has more in common with Marshall Sahlins's historical anthropology that it does with Eric Wolf's historical materialism. Like Sahlins's work, historical processualism is mainly underwritten by a general set of ideas known collectively as theories of practice. Articulated most fully by the sociologists Pierre Bourdieu (1977) and Anthony Giddens (1979, 1984), theories of practice put the actions and representations of historical subjects at the center of analysis. The key feature of this approach is a reciprocal relationship between the actions of social agents and the cultural schemas that motivate and warrant those actions. In Giddens's formulation, which he calls "structuration," cultural structures, internalized as dispositions, guide practices. In turn, those practices establish systems of interaction among agents that embody structures. The process of structuration is fundamentally a social process: structures, also known as schemas, are enacted through collective gatherings and shared experiences, during which the body of sanctioned social memory is winnowed from individual experiences. Thus, for practice theorists, both history and society are constituted in the activities of historical subjects; they are, as Giddens (1976:160) says, matters of "skilled performance."

More recently, the sociologist and historian William Sewell (2005; see also Beck et al. 2007) has supplied two amendments to Giddens's practice theory that I think enhance its suitability for archaeological historical analysis. Sewell clarifies and extends Giddens's opaque definition of structures. Like Giddens, Sewell recognizes that structures are comprised of two elements: cultural schemas and material resources. Sewell defines schemas, which Giddens calls "rules," as virtual, transposable prescriptions for action. Schemas include, for instance, everything from widely-held metaphors about the relationships between men and women to specific knowledge about how to make stone tools. Schemas are virtual because they reside as memories in the minds of individuals and they are transposable because they can be applied in a variety of specific social and material contexts. Sewell defines resources, the other component

of structures, as the concrete human and nonhuman instrumentalities from which agents derive power. Resources are unevenly distributed in society, but no one lacks access to them entirely; everyone, as Giddens (1979:56) notes, possesses the capacity to "have acted otherwise."

Sewell also specifies concrete ways structures can be transformed. He argues that any given practice draws on many different structures, which vary greatly in scope and effectiveness. Some incorporate dearly held values while others merely express passing tastes. Different structures can harmonize, but they also can conflict with one another. Conflicts among them are apt to promote change. Moreover, because structures intersect in complex ways, the sense agents make of schemas (or the import of material resources) is open to negotiation. He also points out that the specific understandings agents possess can be fragmentary or imperfect. Finally, and crucially, he recognizes that the accrual of resources can be unpredictable. Crops can fail or perceived social lapses can sour trade relationships. Each of these scenarios represent contexts in which structures are "burdened with the world," as Sahlins (1985:138) puts it, and therefore liable to be transformed.

For some scholars, practice theory seems to invoke an old and rightly discredited view of historical causation as the outcome of intentional action. Giddens in particular has been criticized for what some see as his undue emphasis on the conscious knowledgeability of social agents (Bintliff 2004). But this critique misses key elements of structuration theory. For one thing, agents often are only dimly aware of the grounds for action. Much of daily life flows from deeply held dispositions, what Bourdieu (1977) calls the "habitus" and Giddens (1979) labels "practical consciousness," inculcated from childhood (Pauketat 2001a:79, Shennan 1993; Toren 1999). Dispositions guide action, but they only are discernible to social actors under certain circumstances. Beyond that, a variety of conditions and factors apart from the rationale an actor consciously warrants can and do intervene to affect the outcome of action. As Sahlins (1985:138) points out, "the world is under no obligation to conform to the logic by which some people conceive it." Unintended consequences flow from the unanticipated actions of others, from

unexpected and changing environmental conditions, and from chance occurrences; practices, therefore, always are partial and imperfect replications of tradition.

Another criticism sometimes leveled against practice theory is that it puts too much emphasis on the actions of society's most powerful members. However, despite practice theorist's talk about individual choice and action, the agents they usually have in mind are not specific, named individuals but rather are classes of individuals defined by some social category, such as gender, class, or age. For that reason, agents are sometimes described as "categorical individuals" or "identity collectives" (Mitchell and Scheiber 2010:16). Moreover, social agents never completely understand cultural schemas; their knowledge of social norms or technical processes is necessarily incomplete because their experiences are circumscribed by their position in society. Their dispositions are formed and their decisions made in the context of social relationships with people whose access to knowledge and power varies.

Practice theory provides a firm basis for archaeological history for at least two reasons. First, its focus on practice puts concrete actions, rather than abstract structures, at the center of analysis. The trouble with structuralism, Pauketat (2003a) argues, is that it reifies the immaterial at the expense of the material. Abstract systems, such as the core-periphery relationship between Europe and North America, come to be seen as the real objects of study, while concrete "facts on the ground," such as the specific ways people realized world-system relationships, become secondary phenomena. Practice theory inverts this: people ground their actions in resources, values, traditions, and experiences, but those structures are only perpetuated by virtue of their having been realized in concrete practices. As Pauketat (2003a:44) says, traditions "by themselves, [do] not constrain practices; people acting as if [they] mattered is what constrains practices." Thus, for historical processualists, practices are not simply reflections of underlying structures. Rather, they are themselves processes. In this view, history is a cumulative record of skilled action, a "genealogy of practices" (Joyce and Lopiparo 2005; Pauketat 2001a:80). Writing history, therefore, requires tracing the "creative negotiations of people whose dispositions were

affected by their experiences" (Pauketat 2001a:87).

Second, practice theory demands explanations for both change and continuity. Structural approaches see transformation as an active process, but continuity merely as the absence of transformation. By contrast, for practice theorists the recapitulation of tradition and the transformation of tradition flow equally from the decisions and dispositions of historical subjects. Both continuity and change are actively produced, moment by moment, in the practices of agents. As the anthropologist Emiko Ohnuki-Tierney (2001:244) remarks, culture is always "in motion—becoming, reproducing itself even when disintegrating at the 'core' and transforming, in a constant ebb and flow." Tradition, embodied in practice, is "continually redefined and revalued" (Pauketat 2001a:86). For this reason, decisions "to reiterate what was done in the past" need to be understood in relation to the ongoing and changing interests and values of individuals, families, and communities (Joyce and Lopiparo 2005:368).

History and Materiality

Like anthropological practice theorists, historical processualists aim to replace structuralist explanations that frame action in terms of behavioral universals with recursive explanations that frame action in terms of historically contingent practices. But in other respects they depart in crucial ways from Sahlins's historical anthropology. Sahlins is rightly criticized for privileging "cultural orders" over social negotiation and the press of unanticipated outcomes. More importantly, though, Sahlins fails to appreciate the role of spaces and artifacts in the production of history. As Pauketat (2009:246) observes, "being a human simultaneously occurs in material and spatial dimensions—at the interface of the body and the outside world—and not in the head." People's actions and representations always occupy space and incorporate objects: eating, building, farming, worshipping, or potting necessarily take place somewhere and require some material instrument.

It is worth noting, though, that the materiality and spatiality of cultural construction often is affected by factors many archaeologists are used to thinking of as external to culture. Droughts or longer-term patterns of climate change can affect farmer's yields or the sizes and distribution of the bison herds mobile groups prey on. Diseases cut down individuals and families without regard to their beliefs. The distribution of key resources—toolstone, arable land, or timber, for instance—structures economic and social opportunities. But these factors become history through technologies, social relations, and values that are properly considered cultural. In this sense, then, ecological conditions, natural disasters, or the unaccountably bad behavior of one's neighbors are elements of cultural traditions—that is, history—no less (and no more) than, say, household composition, the arrangement of living space, the organization of craft production, or the dynamics of intergroup power relationships. The difference between structural and post-structural accounts is that the former conceive of objects and spaces as indicators or expressions of underlying structures, while the latter recognize the direct roles materials and spaces play in cultural processes.

Problem History

Historical processualism mostly is concerned with how particular practices were established and maintained, rather than with ultimate explanations for why human beings act as they do. How, they ask, were people's actions in a particular situation affected by prior practices and how, in turn, did they affect people's actions later on (Pauketat 2003a:42)? How did people use their traditions to achieve particular ends? Questions of this type inevitably shift the focus of research away from abstract laws of behavior toward concrete practices.

But something more is needed to make the genealogies of material production that constitute the immediate answers to these questions intelligible as history. History is not only a genealogy of cultural production, but also a realization of cultural traditions,

however imperfectly they may have been understood. Historical processual research needs to contextualize recurrent patterns of action: the salient details of preparing a meal or building a house only can be appreciated in relation to local histories of cooking or architecture. A too-narrow focus on genealogies of production runs the risk of turning pots into people, recapitulating a central fallacy of culture history. Moreover, history is not written from a single set of practices; genealogies of house building, for instance, need to be articulated with genealogies of food production or genealogies of stone tool manufacture. Doing so requires theoretical propositions—concepts, models, or principles—to select and organize data and to craft a narrative account that weaves together disparate lines of evidence.

Bruce Trigger (1989:33) contends that, in accounting for local patterns (a goal he endorses), historical approaches run the risk of ignoring the cultural and social "regularities" that comparative anthropological research has identified. The challenge of balancing the local with the global is illustrated by Pauketat's discussion of historical processual method. On the one hand, he emphasizes the "undirected and creative" character of practice, and advocates for the use of homologies (Pauketat 2001a:87). On the other hand, he recognizes the need to understand a variety of "social-historical phenomena," such as social movements (Pauketat 2003a:49). The issue comes down to this: how can archaeologists use theories, concepts, models, or analogies without skittering down the slippery slope to structural determinism? Part of the answer, I think, lies in appropriating a research strategy known as "*histoire problème*," or problem history, pioneered by Annales historians. Problem history asks what might be called proximal "why" questions: what factors account for or contribute to the observed state of affairs? "Historicizing," Nicholas Dirks (1996:32) comments, "is nothing more nor less than the constant asking of questions about how something came to be and about what effects things have had over time." For Annales historians, problem history binds together different scales of analysis because answers to such questions necessarily reference processes operating at several different scales (Bintliff 1991). For historical processualism, the approach can link fine-grained genealogies

of practice with models or general concepts drawn from a variety of disciplines, including anthropology, psychology, or ecology, to craft coherent narratives of change. That is, alongside the "how" questions meant to get at the specifics of practice, archaeologists also need to ask narrowly tailored "why" questions that put those practices in processual context. Such questions open the door for a variety of more-or-less general propositions about the nature of the processes at work in a given historical situation.

Tools for Writing Archaeological Histories

Overcoming the hurdles outlined in the first part of this chapter also requires methodological innovations. Beyond abandoning the notion that indigenous culture at the time it was first described by Europeans represents a point of departure for historical analysis, archaeologists need to reconfigure the relationship between archaeological and documentary data. This means revisiting the long-standing problem of analogy. It also means reconsidering the differences and similarities between archaeological and historical data.

Downstreaming and the Supplementary Use of Documentary Sources

The simplest strategy for building trans-Columbian Native histories is to fully acknowledge the temporality of the written record. This means untangling the disparate strands making up the composite image of precolonial and early colonial-period Native life (Lightfoot 1995; Stahl 2001). The situation ethnographers encountered in the twentieth century reflects a host of changes post-dating the earliest historical observations. Early narratives, in turn, likely only dimly reflect the situation at the time of Columbus's landfall. Central to the work of temporalizing ethnographic and historic records is the search for independent lines of evidence—mainly from archaeological research but also from the study of oral histories and other sources—

to better understand the factors affecting their production (Lightfoot 1995:205; Stahl 1993; Wood 1990). In many cases, too little is known about the contexts in which ethnographies or historical documents were produced to properly evaluate their content. As Chance (1996:386) quips, researchers "frequently have gone upstreaming with too small a paddle, or with none at all."

Archaeologists also need to invert the priority given historical documents. This does not mean forsaking texts; clearly, documentary (and oral) sources will continue to play key roles in the interpretation of historical change. But archaeological data necessarily must take pride of place for Native histories covering the centuries before and after Columbus's landfall. The problem, of course, cannot be solved by simply avoiding analogies, however they are warranted. As Wylie (1988:142) observes, "archaeological data stand as test evidence only under interpretation, usually interpretation that is, on the face of it, analogical." Rather, archaeologists need is to move away from illustrative analogies warranted by simple appeals to cultural (or temporal or spatial) continuity and instead use historical analogs as a source of hypotheses which then can be evaluated against archaeological data (Roper 2007a). Doing so inevitably leads to a comparative approach less concerned with the relevance criteria used to select analogies and more concerned with how well chosen analogies fit with the archaeological case under consideration (Stahl 1993:236). In practical terms, this means moving away from research strategies meant to integrate archaeological and historical data, toward one that puts textual and material sources into productive tension (Stahl 2001). Such a supplementary use of documents allows archaeologists to move away from *a posteriori* explanations of historical change rooted in European and American texts and instead move back and forth between historical (or ethnographic) and archaeological data, seeking both continuities and discontinuities. This, of course, is the principal lesson of Strong's and Wedel's pioneering work in the Plains. Such comparative work will also lead archaeologists interested in recent Native history to seek out a broader inventory of analogies, drawn from different time periods and different places (Lekson 2009).

It should be noted, though, that the move toward such comparative work exposes an essential tension in historical analysis. An account of genealogies of practice—of history—depends on the "intensive study of homologies" (Pauketat 2001a:87). However, homologies also constitute the key connecting principle underwriting direct historical research. How, then, can one use comparative methods to rectify the defects of the direct historical approach without simultaneously subverting the goals of historical processualism? Pauketat (2001a:88) makes ample room for comparison, but I believe the problem lingers, particularly for the trans-Columbian period, when the lure of the cultural details provided by early colonial accounts is most acutely felt. Perhaps the best remedy is to maintain a skeptical attitude toward all analogies, ethnographic or historical, and strive to continually assess both the source-side and subject-side criteria by which they are selected and applied.

The Taphonomic Metaphysic

Many scholars view the archaeological and historical records as fundamentally different. Compared to archaeological data, documents seem to describe relatively brief moments in time. Historical data, especially the diaries so important to ethnohistory, are associated with a particular author, who had a particular point of view on the events they describe. Archaeological data, by contrast, seemingly constitute an authorless record.

However, closer inspection reveals that many of these conventional distinctions do not hold up. Many forms of historical data—census records, deeds, or sales invoices, for instance—do not bear the obvious marks of an author. Material representations of identity such as rock imagery clearly express their author's sense of self and community. Nor does the temporal distinction necessarily hold: historical data may include descriptions of long-standing practices, just as archaeological data may preserve a record of brief events. There is, however, a crucial difference between them that has far-reaching consequences for archaeological histories. The

archaeological data on which genealogies of material practice rest always derive from artifacts or features that accumulated over some period of time. This is because material objects, along with the places they are used, are durable and therefore have "career trajectories" or use-lives of varying length and complexity (Bailey 2007:208). Moreover, the reconstruction of genealogies of practice is tied inextricably to an understanding of the surfaces that define spaces and the sediments that contain objects. Simply put, chronological assessments depend on an understanding of deposits and depositional processes (Stein 1987). This means that archaeological data on material practices always are defined by two analytically distinct temporal dimensions: age and duration. The span of an archaeological deposit cannot be reduced to an estimate of temporal imprecision or error, but rather is a definite (at least potentially) measurable property of the sediments and surfaces surrounding and enclosing the materials of interest. For this reason, genealogies of practice have to incorporate what Simon Holdaway and LuAnn Wandsnider (2008:4) call a "taphonomic metaphysic."

Inspired initially by Michael Schiffer's (1972) pioneering work on "formation processes" and by David Clarke's (1968) theoretical approach known as "analytical archaeology," the taphonomic metaphysic stems from the principle that archaeological deposits are accumulations, often called "palimpsests," formed by human activities and natural processes that add to, modify, or obliterate traces of prior activities or processes (Bailey 2007; Holdaway and Wandsnider 2008; Shennan 2004). Geoff Bailey (2007) identifies several types of palimpsests, each of which produces accumulations with different characteristics. Accumulations he calls "true palimpsests," for instance, are produced when an activity, such as sweeping or house building, substantially eliminates traces of prior activities. Cumulative palimpsests, by contrast, incorporate artifacts and other materials used for different activities or at different times. Importantly, sites nearly always comprise deposits reflecting most or all of the processes responsible for Bailey's modes of accumulation.

The temporality of deposits has decisive implications for archaeological history. Most

crucial is the fact that interpretations of material practice are fundamentally dependent on an understanding of the specific factors affecting archaeological accumulations. The study of archaeological deposits turns out to be a very complex business. A second implication derives from an approach founded on these principles and dubbed "time perspectivism" (Bailey 1981). Time perspectivism holds that different phenomena operate over different spans of time and, moreover, that the types of questions one might answer or the kinds of explanations one might offer for observed patterns vary accordingly (Bailey 2007:210; Holdaway and Wandsnider 2008:1; Smith 1992). A critical implication of this view is that the temporal span of many archaeological deposits is different from the subjective experience of time of the people whose activities they represent. Adherents of the time perspectivist approach treat this disjunction as a virtue, arguing that the archaeological record supplies evidence for very long-term processes to which no other dataset attests (Bailey 2007).

At this point one might object that the assumption of periodization underlying the taphonomic metaphysic belies the goal of historical processualism to provide an account of the past built on the experiences of historical subjects. On the face of it, the fact that archaeological data are packaged in units representing periods of time would seem inevitably to lead to structural rather than processual accounts. The problem, though, is less stark than it might seem. For one thing, the issue points up the fact that archaeological histories are not merely ethnographies set in past: the experiences framing action are the social experiences of categorical individuals, communities, or larger social groups that span the lives of named individuals. At the same time, the recognition that accumulation duration is an independent temporal dimension should spur historical processualists to explore new models for interpreting the social significance of short-duration deposits (Smith 1992:30). But equally it means that archaeologists have to carefully match the duration of the archaeological deposits available to them with the historical processual they hope to answer.

Michael Smith (1992:28-29) identifies a number of factors affecting the resolution or

"grain" of archaeological deposits. Some relate to the specific content of the record of interest, including site age and type, or to post-occupation processes or geomorphic setting. However, the most important influences on assemblage resolution are related to archaeological practice. The choice of chronometric method (which in turn is determined in part by the content and age of the assemblage or associated deposit), strongly affects temporal resolution; progressive increases in the precision of radiocarbon dating have substantially increased assemblage resolution in the last 30 years. Archaeological recovery methods also affect chronological precision. Smaller, more precisely defined provenience units enable a better match between assemblages and datable depositional events. Integrated geoarchaeological research improves chronological precision by identifying depositional processes and the sources of archaeological sediments. Finally, the resources archaeologists put toward developing and refining both relative and absolute chronologies help determine the precision of the assemblages available for historical interpretation. It is worth noting that precise dating methods or careful artifact recovery strategies cannot increase the precision of low resolution deposits but that inexact methods can reduce the precision of otherwise high-resolution deposits.

Archaeological Historical Data for the Heart Region

This dissertation uses data on the organization of craft production to write an archaeological history of the Heart region. Data on changes in the ways crafts were produced over time are well suited to historical processualism's emphasis on the genealogies of material practice. Diachronic studies of craft production constitute a kind of microhistory, linking historically situated subjects—craft producers—to the products and byproducts of production recovered by archaeologists.

Measuring Variation in the Organization of Production

Most early efforts to describe variation in the organization of craft production were typological (Costin 1991; Peacock 1982; Rice 1987; Van der Leeuw 1977). For instance, Sander Van der Leeuw (1977) identifies six modes or types of pottery production. However, many investigators now recognize that a typological approach masks significant variation, and therefore have increasingly turned to "bottom-up" approaches that measure variation along several independent dimensions (Costin 1991, 2001:277). Multidimensional methods are not without their own conceptual shortcomings, though (Clark 1995; Pool 1992:277). The most significant of these has been the reliance on dimensions that, strictly speaking, measure consumption or distribution rather than production. For example, the development of a new cuisine (consumption) could lead to changes in ceramic vessel manufacture (production), but that does not mean that dietary changes are an appropriate proxy for changes in pottery production. Defining production in terms of the nature of demand or systems of distribution can obscure the relationships archaeologists seek to explain (Clark 1995: 287; Costin 2001:276; Pool 1992).

The analytic dimensions I use here focus specifically on the characteristics of producers, on their activities and the materials they use, and on the social relations of production in which they are embedded. These dimensions apply equally well to additive and subtractive technologies, and are amenable to the study of production in nonstratified social contexts (Cobb 1993; Cross 1993). Table 1 lists some of the archaeological measures used most frequently to assess each dimension.

Producers can be characterized by the amount and kind of technical knowledge they possess. Different producers, for instance, may use different procedures to achieve similar ends (Lea 2005). In some cases, the knowledge required to produce particular kinds of crafts may be restricted to certain individuals (Gilman and Schneider 1987). Crafts like metal working require special tools and complex facilities (Keller and Keller 1996), but others can be practiced nearly

Table 1. Analytic dimensions and archaeological measures for studying the organization of craft production.

Dimension	Measures	Example(s)
Knowledge	• Variation in operational sequences	Lea 2005; Stout 2002
	• Complexity of production process	Kenoyer et al. 1991
	• Distribution of special tool kits and features	Sliva and Keeley 1994
	• Layout of production facilities	Keller and Keller 1996
Skill	• Product or raw material uniformity and standardization	Clark 2003; Mills 1995
	• Frequency and character of production failures	Sheets 1978; Andrews 2003
	• Product symmetry	Bamforth and Hicks 2008
	• Morphology of production waste	Brown 1990
	• Complexity of production process	Kenoyer et al. 1991
	• Elaborate or difficult to achieve product morphology	Stout 2002
Scale	• Distribution of production facilities and waste products	Arnold 1987
	• Product or raw material uniformity and standardization	Clark 2003; Mills 1995
	• Distribution of special tool kits and features	Sliva and Keeley 1994
	• Size of production facilities and amount of waste	Clark 1986
	• Context of production facilities and waste products	Feinman 1999
	• Raw material source or composition	Habicht-Mauche 1995
	• Burial accompaniments	Seeman 1984
Segmentation	• Distribution of production facilities and waste products	Arnold 1987
	• Raw material form	Cross 1993
	• Assemblage diversity	Pope and Pollock 1995
	• Morphology of production waste	Brown 1990
	• Raw material source or composition	Habicht-Mauche 1995
Intensity	• Distribution of production facilities and waste products	Arnold 1987
	• Product or raw material uniformity and standardization	Clark 2003; Mills 1995
	• Assemblage diversity	Pope and Pollock 1995
	• Size of production facilities and amount of waste	Clark 1986
	• Setting of production facilities and waste products	Feinman 1999
	• Layout of production facilities	Keller and Keller 1996
	• Skeletal morphology	Hollimon 1992
Identity	• Burial accompaniments	Seeman 1984
	• Context of production facilities and waste products	Brumfiel 1998; Feinman 1999
	• Skeletal morphology	Hollimon 1992

anywhere using simple, commonly available implements. Beyond differences in the extent of their technical knowledge, different producers also exhibit different skill levels (Bamforth and Finlay 2008). Skill arises both from knowledge and from practice. By virtue of their training, some producers are consistently able to make more elaborate or more uniform products (Sheets 1978; Stout 2002). At the same time, other things being equal, the more time spent on production the more skilled a producer becomes (Clark 2003). Skill differences are expressed by different error rates (Shelley 1990) and by differences in artifact symmetry (Bamforth and Hicks 2008).

The size and distribution of production facilities can vary. Some facilities may house

many producers, whose output is distributed widely, while others may house only one or two producers who supply local needs. However, the scale of production need not be uniform among contemporary localities: many settlements may have only a few producers of a particular item, while a handful may have many (Bayman and Nakamura 2001; Stark 1991). The recruitment of new producers can vary according to the scale of production (Crown and Mills 1995).

All phases of a particular production sequence may be carried out in one place by a single group or they may be distributed spatially, temporally, or socially (Cross 1993; Pool 1992). Some crafts require the efforts of several cooperating artisans, while others can be pursued by a single individual. Producers may procure their own raw materials or make their own tools, or they may obtain them from distributors or other producers (Arnold 2000). The partitioning of production requires various forms of coordination; different degrees of segmentation can entail different degrees of producer interdependency and control.

Production intensity can vary. Different crafts, or different forms of production, can require different levels of commitment. In some cases, producers devote their full attention to their vocation, to the exclusion of other activities. In other cases, producers must balance their craft production activities with other tasks, such as hunting or farming. Time spent on production may result in increases in productivity, but at the expense of their economic independence. Finally, the social identities of craft producers can be tied to their productive activities in different ways. Some producers may belong to a particular social group, whose economic or political status can vary (Harry 2005). Crafting may be is the primary basis of a producer's social persona (Stout 2002), but for others craft production may simply be one activity among many.

It is worth pointing out that certain archaeological measures have been used to describe variation in more than one dimension of production (see also Costin 2000:Figure 1). Perhaps the clearest example of this is artifact standardization. Since the early 1980s, standardization (regularity in one or more attributes) and uniformity (regularity of proportions) have been used to measure a number of different aspects of production (Andrews 2003; P. Arnold 1991;

D. Arnold 2000; Arnold and Nieves 1992; Blackman et al. 1993; Clark 2003; Costin and Hagstrum 1995; Cross 1993; Kvamme et al. 1996; Longacre 1999; Rice 1981, 1991; Roux 2003; Stark 1995; Whittaker 1987). For example, ceramic standardization has been viewed as a measure of the ratio between producers and consumers (Stark 1995), as a measure of the intensity of production (Blackman et al. 1993; Roux 2003), and as an indicator of the efficiency of production (Rice 1987:202). At the same time, ethnoarchaeological research has shown that the relationship between standardization or uniformity and the organization of production is very complex (Arnold 1991; Stark 1991; Roux 2003; Stout 2002). Although most researchers agree that variations in the degree of assemblage uniformity and diversity are related to aspects of production, it is clear that no single measure can adequately describe the ways in which production is organized. Rather, it is important to compare and contrast different measures of each dimension of production. Moreover, relative comparisons of differences in the organization of production are likely to be more successful than absolute estimates.

Craft Production as Skilled Performance

The final ingredient for writing historical processual narratives is an interpretive link between practice theory and archaeological data on the organization of craft production. For some time, archaeologists and anthropologists have recognized that the study of craft production must be informed by analyses of the social and cultural contexts in which learning takes place (Crown 2001; DeBoer, 1990; Gosselain, 1998; Greenfield, 1984; Minar and Crown 2001; Roux, et al. 1995; Wallaert-Petre, 2001; Washburn, 2001). Recently, this work has been stimulated by an analytic framework developed by social psychologists, sociologists, and anthropologists known as the community of practice model (Bowser and Patton 2008; Eckert and McConnell-Ginet 1992; Holmes and Meyerhoff 1999; Lave 1993; Lave and Wenger 1991; Minar 2001; Minar and Crown 2001; Sassaman and Rudolphi 2001; Wenger 1998). The community of

practice model offers a powerful way of thinking about how knowledge and dispositions are transmitted over time and so is well suited to historical processual research aimed at linking genealogies of material practice with the analysis of social relations and cultural traditions (Wenger 1998:124). In a community of practice, the acquisition and deployment of technical traditions are embodiments as well as expressions of cultural schemas and material resources. Production techniques therefore both exemplify and reproduce the cultural meanings and social relations from which they arise (Dobres 2000). This approach therefore provides the kind of a middle-range bridge—linking micro-scale materials analysis with macro-scale social analysis—that historical processual research calls for.

A community of practice is a group of people regularly engaged in a common endeavor. The concept is built around the idea that learning always takes place within the context of defined social relationships (Lave and Wenger 1991). During the course of their mutual engagement, the members of a community of practice develop shared values, attitudes, and beliefs on the one hand and shared technical knowledge and skills on the other (Eckert and McConnell-Ginet 1992). The process of learning involves the progressive integration of novices into a community of experienced practitioners. That is, the transmission of knowledge and the creation of social identities and social relations are iterative processes. Communities of practice produce social as well as technical competence, because common symbolic understandings, common values, and common beliefs also are a product of collective work. In short, the community of practice model provides a theoretical link between the acquisition of knowledge and the creation of meaning, society, and identity.

Lave (1993:8) identifies four general principles on which the community of practice model is built. First, knowledge is transformed by practice. The relationship between techniques and social knowledge is dynamic and interactive. In a community of practice, artisans talk about the utility and meanings of the methods they use. Second, learning is a component of every activity. Because learning occurs throughout life, the contexts in which techniques are

used by experienced practitioners can be as influential as the contexts in which they were first learned. Third, at any particular point the nature of acquired knowledge may not always be clear. Precisely what a novice has learned from a particular event or process may be difficult to define; learning is not linear and different people learn in different ways at different rates. Finally, knowledge cannot be understood apart from the social relations or cultural meanings to which it is connected. The community of practice model recognizes that learning is primarily a social, rather than cognitive, process. Learning is itself a mode of sociality, one that cannot be separated (temporally or spatially) from the development of social competence.

The community of practice model is particularly well suited to analyzing the transmission of cultural and technical knowledge from adults to children or novices (Shennan 1993; Toren 1999). As the archaeologist Andre Leroi-Gourhan (1993:228) puts it, "individuals at birth are faced with a body of traditions that belong to their ethnic group; a dialog takes place, from childhood, between the individual and the social organism." But the model is equally well suited to analyses of the on-going output of experienced adult practitioners. This is so because competent producers continue to think about how best to achieve the results they desire, about the social and economic significance of their products, and about the demands their customers express for particular items or styles. The twin processes of learning and identity formation never cease.

Affiliation and activity define a community of experienced practitioners. Both criteria are necessary: not every group of people forms a community of practice and not every set of technical practices engenders a community (Wenger 1998:72). Two characteristics distinguish a community of practice from other social networks. First, the members of a community of practice regularly interact with one another in pursuit of a common task, promoting social solidarity and a sense of mutual engagement (Wenger 1998:73). This does not mean that all community members participate equally; some are core members, while others are peripheral (Lave and Wenger 1991). Further, the members of a community of practice negotiate for

themselves, in their everyday practices, the process by which their collective goals will be achieved (Holmes and Meyerhoff 1999:175; Wenger 1998:78-81). This negotiation is cemented by community members' acceptance of mutual accountability for the outcome of their collective endeavors. However, neither the fact of negotiation, nor of mutual accountability, mandates harmony among the members of the group.

Second, communities of practice share a repertoire of resources for carrying out their enterprise (Wenger 1998:82-84). These resources accrue over time and constitute the means by which the members of the community achieve their shared goals. Common styles, common bodies of knowledge, common tools, and common techniques mark the presence of a community of practice, even if its existence is not formally acknowledged by its constituent members (Wenger 1998:125).

The next step in writing an archaeological history of the Heart River region is to pose a set of proximal why questions that can be answered using data on the organization of craft production. Doing so requires a clear view of the kinds of questions that scholars have asked in the past.

Chapter 3:

Prior Models of Northern Middle Missouri Native History

Historical questions always exist in relation to a particular understanding of the past. As a prelude to the specific themes I tackle in this dissertation, this chapter surveys the salient features of the two most influential interpretations of the histories of the Native farming communities of the northern Middle Missouri. Of course, there are other accounts as well, which vary in scope, focus, and theoretical basis (Hanson 1993; Meyer 1977). But most are concerned with changes that took place at the end of the eighteenth century and the beginning of the nineteenth, following a series of disastrous epidemics. By contrast, the two accounts considered in detail here encompass longer-term developments, especially the changes these communities experienced during the centuries spanning the advent of Europeans.

In some respects these two models epitomize the dichotomous approach historians and archaeologists have taken to Native history. One relies exclusively on historical documents and focuses on large-scale processes affecting many different Native groups living in a broad swath of interior North America. The other mainly uses archaeological data and focuses specifically on the culture history of the settlements on the Missouri. Nevertheless, they should be seen as complementary rather than competing because important points of contact exist between them. Together they structure many of the ideas archaeologists currently hold about the region's Native history.

The Ethnohistorical Model

Given their long-standing interest in the fur trade, it is not surprising that ethnohistorians have offered the most comprehensive accounts. In part this reflects the richness of the documentary record available to them. While few written records relating specifically to the

Northern Plains pre-date the middle of the eighteenth century, the record is vast from the 1780s onward. In fact, the sheer number of authors makes it possible to compare and contrast different accounts of events (Wood and Thiessen 1985:221). Many European visitors were avowedly interested in Native culture and lifeways and their narratives often include detailed and lengthy descriptions of settlements, ceremonies, and material culture. Lewis and Clark's journals are the most well known examples of this genre, but Prince Alexander Philipp Maximilian, George Catlin, and others also produced accounts that can be considered incipient ethnographies. Accompanying this documentary record is a nearly unique and tremendously influential visual record created by Catlin, Karl Bodmer, who was Maximilian's artist, and others.

Of course, the notion of a single "ethnohistorical model" is a somewhat clumsy generalization. Ethnohistorians have tackled many different aspects of the impact European colonization had on Native peoples, including changes in warfare, trade, migration, technology, and social institutions. And while their accounts are grounded in analyses of historical documents, many make supplementary use of other sources, including Indian oral traditions, ethnographies, and archaeological data. Interestingly, some of the most prominent investigations were carried out by doctoral students working under the direction of the iconic Plains archaeologist W. Duncan Strong at Columbia University in the 1940s and 1950s (Holder 1970; Jablow 1951; Lewis 1942; Secoy 1953; see also Mishkin 1940).

Still, trade relationships among Native groups and between Europeans and Native Americans have been the overriding concern of many ethnohistorians. Their common emphasis on economic processes and issues, especially on patterns of production and exchange, flows directly from the sources themselves. Economic issues were foremost in the minds of virtually every European journalist—from the North West Company's Verendrye to Lewis and Clark to the American fur traders of the nineteenth century. Commercial concerns brought them to the Northern Plains and they viewed their encounters there through an economic lens. Moreover, it is clear that American Indians and First Nations peoples were vital players in colonial trade

and that, in turn, colonial trade profoundly affected their lives and fortunes (e.g. Binnema 2001; Ewers 1954, 1972; Peterson and Anfinson 1984; Ray 1974; White 1991). The fur trade brought together Europeans and disparate Native groups, promoting culture change and gene flow, leading eventually to the formation of multiethnic communities throughout the Northern Plains and adjacent regions (Swaggerty 1988:351). For these reasons it is unsurprising that economic processes are prominently featured in virtually every Northern Plains Native history.

In keeping with their methodological focus on historical documents, ethnohistorians mostly focus their attention on changes that took place in the in seventeenth, eighteenth, and nineteenth centuries. As I laid out in chapter 2, pre-1500 cultural patterns and processes are considered mainly to establish a context for subsequent changes. There is, however, one ethnohistorical account for the Northern Plains that treats events and processes before and after the advent of Europeans. In a seminal 1954 essay, ethnologist and historian John C. Ewers lays out what he sees as the fundamental patterns and processes of the Northern Plains political economy. The continued relevance of his model is attested by the fact that elements of it appear in a variety of more recent accounts, where they continue to shape scholarly interpretations of Native history (e.g. Lehmer 1977; Thiessen 1993). While Ewers's model lacks detail and documentation, those shortcomings are compensated by its scope and influence. For these reasons the following summary is organized around Ewers's framework.

Ewers begins by distinguishing three quasi-chronological patterns of production and exchange. The earliest, which he calls the "Aboriginal Intertribal Trade Pattern," began before the advent of Europeans and continued to govern political economic relationships among tribes through the seventeenth century. Symbiotic or mutualistic production of prosaic perishables, particularly food and clothing, is the hallmark of this pattern. Mobile groups living on the shortgrass steppe concentrated on bison hunting, bringing meat and hides to the horticultural villages on the Missouri to trade for the farmer's produce (Jablow 1951). Ewers argues that such complementarity arose because it was an efficient adaptation to large-scale ecological

differences, a position taken up more recently by archaeologists working on the Southern Plains (Spielmann 1983). Over time, the differential distribution of key resources, primarily bison herds and arable land, encouraged both farmers and hunters to specialize, thereby maximizing their yields and increasing the aggregate carrying capacity of the region. Relieved of the need to procure meat directly, farmers could concentrate their efforts on increasing the size or productivity of their fields. Mobile groups, for their part, were free to pursue the largest, most productive bison herds.

Ewers envisions several consequences of this pattern. Chief among them is the development of what I call the "hub-and-spoke" exchange system in which mobile groups ferried goods between trading centers where most transactions took place. Ewers recognizes two types of trading centers: primary, permanent centers at the region's horticultural villages and secondary, impermanent centers at rendezvous sites mobile groups used (figure 4). In turn, symbiotic exchange and the hub-and-spoke system inhibited the development of middleman exchange. Because the Aboriginal Trade Pattern involved direct transactions between producers and consumers, and because most of the goods involved were perishable, there was little need for Native brokers. Hunters consumed the maize, beans, tobacco and other produce they received from farmers, while farmers consumed the meat they received from hunters. For the same reasons, the Aboriginal Trade Pattern provided few incentives to accumulate surpluses.

Mutualistic exchange and the hub-and-spoke system, the argument goes, promoted acculturation and economic integration between farmers and hunters and, by the same token, curbed contact and exchange among farming communities. Ewers argues that every farming community possessed the same stock of trade items, mainly garden produce, and therefore that the value of inter-village trade was negligible. Archaeologist and ethnohistorian W. Raymond Wood, whose research is described in more detail later in the chapter, links the paucity of inter-village exchange to the fact that, in the Middle Missouri, critical resources are evenly distributed relative to village locations (Wood 1974:6). Each village enjoyed roughly equal access to

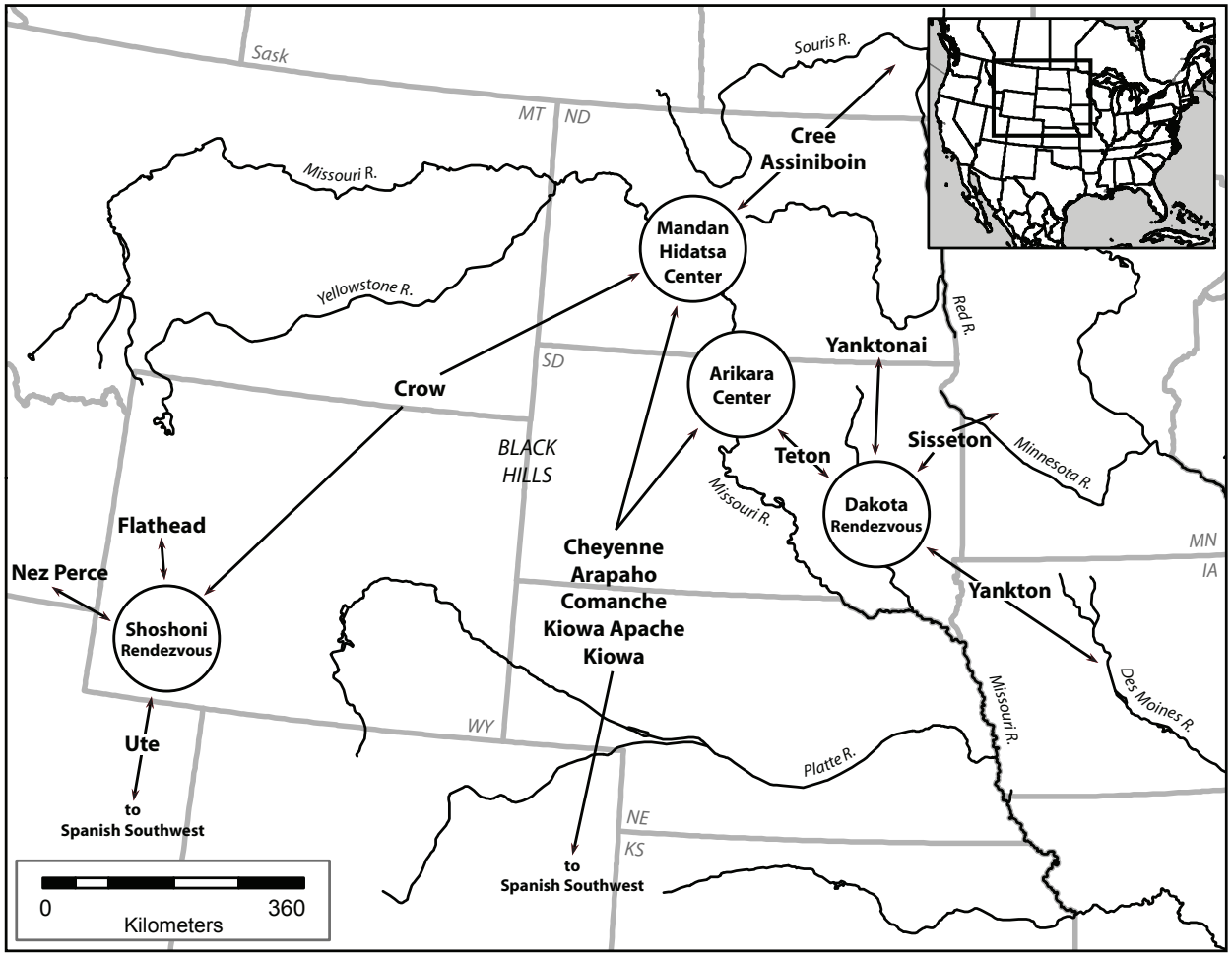

Figure 4. John Ewers's map of Northern Plains trade relationships at the turn of the nineteenth century (adapted from Ewers 1954).

garden plots, timber stands, stone tool raw materials, and bison herds. Because Ewers and Wood view the farming towns on the Missouri as economically self-sufficient, they also see them as politically and socially autonomous.

The appearance of European trade goods, such as cotton cloth, metal knives, glass beads, and copper kettles, marked the beginning of what Ewers calls the "Protohistoric or Transitional Trade Pattern." Though it did not entirely supplant the earlier trade in foodstuffs and hides, Ewers believes that the Transitional Trade Pattern brought about fundamental changes in the political economy of the Northern Plains. Unlike meat and maize, many European trade goods

are both durable and relatively portable and therefore easily could be passed from trader to trader. This encouraged both farmers and hunters to take up the role of middlemen, with the latter moving European commodities between trade centers where they were exchanged for meat, produce, or other manufactured items. Ewers suggests that the availability of European trade goods and the resulting emergence of Native brokers also introduced a novel factor to intertribal trade: profit. In each successive exchange the prices charged for trade goods increased; by the turn of the nineteenth century, mark-ups of 100 percent were common (Ewers 1954:439).

Most ethnohistorians believe that, among European imports, horses and guns had the greatest impact on Native societies (Secoy 1953). Spanish conquistadors and colonists brought horses to North America in the sixteenth century, but it was not until the second half of the seventeenth century that Native groups living on the fringes of New Spain began experimenting with an equestrian economy. This period of experimentation was brief: by the turn of the eighteenth century, horses were pouring out of the stock-raising region around Santa Fe, into the Southern Rocky Mountains and Southern Plains, driven there by Ute, Comanche, and Apache middlemen who exchanged them for bison robes and meat. Within a century, every group on the Plains owned them.

From the beginning, horses were much more than commodities; they were, as Joseph Jablow (1951:79) observes, "all important instrument[s] of production." Horses increased a hunter's productivity by increasing his range and decreasing the time required to locate game. They also lowered transportation costs, making it possible to carry a greater quantity of goods to more distant trade centers, further opening up the possibilities for middleman trade. For these reasons, horses enabled the production of unprecedented surpluses, a share of which was used to purchase even more horses. The ensuing economic spiral increased both the quantity of goods traded and expanded the geographic scale of the system. These changes took place just as European demand for furs was stimulating competition among Native groups, which in turn further increased the total value of exchanged items and expanded the reach of the system.

The Rio Grande valley remained the primary source of horses throughout the eighteenth century. However, firearms—an equally influential European trade item—only could be obtained from English and French traders operating north and east of the Plains. This was because the Spanish, beginning in the 1500s, embargoed the sale of guns to Native peoples. Spain's policy produced two expanding frontiers, with horses spreading north and east and guns spreading south and west (Secoy 1953). In the middle of the eighteenth century the horse frontier and the gun frontier collided at the primary trade centers on the Missouri. Ewers and other ethnohistorians have seen the resulting exchange of horses for guns as the epitome the Transitional Trade Pattern (Jablow 1951), reinforcing the hub-and-spoke trading system and significantly increasing the villager's wealth and influence.

In sum, ethnohistorians attribute a range of structural changes in Northern Plains societies to key elements of the Transitional Trade Pattern, especially the rise of middleman trade, the growing value of goods traded, and the increasing power of incentives to produce and control surpluses. The catalog of structural changes includes altered social relations and gender roles within the household (Albers 1983; Etienne and Leacock, eds. 1980); increasing social inequality and the rise of class distinctions (Lewis 1942); and increasing competition among bands and communities for critical trade relationships, which in turn led to inter-group conflict. Some scholars argue that this trade pattern eventually led Native peoples to become dependent on European traders; having abandoned stone and bone tools in favor of metal tools, hides in favor of sewn clothing, the argument goes, they no longer were able to support themselves without the goods the traders supplied. Together, these processes led to a general increase in productivity, as individuals, families, and communities sought to increase their participation in the fur trade.

In the 1780s, European tenant traders began living on the Missouri, initiating Ewers's third economic pattern, the "Historic Pattern" characterized by direct trade between Europeans and villagers. Initially, traders established their position in local society by marrying Indian women. Later, following the Louisiana Purchase, fur companies began building trading posts

near the villages as well as at rendezvous mobile groups maintained.

For Ewers, the Historic Pattern extended and solidified processes begun during the earlier Transitional Trade Pattern. Intertribal conflict further increased as European traders sought to bypass some of the peripatetic Native middlemen who until then had controlled the flow of European goods destined for the primary trade centers on the Missouri. The trader's increasing desire for bison robes put greater demands on women's labor, further altering gender roles and family structure. The trade network continued to grow in size and complexity, as more groups acquired horses and guns and became participants. However, the Historic Pattern post-dates the events and processes of interest here.

Recent Revisions to the Ethnohistorical Model

In the decades since it was first articulated, both archaeologists and historians have challenged some of the assumptions of the ethnohistorical model and amended or overturned its conclusions. Historians, for instance, have explored Native peoples' economic motivations, revealing a complex and volatile blend of self-interested and culturally conditioned decision making (e.g. Anderson 1994; Miller and Hamell 1986; Ray and Freeman 1978; Trigger 1991). They discovered that Native peoples were savvy consumers, who understood how to manipulate markets to their advantage and who successfully played European traders against one another. It is also clear, though, that local social and cultural factors structured demand (Baerreis 1961). Traders attempted to satisfy those demands (Wishart 1992), even if they did not entirely understand their social and political context. Recently, historians have also given greater explanatory weight to ecological processes and to the mechanisms responsible for the distribution of social and economic power, even as they have continued to emphasize the multiethnic constitution of the fur trade (Binnema 2001; Ray 1974).

On balance, though, archaeologists have advanced the most significant critiques.

Archaeological data from settlements on the Missouri and elsewhere show that, before the advent of Europeans, patterns of production and exchange were far more complex than a simple model of subsistence complementarity allows. Most strikingly, the ubiquity of bison remains in village sites attests to the farmer's substantial and consistent commitment to hunting (Blakeslee 1975). Conversely, it is equally clear that mobile groups did not focus solely on bison hunting; some, for instance, harvested and traded prairie turnip, an important source of carbohydrates, a point Ewers himself makes (1954:434; Blakeslee 1975:201). Archaeological data also demonstrate that, long before the fur trade, durable prestige goods, not just food and clothing, moved through Northern Plains exchange networks. Artifacts made from marine shell, for instance, can be found in every village in the Middle Missouri (Wood 1974, 1980). Exotic raw materials such as catlinite and native copper circulated widely. High-quality raw material for manufacturing stone tools, especially Knife River flint from western North Dakota, was traded throughout the Northern Plains and beyond (Nicholson 1991; Walde 2003). These same data show that the trade system was as extensive before the coming of the horse as it was after, though perhaps configured differently. In fact, it is now clear that in many places European trade goods flowed along existing avenues of trade (Wood 1972; Peterson and Anfinson 1984).

Archaeological data also show that production for exchange, both of durable goods and of foodstuffs, has long been a feature Plains economies. At various time and places bison meat (Brink 2008), bison hides (Creel 1991), and stone tool raw materials (Vehik 1990) were produced in quantities well beyond what was necessary for local consumption. These data suggest that, contrary to the expectations of the ethnohistorical model, Native economies produced surpluses before the advent of the fur trade. How these surpluses were allocated is mostly unknown, but this finding does indicate that trade was integral to Plains economies and that economic intensification was an important process.

Various lines of evidence show that increasing social inequality and social complexity long antedated the arrival of Europeans and European goods. On the Southern Plains, large-scale

trade networks developed after the middle of the fifteenth century, hand-in-hand with a dramatic increase in population aggregation as well as increasingly widespread violence. Using data on the frequency and distribution of exotic ceramic vessels, marine shell, and stone tools made from non-local raw materials, Susan Vehik (2002) argues that control of trade was one means by which emergent political leaders sought to expand their prestige and power. Coupled with control of ritual knowledge, their trade relations fueled increasing social inequality, long before the appearance of horses, guns, or trade goods. Dale Walde (2006) draws a parallel conclusion for the Northwestern Plains. Using data on the size and occupation duration of winter camps, he argues that hunting groups there practiced seasonal sedentism and that the organizational requirements of the resulting large camps promoted tribal social forms and incipient social inequality. In Walde's view, such tribalization was a product of interaction with encroaching sedentary hunter-farmers beginning in the 1000s, rather than encroaching Europeans in the 1600s.

Archaeological and documentary data together suggest that the interactions among horticultural towns were more complex, and more intimate, than the ethnohistoric model credits. Drawing on a spectrum of sources, including written records and physical anthropological and contemporary environmental data, Donald Blakeslee (1975) argues that trading was not confined only to major settlements and large rendezvous, but instead took place in a wide variety of settings. For this reason, he describes what he calls the Plains Interband Trade System as a "reticular rather than a centralized network" (Blakeslee 1975:228). He also makes the case that the trade system was "redundant," by which he means that groups obtained through trade items or materials they could themselves produce. Villagers traded garden produce to other villagers; both farmers and hunters produced and exchanged finished leather goods. Blakeslee sees such redundancy as a risk minimization strategy because it sustained important social relationships between individuals and communities that could be activated during times of need.

The Northern Middle Missouri Model

Ewers is not sanguine about the value of archaeology for the study of trade: though he recognizes that archaeologists might eventually provide relevant evidence, he nevertheless maintains that archaeological data alone cannot be expected to yield a "true picture of the aboriginal trade pattern" because many trade items were perishable (Ewers 1954:435). In retrospect, of course, Ewers's skepticism was not justified; on the contrary, archaeologists have shown that their data, along with oral history, can be used effectively to augment as well as critique conclusions drawn from the documentary record. No better example of this can be found than the work of W. Raymond Wood, who, as both an archaeologist and an ethnohistorian, has made the most extensive contributions to the study of northern Middle Missouri Native history. In some respects, Wood's history contrasts sharply with Ewers's. For one thing, Wood puts archaeological data, especially on settlement patterns, ceramics, and architecture, front and center. Where Ewers paints the Native history of the Northern Plains with a broad geographical brush, Wood focuses attention specifically on the farming towns of the northern Middle Missouri. He also explicitly recognizes the dynamic character of Native history in a way that Ewers does not, emphasizing the effects of both local and regional social processes. Nevertheless, there are important points of contact between Wood's northern Middle Missouri model and Ewers's ethnohistorical model.

Wood's (1967; see also Bruner [1961] for a cognate synthesis) history combines traditional culture historical elements with a concern for social and economic processes. He partitions the history of the Heart region's farming communities into three conventional culture historical units: the Thomas Riggs focus, which he dates from 1100 to 1400, the Huff focus, from 1400 to 1600, and the Heart River focus, from 1600 to 1797. No archaeological data on nineteenth-century northern Middle Missouri settlements were available when he produced his synthesis and so his model is limited mostly to events and processes pre-dating the 1781

epidemic. (Because Wood had few absolute dates to work with, his chronology has been modified somewhat over time; the current Middle Missouri chronology is discussed in chapter 4 and appendix 1).

Wood argues that the Thomas Riggs focus is the earliest archaeological culture bearing unmistakable historical connections to the Mandans Europeans visited in the 1700s. He characterizes Thomas Riggs focus villages as small, loosely structured settlements, dispersed widely throughout the Missouri River valley. Their geographical isolation led in turn to social isolation: each Thomas Riggs community, he argues, operated independently. Evidence for long-distance trade is present, but comparatively limited. Warfare, too, appears to have been infrequent; encircling fortifications, while more often present in the south, were uncommon overall.

The subsequent Huff focus is unquestionably the direct descendant of the Thomas Riggs focus, but a number of important modifications in settlement pattern, pottery design, and architecture are evident. The distribution of Huff focus villages is much more limited, occurring only upstream from the mouth of the Cannonball River. They also were as much as three times larger than their Thomas Riggs predecessors. Village layout became more structured, with public space more clearly marked and houses laid out in definite, if undulating, rows. Fortifications, once uncommon, surrounded virtually every Huff focus settlement. At the same time, there is much greater evidence for contacts with downriver villagers as well as with mobile bison hunters.

Wood argues that two different modes of inter-group interaction—war and trade—were responsible for these changes. In his view, war, precipitated by drought, prompted the dispersed Thomas Riggs focus communities to coalesce into a smaller number of larger Huff focus settlements. Their antagonists may have been mobile bison hunters, drawn to the villager's agricultural stockpiles, or competing downriver village groups. In either case, settlement consolidation led rapidly to a cascade of social changes, especially increasing organizational

complexity, which was expressed, among other ways, in the Mandan's intricate ceremonial and social life that so impressed European journalists in the nineteenth century.

In Wood's model, trade and other forms of peaceful interaction accompanied conflict-induced village consolidation. Traded ceramic vessels are present in the Huff site assemblage, but perhaps the most persuasive evidence for social interaction can be seen in the formal and decorative similarities between Huff focus pottery and pottery from downriver villages, as well as in the introduction from the same source of a new and distinctive architectural form. At the same time, Wood concurs with Ewers that mutualistic interaction between settled farmers and mobile hunters was important to the growth and consolidation of villages in the Heart region. Thus, even though hostility may have made them necessary, the larger "cosmopolitan" communities of the Huff and Heart River foci also seem to have promoted interaction with outside groups (Wood 1967:164).

These broad trends continued in the seventeenth and eighteenth centuries during the Heart River focus. Settlement distribution was further restricted to an even shorter stretch of the Missouri above and below the Heart River. The material changes prompted by interaction with downriver hunter-farmers during Huff focus times continued or even accelerated. Settlements continued to be surrounded by substantial, though differently designed, fortifications.

Comparison

Both Ewers and Wood invoke economic as well as ecological processes in their accounts of historical change. Both emphasize the central importance of farmer-forager mutualism. Both hold the view that the region's farming communities were socially, politically, and economically autonomous, although Wood's argument is more complex and incorporates specific ethnographic and oral historical data. However, they differ on other points. General arguments about village autonomy notwithstanding, Wood sees intervillage trade between Ewers's Arikara and Mandan-

Hidatsa trade centers, and the ensuing acculturation of the Mandans, as important social process. To some extent this reflects the different geographic scales at which their models are drawn. But it also reflects the clarity of the archaeological evidence for inter-community interaction. Wood also recognizes that warfare was an important social process. Lacking access to the unequivocal archaeological evidence for warfare before the advent of Europeans, Ewers saw conflict mainly as a feature of the Transitional and Historic trade patterns.

Research Questions

Though the evidence archaeologists and historians have so far assembled suggests that key elements of the ethnohistorical model of Native history on the Northern Plains may be in error, many other elements remain untested, particularly for the northern Middle Missouri. Most importantly, the model's central thesis—that European material culture and European systems of value catalyzed a fundamental rupture in Native societies—has not been evaluated. Most scholars continue to assume that the "historic" political economy of the Northern Plains differed fundamentally from its "prehistoric" precursor. Although the long-standing importance of the exchange of durable goods is widely acknowledged, most scholars nevertheless continue to emphasize the structural role of mutualism before 1700 and of middleman exchange after 1700. Most continue to characterize the transition between these two patterns as an unprecedented period of economic intensification, stimulated largely by the availability of European trade goods, especially horses and guns.

Other taken-for-granted features of the ethnohistorical model are its geographical scope and its fundamental analytic structure. Both ethnohistorians and archaeologists studying post-1500 culture change on the Northern Plains continue to take a broad-scale view, one emphasizing hub-and-spoke exchange and the division of labor linking farmers to hunters. Allied with this is a focus on named tribal groups as the units of analysis. And while Wood's model

effectively refutes Ewers's claim that there was little or no interaction between the Mandan-Hidatsa trade center and the Arikara trade center, neither approach considers evidence for local, intra-center trade. Rather, both assert the economic and political autonomy of each center's constituent communities. Thus, processes of change typically are viewed at the largest scale, involving historical structures or systems rather than choices made by individuals, families, or communities.

To evaluate the ethnohistorical model's claim that the Transitional Trade Pattern prompted regional economic intensification, I consider how Heart region artisans produced crafts before and after the advent of European trade goods. If economic intensification can be identified in the archaeological record of the Heart region, when did it begin and under what circumstances? Did patterns or modes of craft production change in response to the introduction of trade goods? Conventionally, intensification is defined in terms of changes in agricultural productivity measured by increases in the amount produced per unit land (Morrison 1994). However, on both evidentiary and theoretical grounds such subsistence intensification can be linked to other modes of economic change (Stark 1991), many of which leave robust traces in the archaeological record. Here I combine data on changes in the organization of craft production with data on changes in subsistence practices to assess the timing and extent of overall economic change.

Apart of inferences about the productivity of craft producers, data on the scale, intensity, and segmentation of production also can be used to study patterns of inter-community exchange within the Heart region. Both Ewers and Wood, largely on theoretical ecological grounds, argue that the farming towns of the northern Middle Missouri were economically self-sufficient and therefore socially and politically autonomous. Owing to their focus on mutualism and on intertribal, hub-and-spoke exchange, little attention has been paid to the nature of the connections among farming communities; interaction among them was thought to have been indirect at best, perhaps taking place through mobile intermediaries. Here I use archaeological data to test the

proposition that the residents of each farming community put equal emphasis on various type of production and therefore could operate independently. Asking this question shifts the long-time focus of Native histories away from a sub-continental scale and an emphasis on named tribal groups, toward a local level where the experiences and actions of individuals, families, and communities can be brought into focus.

I begin addressing these questions in the next chapter by describing both long- and short-term trends in northern Middle Missouri settlement, subsistence, and trade practices. In that discussion I compare and contrast archaeological data with historic and ethnographic data collected in the nineteenth and twentieth centuries. I then turn in chapters 6 and 7 to a fine-grained account of changing patterns of stone tool and pottery production in the Heart region.

Chapter 4:

Subsistence, Settlement, and Society in the Northern Middle Missouri, 1200-1750

The First Villages

Aggregated farming villages—compact settlements housing at least 100 people—first appeared in the Middle Missouri subarea in the 1000s (Benn and Green 2000; Johnson 2007a; Tiffany 2007a; Henning and Toom 2003; Toom 1992a). Archaeologists assign these communities to a culture-historical unit known as the Initial variant of the Middle Missouri tradition. The Middle Missouri tradition is one expression of the widespread and long-lasting Plains Village pattern, which is defined by a set of core economic and technological practices, including a mixed farming and hunting subsistence economy; construction of substantial timber-frame houses located close to arable land; extensive use of bell-shaped maize storage pits; and production of distinctive bone and stone implements and ceramic containers (Wood 2001). The distribution of Initial Middle Missouri villages straddles the Plains-Prairie border, stretching from central and southeastern South Dakota eastward into northwestern Iowa (figure 5).

In the northern half of the Middle Missouri, aggregated farming settlements began coalescing in the 1200s. Archaeologists have long believed that these northern communities, together known as the Extended variant of the Middle Missouri tradition, were related to, but distinct from, earlier Initial variant communities in the south and so questions about the nature of the relationship between them have figured prominently in regional culture-historical research. In his first synthesis of Middle Missouri archaeology, for instance, Donald J. Lehmer (1954) argues that Extended variant groups descended directly from Initial variant groups. Later, with more chronological data in hand, he came to believe that Initial and Extended variant groups were culture-historical cousins, co-descendants of a common Late Woodland ancestor (Lehmer 1971:99-105; see also Winham and Lueck 1994). Still, doubts about the nature of the connection

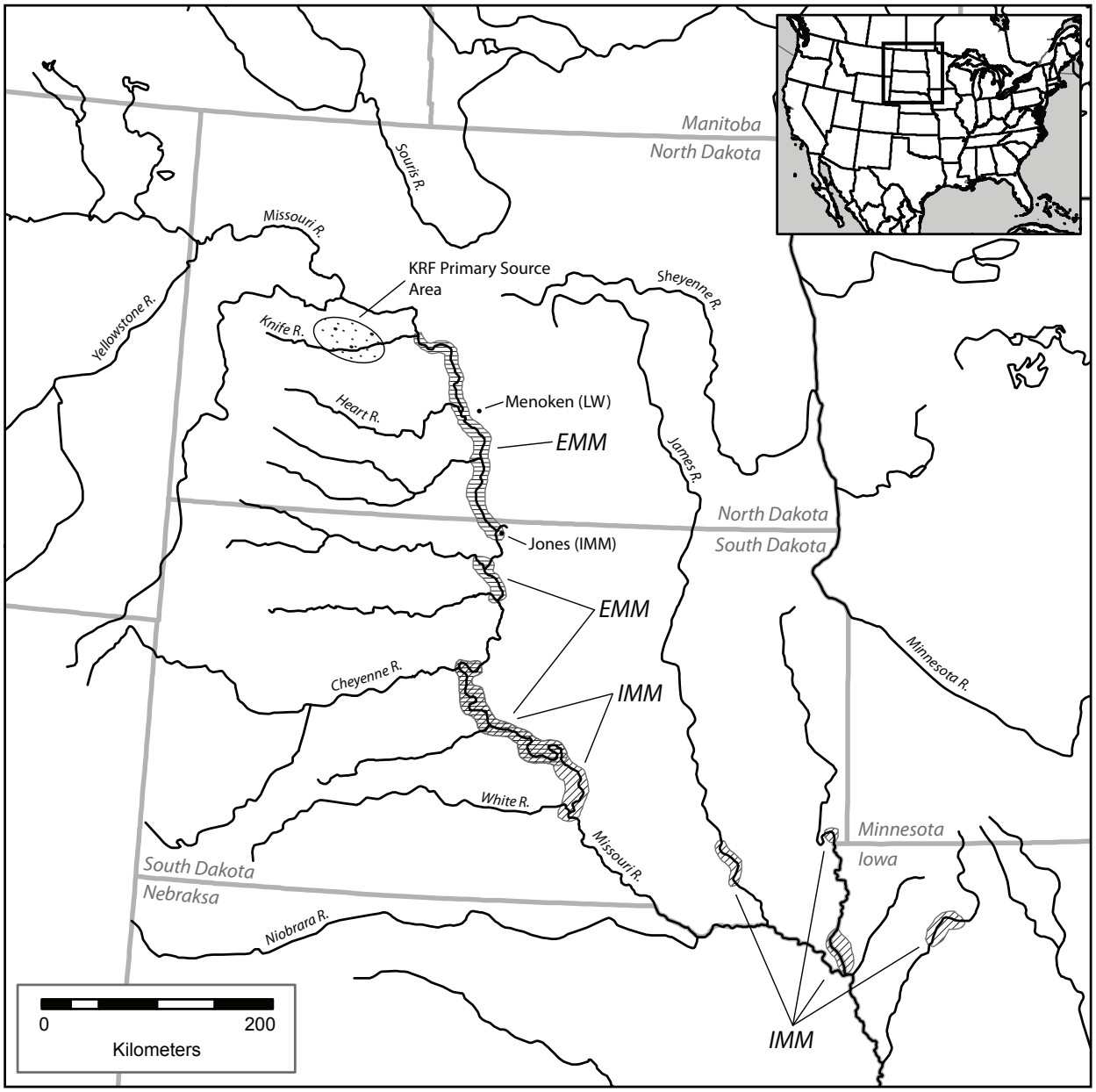

Figure 5. Map showing the locations of Initial Middle Missouri (IMM) and Extended Middle Missouri (EMM) settlements.

persist. Contrary to Lehmer's revised interpretation, for instance, Peter Winham and Francis Calabrese (1998:298) maintain that direct descent, perhaps combined with community fissioning, remains the simplest explanation.

Work carried out in the northern Middle Missouri in the last ten years sheds new light

on the problem. Analyses of architecture, pottery, and other artifacts from twelfth-century sites there reveal that the founding of Extended variant communities was a direct consequence of regular interactions between Late Woodland bison hunters and Initial Middle Missouri farmers (Ahler 2007; Johnson 2007b; Krause 2007). These interactions were prompted, at least initially, by the concerted efforts Initial Middle Missouri traders made to obtain Knife River flint (KRF), a high-quality toolstone found in west-central North Dakota, mainly in the area surrounding the confluence of Spring Creek and the Knife River (figure 5). The scale of their efforts can be measured by the makeup of Initial variant chipped stone assemblages. At Jones Village in the Cannonball region, the northernmost Initial variant site, 89 percent of the chipped stone tools and waste flakes are made from KRF, even though the principal quarries are more than 200 km away and other suitable raw materials can be got from quarries nearer at hand (Ahler 2007; Johnson 2007b). Even farther south, at the Sommers site, in the heart of western Initial Middle Missouri settlement and some 375 km from the quarries, more than 50 percent of the flaked stone consists of KRF (Johnson 1984). In both cases, the intensive Initial Middle Missouri use of KRF contrasts markedly with the use by later communities in the same areas of a much wider range of both local and distance sources (Ahler 1977a; Johnson 1984).

The character and consequences of the KRF trade can be best appreciated by comparing data from Initial Middle Missouri sites, especially Jones Village in the Cannonball region, with data from Menoken Village, a fortified Late Woodland settlement located on Apple Creek in the Heart region, about 15 km east of the Missouri (figure 5). In addition to the prevalence of KRF, assemblages from both sites exhibit similar stone tool production technologies (Ahler 2007; Johnson 2007b). Like many Initial variant assemblages, the Menoken assemblage includes imported marine shell beads. House forms at Menoken and other Late Woodland sites echo, though do not replicate, Initial Middle Missouri house forms. Both groups made use of similar distinctive bone and antler ornaments (Ahler 2007). Perhaps most tellingly, the Menoken ceramic assemblage exhibits the formal, decorative, and technological attributes of both Late

Woodland and Plains Village potting traditions (Krause 2007; Swenson 2003). At the same time, the Menoken assemblage includes a number of tool forms absent from Initial Middle Missouri assemblages, but present in other Late Woodland assemblages, including Prairie Side-notched arrowpoints and Avonlea-like arrowpoints. The distinctive double-ended draw planes in the Menoken assemblage also occur in earlier Middle Woodland Sonota complex sites (Ahler, Kellet, and Crawford 2003). Taken together, these data paint a picture of structured, face-to-face interactions between Initial Middle Missouri and Late Woodland groups. In the 1200s, the processes of acculturation underway at Menoken and other Late Woodland settlements culminated in the founding of Extended variant communities. As Stanley A. Ahler (2007:30) succinctly puts it, "the movement of Knife River flint from north to south likely set the stage for the movement of maize horticulture from south to north."

Apart from evidence for Late Woodland acculturation in the 1100s, the pluralistic origins of the Extended variant can be seen in chronological, geographical, and content differences between the Initial and Extended variants. For instance, technological differences exist between Extended and Initial pottery. Initial variant potters used cord-wrapped paddles to finish their vessels, while Extended variant potters used carved paddles, though both produced vessels with smoothed exteriors. Both made pots with straight rims and pots with S-shaped rims, but the specific forms they produced varied, as did the techniques they used to produce them. Absent from Extended variant assemblages are the angular, low-rim vessel forms commonly found in eastern Initial variant assemblages (Tiffany 2007b). High-rim forms reminiscent of some Extended variant types are present in western Initial variant assemblages, but the details of rim shape suggest that they were manufactured differently (Lehmer 1971:72). Also absent from Extended variant assemblages are ceramic vessels inspired by Mississippian styles—a hallmark of Initial variant pottery. The motifs Extended and Initial variant potters used to decorate their vessels are quite distinct. Finally, observes Wood (1967:128), Extended variant pottery assemblages are stylistically and technologically homogeneous, compared to Initial variant

pottery.

The mix of stone tool raw material sources Extended variant flintknappers used differs from those their Initial variant predecessors living in the same areas used (Ahler 1977a; Johnson 1984, 1999). The disappearance of Initial variant communities in the latter part of the thirteenth century seems to have led to the collapse of the intensive KRF procurement system. Extended variant flintknappers still used KRF, but obtained it in different ways and applied different technologies to it (Ahler 2007). They also made use, particularly at sites below the Grand River, of a wider array of local or near-local sources, as well as exotic stones from sources to the west.

Extended variant houses are larger than Initial variant houses, though both share a basic architectural pattern. In fact, only three of 67 excavated Initial variant lodges are bigger than the mean size of 46 excavated Extended variant lodges (Lensink and Tiffany 2005). Overall, the layout and construction of Extended variant houses are more uniform than Initial variant houses, particularly Initial variant houses in northwest Iowa. The mean size of Extended variant settlements exceeds that of Initial variant sites located in northwest Iowa, but is roughly comparable to Initial variant settlements on the Missouri in south-central South Dakota (Henning 2007; Toom 1992b).

Extended Middle Missouri settlements likely first appeared well north of the northernmost Initial variant settlements, in an area previously occupied only by bison hunters. Archaeologists have long known that most of Extended variant sites are located in the Knife, Heart, and Cannonball regions, a circumstance leading Don Lehmer (1971:99) to describe the northern Middle Missouri as a sort of Extended variant "homeland." This distribution indicates that Extended variant settlements did not spread outward from the western Initial Middle Missouri core area in the Big Bend region, as one might expect if the former developed directly from the latter. Interestingly, though, the radiocarbon data currently available seems to indicate that Extended variant communities appeared essentially simultaneously across much of their maximum range sometime in the mid-1200s (Johnson 2007a).

Debate continues over whether Initial and Extended variant communities co-existed in the Big Bend and Bad-Cheyenne regions, a problem complicated by a plateau in the radiocarbon calibration curve spanning the late 1200s and early 1300s. Joseph A. Tiffany (2007a) believes that the apparent temporal overlap of the two taxa may simply be a consequence of the statistics of radiocarbon date distributions. However, Craig Johnson (2007a; see also Ann Johnson 1979a:162) believes that both Initial and Extended Middle Missouri settlements may have existed concurrently in the Big Bend in the mid-1200s. In fact, there are hints—largely in the form of possible trade vessels—that Extended and Initial variant communities interacted with one another. However, if so, the meagerness of the ceramic evidence indicates that such interactions were limited at best (Tiffany 2007b:104, 113).

In sum, the evidence indicates that the Middle Missouri subarea witnessed two episodes of "neolithization" (Ahler 2007; Roper 2007b). The first occurred on the Plains-Prairie border, beginning in the eleventh century. There, multiple Late Woodland groups, who had been experimenting with agriculture and settled village life for some time, came together to form aggregated Initial Middle Missouri communities. Interaction with Mississippian communities in the late 1000s, especially the pre-eminent Mississippian polity at Cahokia, seems to have been a crucial catalyst for this process (Tiffany 2003, 2007a). The second episode of neolithization led to the formation of Extended variant communities from multiple Late Woodland groups living in the northern half of the Middle Missouri. Again, interaction with more complex groups, in this case Initial Middle Missouri villagers, seems to have been an important catalyst. However, these two episodes of village formation were marked by contrasting economic changes. In the south, Late Woodland farmers added regular bison hunting to their economic system, while in the north Late Woodland hunters added farming.

Spatial and Temporal Distribution of Extended Middle Missouri Villages

Extended variant settlements occur in nearly every part of the Middle Missouri subarea, from the Big Bend region north into the Garrison region, a distance along the Missouri of more than 650 km (Johnson 2007a; Lehmer 1971:66; Winham and Calabrese 1998) (figure 5). Their distribution, though, is patchy, with more sites occurring in the north than in the south. Within the northern Middle Missouri, by far the best-known sites are located in the lower Cannonball region, among them the Paul Brave, Jake White Bull, Havens, Tony Glas, and Fire Heart Creek sites (Ahler 1977b; Lehmer 1966; Sperry 1995; Wood, ed. 1999; Wood and Woolworth 1964). Because most of these sites contain just one component, clear surface evidence of their size and layout has been preserved. By contrast, more recent occupations overlie many Extended variant sites in the Knife region and as a result comparatively little is known about them. Only one Extended variant site in the Heart region has been excavated, but unsystematic surveys and recent studies of museum collections leave little doubt that many are located there (Ahler 2001; Lehmer 1971:Figure 39; Winham et al. 1994).

A second cluster of Extended Middle Missouri sites is located well to the south, above and below the mouth of the Bad River, in the Bad-Cheyenne and Big Bend regions (Johnson 1979a; Lehmer 1971; Toom 1992b). This southern group is smaller and less well-known; the most extensively reported settlement there is the Thomas Riggs site (Hurt 1953; Johnston 1967; Meleen 1949). Like those in the Knife region, later occupations blanket many of the southern Extended variant villages. Finally, a handful of Extended Middle Missouri settlements exists between the two larger clusters, in the Grand-Moreau region (Johnson 1985). Little is known about these communities or their relationships to the north or south.

In his recent chronological assessment of Middle Missouri subarea settlements, Johnson (2007a) argues that the Extended variant lasted about 200 years, from 1200 to 1400. The earliest sites dated by high-quality radiocarbon assays were founded in the first half of the thirteenth

century (Johnson 2007a:Table C.3). Tiffany (2007b) argues that ceramic evidence points to a beginning date of about 1250. Interestingly, these early sites are scattered throughout much of the Middle Missouri subarea, occurring in the Knife, Cannonball, Grand-Moreau, and Big Bend regions. The latest sites with Extended Middle Missouri pottery assemblages have produced acceptable radiocarbon assays spanning the turn of the fifteenth century. Those include settlements in the Cannonball and Bad-Cheyenne regions.

Two factors complicate assessments of the age and duration of the Extended variant. One is the existence of plateaus in the radiocarbon calibration curve during the period in question. A minor plateau occurs in the middle of the 1200s and a major reversal spans the entire fourteenth century. The impact of these plateaus depends in part on the precision of the available dates. The second factor is the paucity of sites dated by radiocarbon from the Heart region. A dozen or more settlements likely to have been occupied during this period is present there, but little is known about them. However, the pottery assemblage from the mid-fifteenth century Bypass Village includes types not present in Extended variant assemblages, suggesting that an ending date of 1400 is appropriate. On balance, and despite these potential pitfalls, the data at hand support Johnson's assessment, which I adopt here.

Only limited differences exist among Extended variant ceramic assemblages. Johnson (1999, 2007a) partitions his sample of Extended Middle Missouri components into northern and southern groups based on the greater popularity of Fort Yates ware, an S-rim form, in the north. Tiffany (1983) draws a similar geographic distinction based on ceramic and other lines of evidence. Building on Wood's (1986a) and Francis Calabrese's (1972) research, Ahler (1993a) uses pottery differences to define two sequential Extended Middle Missouri phases for the Knife region. Despite these differences, though, all scholars recognize the striking material and architectural similarities among Extended Middle Missouri sites and assemblages, regardless of their age or location (Calabrese 1972; Johnson 1999, 2007a; Will and Hecker 1944:10, 58; Wood 2001). Spatial differences among Extended variant ceramic assemblages are proportional rather

than typological and Johnson (1999, 2007a) sees little evidence for temporal change in Extended Middle Missouri ceramic technology. Ann Johnson (1979a) documents formal variability among Extended variant houses, but it is not clear that these differences are spatially or temporally patterned. Given the very wide geographical distribution of Extended variant communities, it seems likely that a number of social divisions are represented, probably even more than the number of currently defined archaeological phases. However, in view of their acknowledged homogeneity, and because no one has yet attempted a systematic study of the differences among them, Extended Middle Missouri settlements are here discussed as a single cultural taxon, rather than in terms of local phases. Appendix 1 provides additional discussion on Middle Missouri tradition taxonomy and chronology.

The Middle Missouri Tradition Community

Middle Missouri tradition farmers built their settlements on high terraces or bluffs overlooking the river's floodplain, a location that gave them ready access to a mixture of crucial resources. Spreading below the villages, the floodplain gallery forest supplied wood for fuel and lodge construction. Cleared of trees and brush, the floodplain's easily worked soils yielded reliable harvests using efficient and productive water-table or overbank-flood farming techniques (figure 6). The river and its tributaries produced fish and shellfish and served as natural traps for bison and antelope during their seasonal migrations (Lehmer 2001). Behind the villages, away from the river, wooded draws sheltered a wide variety of game animals and wild plants (figure 7). Small resident herds of bison were present in the river valley throughout the year (Hanson 1984). The upland steppe to the west was the setting for regular communal bison hunts targeting large migrating herds (Bamforth 1988).

Figure 6. The floodplain gallery forest, cleared for fields of maize (photo by Mark D. Mitchell).

Extended Middle Missouri Settlements and Settlement Patterns

Extended Middle Missouri communities vary in size (table 2). The smallest documented village covers just 0.8 ha, while the largest covers 6.5 ha; the mean size of 13 settlements for which data are available is 3.7 ha. Northern settlements are larger on average (4.3 ha) than southern settlements (2.6 ha). Later settlements are larger than earlier settlements. The mean area of eight sites founded in the 1200s is 3.3 ha, while that of three sites founded in the 1300s is 4.1 ha.

Mapped settlements consist of 12 to 56 houses, often arranged in irregular rows or arcs (figure 8). A center-to-center spacing between adjacent lodges of 19 m to 22 m leads

Table 2. Extended Middle Missouri community sizes.

Division	Mean Area (ha)	Houses per Site	Density (houses/ha)	Estimated Population[a]
EMM South	2.6	12-22	7.4	120-264
EMM North	4.3[b]	14-56[b]	7.9	140-672
Means	3.7	28.1	7.8	309

[a] See text for explanation of population estimates.
[b] Omitting Grandmother's Lodge (32EM59).

some archaeologists to describe Extended variant settlements as "open" or "dispersed" (Ahler 1993a:78). Interestingly, despite their size differences, the residential densities of Extended Middle Missouri settlements vary little, either spatially or temporally. The mean density of eight sites dating to the 1200s is 8.0 houses/ha, while that of four sites dating to the 1300s is 7.7 houses/ha (see also Ahler 1993b:Table 24.2; Johnson 1999:58). The mean density of the four fortified sites in the sample (8.4 houses/ha) is only slightly greater than that of the nine

Figure 7. The Middle Missouri uplands (photo by Mark D. Mitchell).

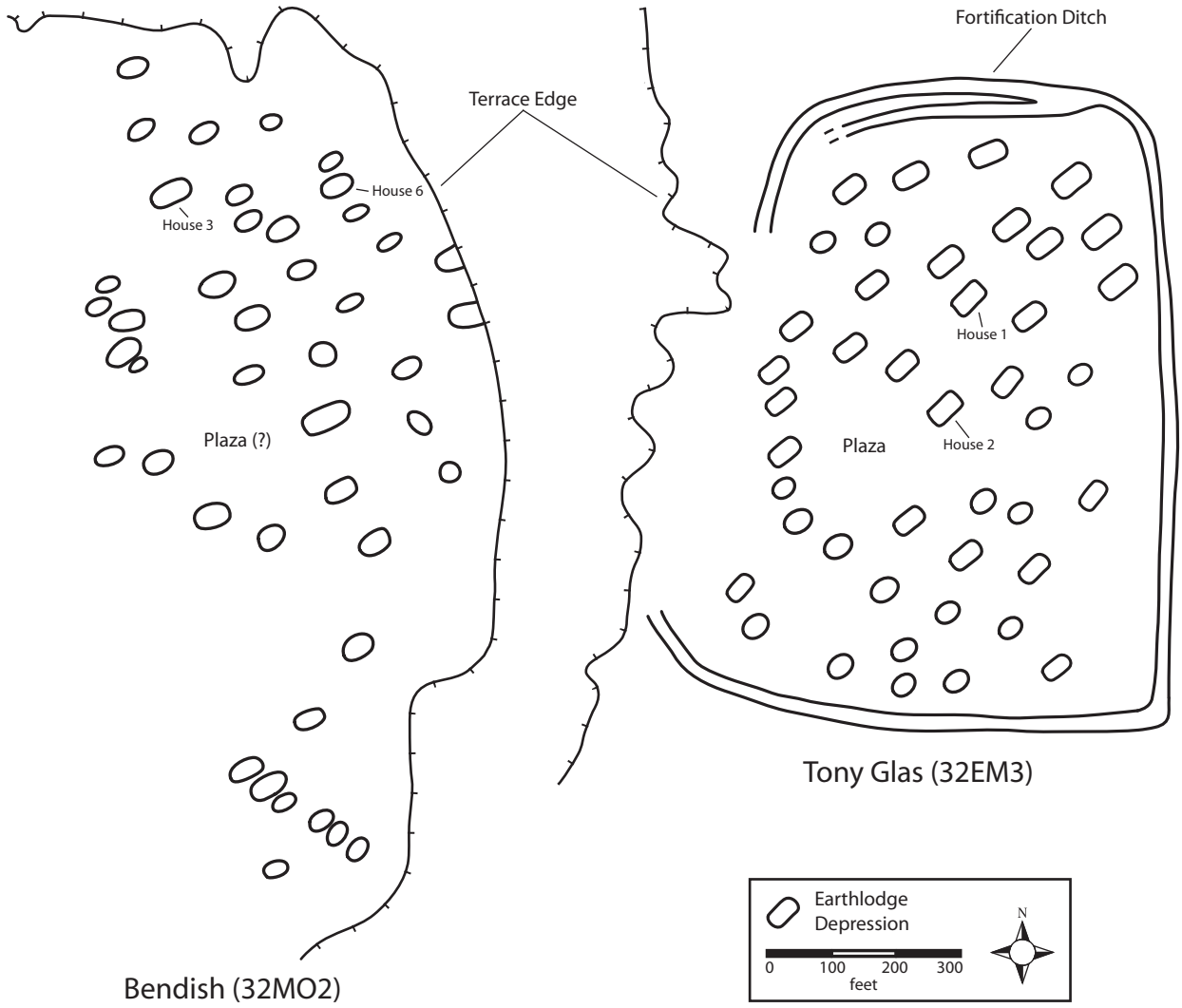

Figure 8. Plan views of two Extended Middle Missouri settlements. Right: Tony Glas, located on the east bank of the Missouri in the Cannonball region; Left: Bendish, located in the Heart region on the west bank (adapted from Mead [1999] and Thiessen [1995]).

unfortified sites (7.5 houses/ha).

To calculate the populations of these communities most archaeologists assume that each residential structure accommodated 10 to 12 people, though there is only limited empirical evidence supporting this figure. In his early twentieth-century study of Hidatsa architecture, Gilbert L. Wilson (1934) estimates that each dwelling housed 5 to 16 individuals. Household

sizes in Ricky Roberts's (1977) summary of 20 historic accounts for the Mandans, Hidatsas, and Arikaras range from about 10.5 up to 30 people. For the Mandans and Hidatsas, David Thompson, who visited the communities on the Knife River in the winter of 1797-1798, provides the most important account. He reports an average of 8 people in each Mandan household and 8 to 10 in each Hidatsa household (Tyrell 1916; Wood 1977). (Unaccountably, Lehmer [2001:247] states that Thompson reports an average of 13 people living in each lodge). Waldo Wedel's (1979) often-cited figure of 5 sq. m of floor area for each member of a Central Plains tradition household, when applied to typical Middle Missouri lodges, yields values near the upper limit of Roberts's historic data. However, as Roberts points out, floor area calculations fail to account for differences in lodge size due to household status, which certainly obtained in the nineteenth century and, as I argue later, likely did during Extended variant times as well. In any case, the lower end of the ethnographically documented range is probably a better fit with Alfred Bowers's (1950, 1992) qualitative data on household composition. For both the Mandans and Hidatsas, Bowers argues that each lodge housed sororal extended families composed of sisters along with their parents, spouses, and children. Given these data, I accept here the customary range of 10 to 12 people per lodge. Using those figures, the populations of the Extended variant settlements range from 120 to 672 people. The average community housed 309 people, based on a mean value of 28.1 lodges in each village and 11 people in each lodge.

Though commonly called "earthlodges," Middle Missouri tradition dwellings are best described as timber-frame or post-and-beam structures (Roper and Pauls 2005) (figure 9). They were rectangular in plan, roughly one and a half times as long as they were wide; the walls sometimes curved slightly, giving them a vaguely boat-shaped plan. Most were built over a pit ranging from about 20 cm to 100 cm deep (Ahler 1993b). Access was gained through a narrow, covered entry passage projecting 3 to 6 m from the southwest wall. Inside the lodge, a sloping ramp, often with a step on the interior end, connected the end of the passage to the floor level. In virtually every case, the long axis of the house is oriented roughly northeast-southwest. The

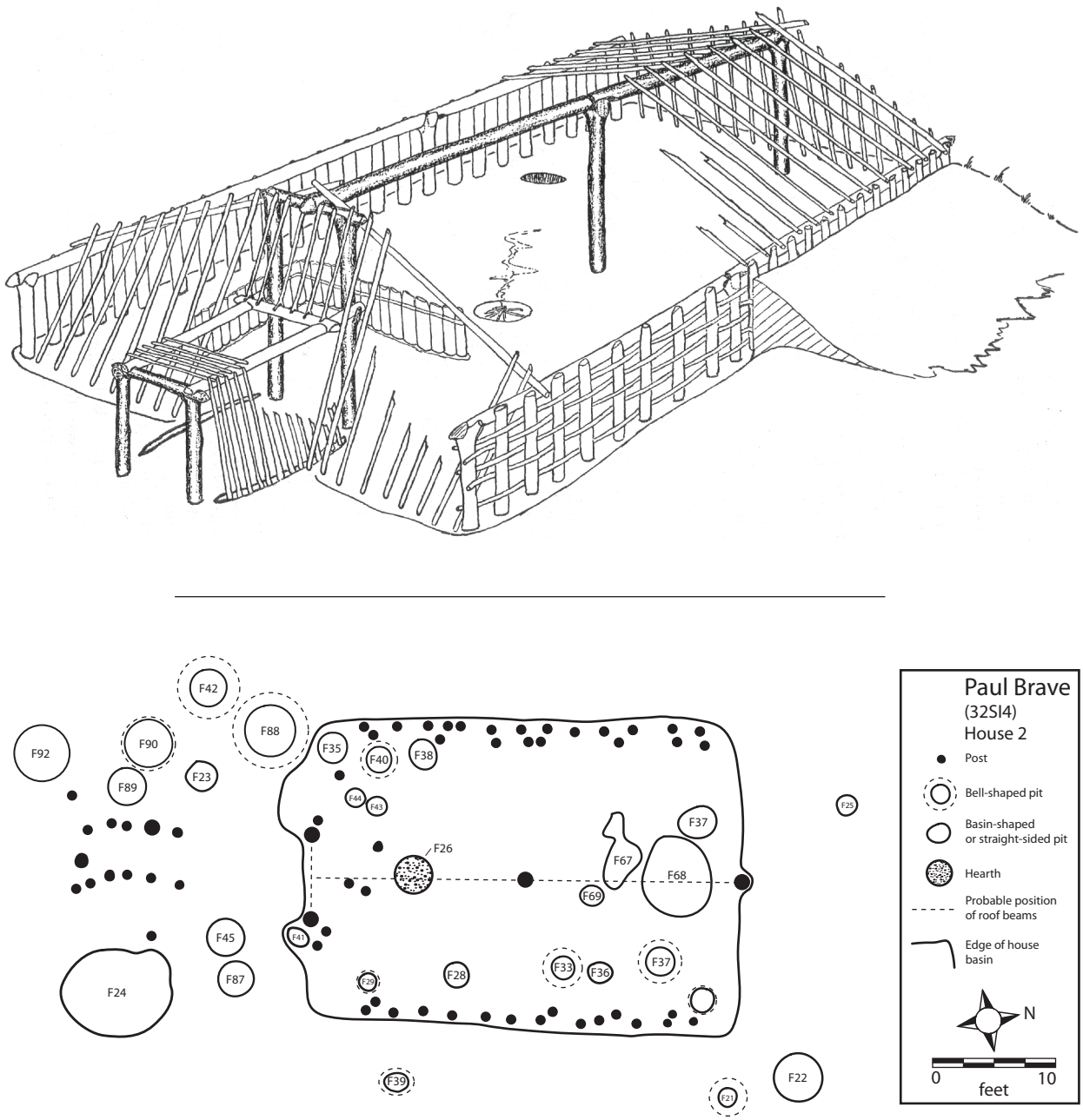

Figure 9. Two views of Middle Missouri tradition lodges. Upper: Isometric view of a lodge from the Huff site; Lower: Plan view of a lodge from the Paul Brave site (adapted from Wood [1967] and Wood and Woolworth [1964]).

arrangement of support posts indicates that they were built with gable or gambrel roofs. The lodge's central ridge beam was supported by a large post set in the rear wall, another near the

center of the lodge, and one or two pairs of posts flanking the entryway. Lines of closely spaced posts mark the lodge's long, load-bearing walls. The near absence of posts on the short end walls indicates that they were comparatively insubstantial (Lehmer 1966:8). In some structures, rows of secondary posts positioned along either side of the lodge centerline helped support the weight of the roof. Some may have featured a low storage area, known to the nineteenth-century Hidatsa as an *atuti*, surrounding the primary living space defined by the vertical wall posts (Lehmer et al. 1973).

Archaeologists disagree about the type of material used to cover Middle Missouri lodges (Roper and Pauls 2005). Evidence from burned structures indicates that their timber frame was covered with successive layers of small poles, willow twigs, and grass thatch (Hurt 1953:8; Lehmer et al. 1973:164). Lehmer (1971; Lehmer et al. 1973) maintains that the outermost covering was earth. However, the lack of burned earth or twig-impressed daub at many sites leads others to conclude that the roof was finished with lighter materials such as bark (Alex 1973; Hurt 1953; Wood 2001). Geophysical data from Huff Village, a fifteenth-century Middle Missouri tradition community, support the latter interpretation (Kvamme and Ahler 2000:36). The walls of some Middle Missouri tradition structures likely were wattle-and-daub; earthen embankments backed others (Alex 1973; Wood 1967).

Large, cylindrical and bell-shaped storage pits lined the walls of these buildings. Excavation and geophysical data reveal the presence of many exterior storage pits as well, especially flanking the covered entryway. A large central hearth was positioned on the lodge centerline, close to the foot of the entry ramp; smaller, secondary hearths often were located in the rear or along the walls. Some buildings featured a wooden screen at the foot of the ramp. Elevated benches or platforms ran along the front or rear walls; when located on the rear wall such raised areas sometimes have been interpreted as altars. Perhaps the most enigmatic feature, present in about half of the excavated Extended variant houses, is an elongated pit or trench in the back of the building, oriented across its long axis. The presence in some houses of numerous

small postholes suggests that they contained wooden platforms or racks.

On average, Extended variant houses were twice as large as eastern Initial variant houses and 50 percent larger than western Initial variant houses (table 3). They also varied greatly in size. In the sample of 46 excavated Extended variant lodges I consider here the smallest is 59.4 sq. m while the largest is 279.1 sq. m. Nearly all of this variation occurred contemporaneously within individual Extended variant communities. At the Thomas Riggs site in the Bad-Cheyenne region, six excavated houses range in size from 65.4 sq. m to 259.5 sq. m. The smallest of six houses at the South Cannonball site in the Cannonball region is 71.2 sq. m and the largest is 152.7 sq. m. There are no temporal or spatial differences in lodge size. The mean area of 16 houses built in the 1200s is 109.5 sq. m, while that of 19 houses built in the 1300s is 111.2 sq. m. Southern houses average 116.3 sq. m and northern houses average 113.8 sq. m.

Many communities were organized around an open space or public plaza, commonly flanked on the north side by an especially large structure (Johnson 1999; Wood 1967:156). Ten of 12 settlements for which data are available probably (*n*=7) or definitely (*n*=3) incorporated a plaza (table 4). The prominent plaza at the Tony Glas site in the Cannonball region measures about 60 m across (figure 8); the plaza at the Durkin site in the Big Bend region is about the same size. The oblong plaza at Larson Village, founded in the late 1400s, is somewhat smaller, measuring about 43 m long and 26 m wide. Geophysical and other data show that community plazas were kept free of storage pits and other features and were maintained throughout the

Table 3. Sizes of Initial Middle Missouri (IMM) and Extended Middle Missouri (EMM) houses.

Division	*n*	Mean House Size (sq. m)	S.D. (sq. m)	C.V.[b]
IMM East[a]	19	50.7	15.5	30.6
IMM West[a]	48	80.3	25.0	31.1
EMM South	13	116.3	48.0	41.3
EMM North	33	113.8	40.8	35.8

[a] Lensink and Tiffany (2005:Table 11.1).
[b] Coefficient of variation. For the Extended variant, c.v. calculated only for sites with three or more excavated lodges; for the Initial variant, c.v. calculated for all structures combined.

Table 4. Frequency of public plazas at Extended Middle Missouri settlements (Grandmother's Lodge [32EM59] omitted).

Division	Definite Interior Plaza	Possible Interior Plaza	No Interior Plaza	No Data	Total
EMM South	1	3	0	2	6
EMM North	2	4	2	7	15
Total	3	7	2	9	21

life of the settlement (Kvamme and Ahler 2000; Kvamme 2008; Mitchell 2008). Nineteenth-century descriptions and pictures portray some of the uses village residents made of these spaces. George Catlin's depictions of the Mandan's Okipa ceremony at Mih-tutta-hang-kusch adjacent to Fort Clark made the plaza there famous. Catlin's depictions call attention to the sacred function of the space by emphasizing the plaza's central shrine, symbolizing a wall the Mandan's principal culture hero, Lone Man, built to protect them from a world-spanning flood. However, photographs taken at Like-A-Fishhook Village in the 1870s and 1880s show that the plaza there was used for a variety of purposes, both sacred and secular.

Defensive fortifications, consisting of a shallow ditch backed by a log palisade, surround seven of the 20 Extended variant sites for which data are available (table 5). Because many settlements were built on the edge of high, steep-sided terraces of bluffs, ditches only were necessary on the sides of the village facing away from the floodplain. In some cases, village defenses incorporated ravines or other topographic features. A few settlements featured projecting strong points, known as bastions, from which the settlement's defenders could direct crossing fire at an attacking force. Unlike the fortifications some other village groups built, Extended Middle Missouri fortifications always surrounded all of the settlement's domestic structures. Evidence from two settlements in the Bad-Cheyenne region (Lehmer 1971:126) suggests that fortifications were laid out and built prior to the construction of the settlement's lodges.

Half of the southern Extended variant villages in the sample are fortified. In the north, defensive features are far less common. This north-south difference is also evident in survey data

Table 5. Frequency of fortified Extended Middle Missouri settlements.

Division	Fortified	Unfortified	No Data	Total
EMM South	3	3	0	6
EMM North	4	10	2	16
Total	7	13	2	22

(Winham et al. 1994). The meaning of this pattern has been a recurrent subject of debate among archaeologists. The fact that both fortified and unfortified Extended variant sites can be found throughout the Middle Missouri complicates the situation. Beyond the question of prevalence, trends in fortification design are equally complex. Some possibly early Extended Middle Missouri settlements, such as Thomas Riggs in the Bad-Cheyenne region, are surrounded by bastioned fortifications (Johnston 1967), but so are some of the most recent, such as Helb (Kay 1995).

Several lines of evidence indicate that Extended variant settlements were occupied relatively briefly (Ahler 1993a; Johnson 2007a; Toom 1992b). Most exhibit spatially extensive sheet midden deposits, but mounded refuse piles are conspicuously absent. Lodges seldom were remodeled or rebuilt. Some sites contain superimposed features or structures, but most do not. Dennis Toom (1992b) argues these data indicate that Extended variant communities relocated every 25 to 50 years, moving when local resources were exhausted. This pattern is clearest in the Cannonball region, where most sites contain just one component. Elsewhere, Extended variant components often are obscured by later occupations. Especially in the Knife region these overlying components may in fact indicate uninterrupted occupation into the 1400s or later.

Post-1400 Settlement Change in the Heart Region

Aspects of the Extended variant community plan became more formal in the fifteenth century. The irregular rows or clumps of houses characteristic of thirteenth and fourteenth century settlements were straightened and the spaces between houses became more uniform.

Plazas became better defined as well. At Larson Village, founded in the late 1400s, the plaza was maintained throughout the 250-year history of the settlement (Mitchell 2008). Defensive works became more common, more complex, and more laborious to build. By the end of the fifteenth century defensive features surrounded virtually every settlement in the Heart region, though they were less common in the adjacent Knife and Grand-Moreau regions (Mitchell 2007). In the eighteenth century, stout, well-designed fortifications surrounded all of the Heart River towns (Swenson 2007). The use of projecting bastions increased after 1400, as did the depth of the accompanying ditch. At the Extended variant Thomas Riggs site, the ditch in front of the bastioned palisade was less than 50 cm deep (Johnston 1967:394-395). At the Huff site, built in the middle of the fifteenth century, the ditch varied from 75 to 135 cm deep and the fortification incorporated a line of outward-projecting poles positioned between the inner edge of the ditch and the stockade (chevaux de frise) (Wood 1967:54-57). In the seventeenth century, the ditch encircling Double Ditch Village was more than 125 cm deep (Ahler, ed. 2003a).

Dramatic and far-reaching changes to the settlement system accompanied these modifications to the Extended Middle Missouri community plan, changes which greatly increased the number of people living in the Heart region. Two processes were responsible. First, the populations of individual settlements increased. The mean residential density for a sample of 13 Extended Middle Missouri sites is 7.8 houses/ha. By contrast, the mean density of six sites founded between the mid-1400s and the late 1600s is three times as great at 23.9 houses/ha (table 6) (see also Ahler 1993a:83). Mean site size reached a peak in the fifteenth century. The largest settlements ever built in the region were founded around the turn of the sixteenth century. The 1600s and 1700s witnessed a decrease in mean settlement area, with several communities contracting progressively during this period. However, high residential density remained a feature of all northern Middle Missouri communities into the nineteenth century: the mean density of six sites occupied between 1700 and 1830 remained essentially unchanged at 22.8 houses/ha. As a consequence, mean community size tripled from about 309 people between 1200

Table 6. Changes in residential density and site size over time in the northern Middle Missouri.

	Mean Density		Mean Area	
Time Period	houses/hectare	*n*	hectares	*n*
1200-1300	8.0	8	3.3	8
1300-1400	7.7	4	4.1	3
1400-1600	23.9	6	4.0	8
1700-1830	22.8	6	3.0	7

and 1400 to just under 900 in the 1400s and 1500s. The sixteenth century population of Double Ditch Village topped 2000.

The second change to the settlement system was the formation of village clusters. In the 1200s and 1300s Extended variant settlements could be found in every part of the Middle Missouri, though little is known about the distances between contemporaneous communities. Wood (1967:124) believes that there are more than 100 Extended variant sites, distributed over some 650 km of the Missouri River valley, though there seems to have been several unoccupied stretches of the river. While there were more settlements in the northern half of the Middle Missouri than in the southern half (Lehmer 1971; Winham et al. 1994), most scholars agree that they were widely spaced, given their short occupation durations. Lehmer (1970, 1971) proposes a relatively complex scenario that has Extended variant communities expanding southward initially, later retreating after a period of conflict with Initial Middle Missouri communities, and finally attempting a second, ultimately unsuccessful southward migration some two centuries later. However, key aspects of his model have proven to be in error (Johnson 1979a) and given the fact that the currently accepted chronology has Extended variant sites distributed essentially throughout their maximum range from the early 1200s to the late 1300s (Johnson 2007a), it seems likely that the distances between them were even greater than many have believed.

After 1400, Middle Missouri tradition sites were built only along a 150-km stretch of the valley, from the mouth of the Knife River south to the mouth of the Cannonball. By 1500, the southern limit had again shifted northward, to the mouth of the Little Heart River, though it is not clear whether the entire valley between the Little Heart and the Knife, some 110 km, was

occupied. In fact, two settlement clusters may have begun to develop at that time, with a gap of about 40 km between them, stretching from the mouth of Painted Woods Creek to the mouth of Square Butte Creek. In any case, by the beginning of the seventeenth century, settlements in the northern Middle Missouri had coalesced into two compact clusters, one below the mouth of the Knife River and the other above and below the mouth of the Heart. The Heart region cluster was especially large: at least 21 settlements occupied sometime between 1500 and 1750 are strung along a 40-km stretch of the river, from the Square Buttes south to the mouth of the Little Heart (figure 10). Lehmer (2001:247; Wood and Irwin 2001:352) puts the mid-eighteenth-century population of the Heart region at about 8,000 or 9,000. Given the settlement size and density data reported here it seems likely that the sixteenth-century population was substantially greater.

The twin processes of population aggregation and settlement clustering were accompanied after the turn of the sixteenth century by a significant increase in the occupation duration of many Heart and Knife region settlements. As noted previously, most Extended Middle Missouri villages were occupied for a generation or two, some 25 to 50 years (Toom 1992b). Extended variant lodges seldom were remodeled and refuse accumulations were limited to spatially extensive but comparatively thin sheet middens. By contrast, massive accumulations of domestic debris piled up in mounds ring many post-1500 sites. Even today, the mounds surrounding Double Ditch Village stand nearly three meters high. Lodges there were rebuilt over and over, and extensive sediment borrowing and transport repeatedly transformed the site's surface (Ahler, ed. 2005). Several of the largest northern Middle Missouri sites—most notably Double Ditch and Larson villages in the Heart region and Lower Hidatsa in the Knife region—were occupied continuously from at least 1500 to the late 1700s, making them nearly permanent features of the regional cultural landscape. Coupled with the processes of population aggregation, this increase in occupation duration substantially increased the impact northern Middle Missouri farming communities had on their local resource base.

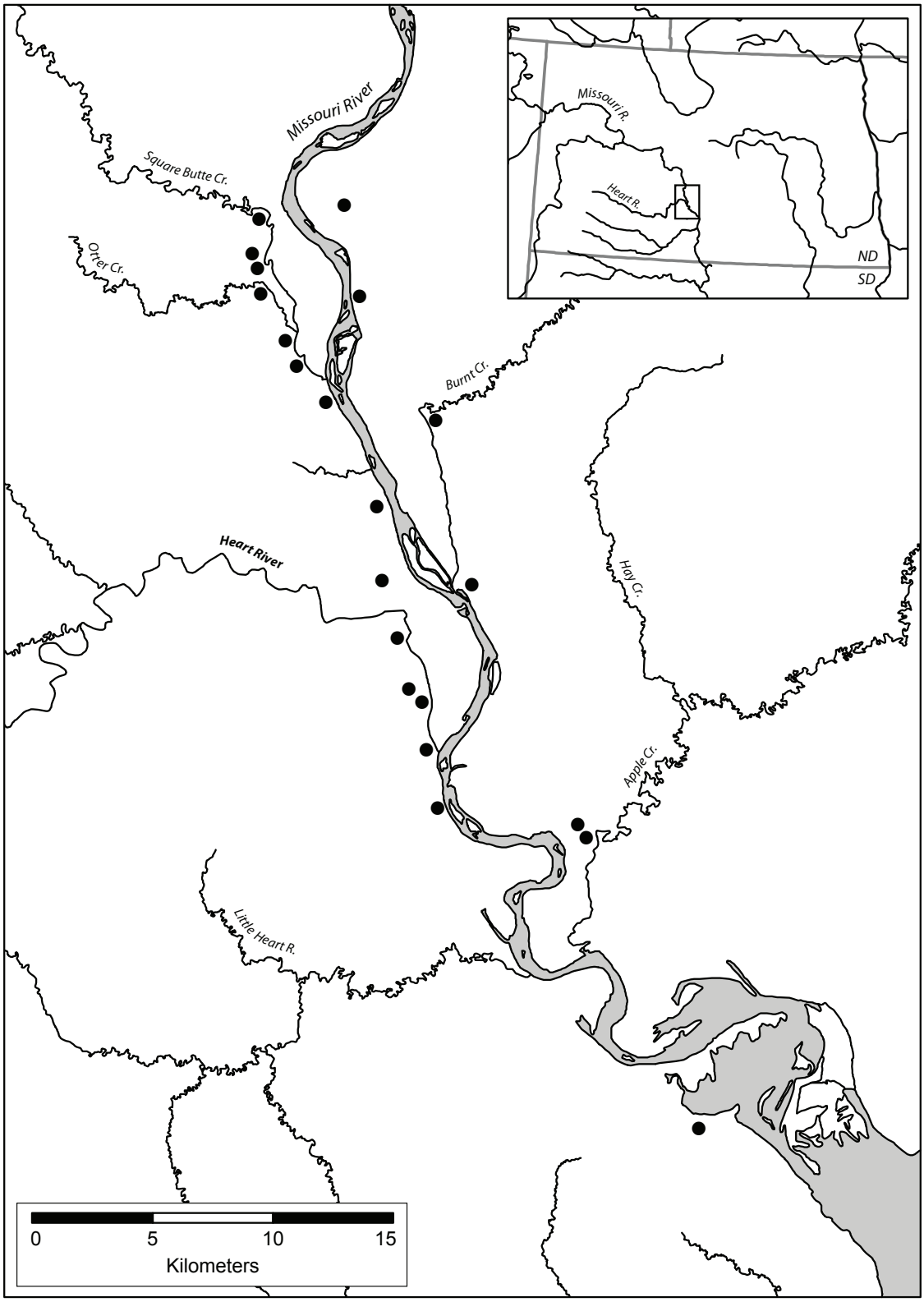

Figure 10. Map of the Heart region showing major settlements occupied after about 1500.

Northern Middle Missouri Society in the Nineteenth Century

A wealth of historic and ethnographic data is available on Mandan and Hidatsa culture and social organization. Together these sources paint a detailed picture of life in the Missouri River towns. It is worth bearing in mind, though, that with the exception of accounts penned by Verendrye and his sons all of the historic sources describe the situation following the departure of the Mandans from the Heart region in the wake of the continent-wide smallpox epidemic of the early 1780s. Owing to the amalgamation of Mandan and Hidatsa communities in the Knife region in the late 1700s and early 1800s, many historic sources express some uncertainty about the differences and similarities among the two groups during earlier periods. Moreover, certain topics are treated only briefly, perhaps because the seemingly exotic, and remarkably complex, ceremonial life of the Mandans and Hidatsas was of greater interest to many early journalists than were the quotidian details of family life. Most ethnographic data were obtained during the first three decades of the twentieth century, decades after the last earthlodge village—Like-A-Fishhook—was shuttered. In addition, the two most prolific and influential ethnographers, Gilbert L. Wilson and Alfred W. Bowers, interviewed some of the same informants.

In the late eighteenth century, the Mandans at Heart River appear to have been organized into four or perhaps five divisions, each of which occupied one or more settlements (Bowers 1948, 1950; Parks 2001b; Wood and Irwin 2001). The largest division, the Nuweta (also known as Nuitadi), lived in settlements on the west bank of the river near the mouth of the Heart, including On-A-Slant Village. A second division, the Istope, also lived on the west bank, north of the Nuweta (Bowers 1950:25). Sometime during the eighteenth century the Istope were joined by the smallest division, the Awikaxa, who until then likely had been living near the mouth of the Grand River. Later, they merged with the Nuweta. Across the Missouri, on the east bank, the Ruptare division (also known as Nuptadi) occupied several large communities, including Double Ditch and Larson villages. The existence of a possible fifth division, the Mananare, is not well

attested. In any case, Bowers (1948:170) states that the Mandans recognized the common origin of the divisions in myth.

Linguistic and cultural differences marked the four main divisions in the nineteenth century and those differences continued between the two largest, the Nuweta and Ruptare, into the twentieth century. The extent to which the Mandans made use of an inclusive tribal designation, recorded by Washington Matthews in the 1870s as Numakaki (Parks 2001b:363), is not known. Certainly, individual communities assisted one another in various ways (Bowers 1948:177, 214-215), though intra-division loyalties may have taken precedence.

Crosscutting these divisions were as many as thirteen exogamous, property-holding matrilineal clans (Bowers 1950; Wood and Irwin 2001). Clans were distributed throughout the communities of the Heart region and were grouped into unnamed east-side and west-side moieties. Lone Man founded the west-side moiety, which is associated with the bison. The east-side moiety was founded by Clay on the Face and is associated with maize. The moieties originally were exogamous, but after the smallpox epidemic of 1837 they ceased to regulate marriage. By the early twentieth century only four clans remained.

Clans owned ritual paraphernalia and were ranked according to the importance of the ceremonies they controlled; members of the west-side Waxikena clan held many leadership positions owing to that clan's ownership of rites to the Okipa, the Mandan's principal religious ceremony. Clans had a duty to assist their members. Families able to do so took in orphans and the elderly and helped young men accumulate goods needed to purchase rights to sacred knowledge or to perform important ceremonies. Clans also assisted with funeral preparations and managed the transfer of houses and fields when a member died without heirs.

Another feature of Mandan society in the nineteenth century was men's and women's age-grade societies. Cohorts of boys or girls, 10 to 15 years old, collectively joined their first societies by purchasing rights from existing members, with whom they established father-son or mother-daughter relationships. These relationships facilitated instruction and social development

as each cohort advanced from society to society. Each society performed specific functions and had its own leaders, dances, songs, and regalia (Wood and Irwin 2001:360). Members of the Black Mouth society, middle-aged men known for their bravery, were responsible for maintaining order in the village and on communal hunts, and for enforcing community rules. Members of the women's White Buffalo Cow society served as community doctors. Society membership also entailed responsibilities separate from those imposed by the household or clan (Bowers 1950:62-63). Individuals were expected to help prepare and assemble the items their age-mates needed to purchase ceremonial rights or sacred or secular knowledge. Age-grade societies also created a network of fictive kin relations that facilitated the transfer of economic and political power from older to younger community members.

Each household, known as a lodge group, was made up of sororal extended families (Bowers 1950:26-29; Wood and Irwin 2001). Post-marital residence was generally matrilocal. The women of the household owned the lodge and its furnishings, as well as the associated tools and the dogs, mares and colts. They also owned the household's gardens. Men owned gear used in hunting and war, along with the stallions and geldings. Husbands and wives shared ownership of sacred bundles. Clothing and personal items were individually owned. Lodge groups collectively controlled one or more game pits and fishtraps. Household status varied significantly. High-status lodge groups controlled important ceremonial objects and sacred knowledge; they received both property and prestige in exchange for hosting and officiating ceremonial events (Bowers 1950:75). Lodge groups sometimes moved between villages to enhance their status or in response to political or economic disputes.

Bowers (1948:148) describes Mandan village and tribal leadership as a "theocracy" made up of older men who owned sacred bundles. The constitution of village and tribal councils varied depending on the status of different bundles (Bowers 1950:33). From these changing groups two principal leaders were selected, a war chief recognized for his accomplishments in battle, and another recognized for his sacred knowledge, generosity, and political skills. Top

leadership positions may have been partly hereditary, but a man's authority rested largely on his skill as an orator and on his ability to persuade his peers (Bowers 1950:35). A leader's power was measured by the extent to which his opinions were accepted. It was also the case, though, that leadership of various activities was widely dispersed throughout the community, among clan leaders, society leaders, and ceremonial priests.

It seems entirely likely that the organizational transformation of the 1400s and 1500s, as well as the devastating epidemics of the 1700s and 1800s, shaped the documented features of nineteenth-century Mandan society (Bruner 1961; Wood 1967). However, the extent to which the social and cultural practices described by explorers and anthropologists reflect practices of earlier periods is an empirical question, one taken up in the final chapter.

The Changing Cultural Landscape of the Middle Missouri

About 1300, bearers of a distinct culture archaeologists call the Coalescent tradition began building villages in the Middle Missouri subarea, alongside long-time Middle Missouri tradition residents. Relatively little is known about these newcomers, known as the Initial variant of the Coalescent tradition. Only a handful of Initial Coalescent settlements was built, nearly all of which are clustered along a short stretch of the Missouri in the Big Bend region of south-central South Dakota. Archaeologists once thought Central Plains tradition immigrants, driven northward to the river by drought, established these communities (Lehmer 1971). More recent work demonstrates that the historical relationships between the Coalescent and Central Plains traditions are more complex than a simple migration model implies (Johnson 1998, 2007a; Steinacher 1983; Steinacher and Carlson 1998). The tenor of their interactions with resident Extended Middle Missouri groups is not known.

In the fifteenth century, Coalescent groups, now known as the Extended variant of the Coalescent tradition, began moving out of their enclave in the Big Bend. By the turn of the

seventeenth century, Extended Coalescent communities could be found throughout a 425-km stretch of the valley, from the mouth of the White River to the North Dakota line. Eventually, more than 175 would be built. Archaeologists know little about the relationship between the Extended and Initial variants of the Coalescent tradition, although most agree the two are closely related (Johnson 1998, 2007a; Krause 2001).

The settlements Extended Coalescent peoples built differed markedly from those of their Middle Missouri tradition neighbors (Krause 1999). In comparison to the compact, bounded villages of the Middle Missouri tradition, Extended Coalescent villages were sprawling, consisting of lines or loose clusters of lodges running along bluffs or terraces above the river (Krause 2001). The average Extended Coalescent settlement covered 5.7 ha (Johnson 1998:318), an area about 40 percent larger than contemporaneous Middle Missouri tradition settlements. However, the median number of lodges comprising an Extended Coalescent site was 15 (with a range of 2 to 200), much smaller than the Middle Missouri tradition median of 97 (ranging from 27 to 125). The notable absence of midden deposits at virtually all Extended Coalescent sites suggests a degree of residential mobility even greater than that of pre-1500 Middle Missouri communities. Most Extended Coalescent settlements are not fortified; those that are often feature a small ditch and stockade encircling only a portion of the community (Mitchell 2007).

Like their Middle Missouri tradition contemporaries, Coalescent tradition groups built substantial timber-frame or post-and-beam houses with extended entryways, but on a radically different plan. Most were circular to square and featured four massive center posts set around a central hearth. The surface sod layer was removed prior to construction, creating a sunken, basin-shaped floor (Krause 2001:203). The walls consisted of a ring of peripheral posts surrounding the central four-post framework. Compared to the notably uniform Middle Missouri tradition long-rectangular lodges, Extended Coalescent lodges were highly variable in both plan and construction, ranging from circular, to subrectangular, to oval in shape. Initial Coalescent lodges were relatively small, just 5 m to 12 m in diameter and enclosing on average 59.7 sq. m (Johnson

1998:313). Extended Coalescent lodges were larger, with a median diameter of 11.9 m, enclosing about 111 sq. m of floor space, comparable in size to contemporaneous Middle Missouri tradition houses (Johnson 1998:318). This correspondence suggests that the size, and perhaps the makeup, of Extended Coalescent and Middle Missouri tradition lodge groups may have been similar.

The explosion of Extended Coalescent settlement in the late 1400s and 1500s, especially the establishment of numerous communities in the lower Cannonball and Grand-Moreau regions, clearly altered the social dynamics of the northern Middle Missouri (Wood 1967, 2001). Architectural and ceramic data, which I detail later in the chapter, indicate that interactions between Middle Missouri tradition communities in the Heart region and Extended Coalescent communities in the Grand-Moreau region were multifaceted. There is no doubt that both people and objects were moving between Coalescent and Middle Missouri communities, but warfare and competition also seems to have played a part in their interactions.

Making a Living in the Northern Middle Missouri

Though commonly described as a "dual" strategy combining bison hunting with maize farming, the Middle Missouri tradition economy was in fact a dynamic amalgam of hunting, farming, gathering, fishing and shell fishing, and trading. This economic diversity was faciliated by the ecological diversity of the Missouri River valley, which encompasses a mosaic of aquatic, riparian, and terrestrial environments. Some of these environments are exceptionally productive. The river's spring flood regularly replenished soil nutrients, maximizing yields, minimizing fallow times, and ameliorating the effects of local droughts. During the summer thousands of bison congregated in the uplands.

Hunting and Fishing

Bison supplied the overwhelming majority of the animal protein northern Middle Missouri communities consumed (Toom 1992b:165). Bison also supplied a host of other crucial products: their hides were used to make bedding, clothing, containers, and tent covers; their tallow was mixed with dried meat and other ingredients to make pemmican; and their bones were used to make a wide variety of tools. Indeed, many scholars regard bison dependence as a fundamental feature of Plains cultures (Bozell, Falk, and Johnson 2006; DeMallie 2001). However, the undeniable importance of bison has overshadowed evidence for dietary diversity in the Heart River region. Understanding that diversity is crucial for understanding patterns of economic change there.

The patterns of animal exploitation I examine here are derived from data on the number of identified specimens or NISP. Only counts of specimens for which the faunal analyst could determine both the body part and the taxon (genera or species) are included. Between-site comparability of these data is ensured by the use of consistent sample processing and analysis methods and by the fact that most of the archaeofauna described here were studied by a single analyst, Carl R. Falk.

NISP data have the virtue of easy quantification, but because they are subject to a variety of confounding factors they cannot be taken as direct proxies for the economic or dietary importance of different kinds of animals (Klein and Cruz-Uribe 1984). For instance, the NISP is strongly affected by species-specific bone fragmentation patterns, as well as by butchery and carcass transportation practices. Birds and fish, for instance, may have been prepared inside lodges, unlike bison which would have been butchered outside, often away from the village. Some bird and fish bones likely were discarded after the meat was consumed, rather than before as was the case for larger mammals. Data on the minimum number of individuals (MNI) present in an archaeofauna are less subject to these factors, but can be difficult to calculate and in any

case are available only for a small number of northern Middle Missouri sites, owing mainly to the time required to do so. Even if they were more widely available, though, MNI values can overemphasize, at least in percentage terms, the occurrence of comparatively rare taxa. For these reasons, I use data on the number of identified specimens here, though they should be interpreted as relative measures of the use different communities made of different animal resources.

Apart from the effects of different quantification methods, several factors archaeologists often describe as "sampling errors" affect interpretation of these data. The most obvious of these is differences in the field methods used to recover different bone assemblages. Fish and bird remains are particularly susceptible to such recovery biases owing to their comparatively small size. Another form of sampling error is related to sample size. Compared to larger samples, small samples are more likely to misrepresent the characteristics of populations. The most important parameter here is the number of sampled contexts, rather than the total number of identified specimens, though these two values may be correlated. I return to the issue of sampling bias later in the chapter.

To simplify comparison and discussion the faunal data are organized into six groups based on the type and size of the identified animal. The large artiodactyl group consists almost exclusively of bison, although some archaeofauna include a small number of elk bones or antler pieces. Small artiodactyls include deer and pronghorn. The large canid group represents a mixture of wolves, coyotes, and domestic dogs. Small-to-medium mammals include mustelids, foxes, carnivora, lagomorphs, and other species. The bird group includes both alimentary and decorative species. Excluded are the bones of micromammals, reptiles, and amphibians, though in some cases these animals may have been consumed or captured for other purposes. It is worth remembering, though, that the majority of the archaeofauna from these sites, at least as measured by weight, consists of unidentifiable bone fragments and therefore is excluded from the data presented here. Most of that unidentified fraction consists of bison bones.

Only limited data are available for thirteenth and fourteenth century sites (table 7).

Table 7. Proportional distribution of identified faunal remains (NISP), organized by six major taxonomic groups, in Late Woodland and Extended Middle Missouri assemblages.

			Faunal Group						
Site	Region	Sample Type[a]	Large Artiodactyl	Small Artiodactyl	Large Canid	Sm.-Med. Mammal	Bird	Fish	NISP
Jake White Bull[b]	Cannonball	G1-G3	72.0	2.0	10.3	8.3	2.7	4.7	300
Cross Ranch[c]	Knife	G1-G3	84.5	6.0	7.8	0.4	1.0	0.3	716
Menoken[d]	Heart	G1-G3	89.0	1.1	5.3	1.6	1.8	1.1	1346
		G1-G4	82.8	1.0	5.0	1.6	5.5	4.0	1447
White Buffalo Robe[e]	Knife	G1-G5	57.3	5.4	34.4	0.7	2.3	0.0	1532
Travis I[f]	G-M	G1-G5	43.3	2.5	0.6	0.4	13.8	39.4	804
South Cannonball[g]	Cannonball	Unsystematic	85.0	2.2	5.5	0.8	1.9	4.7	8326
Thomas Riggs[h]	B-C	Unsystematic	72.5	11.3	0.9	5.8	7.2	2.3	2462

[a]G1-G3 (coarse fraction) samples include all items retained by 1/4-inch mesh screen; G1-G4 samples include items retained by 1/8-inch mesh; G1-G5 samples include items retained by 1/16-inch mesh; [b] Falk 1977; [c] Ahler et al. 1993; [d] Falk 2003; Cruz-Uribe 2003; [e] Falk et al. 1980; [f] Alex 1982; Artz 1982; Haberman 1982; Toom 1992b; [g] Falk et al. 1984; [h] Hurt 1953.

Archaeofauna obtained through fine-mesh recovery methods are available for just one Extended Middle Missouri site in the Knife region (Falk et al. 1980), one in the Cannonball (Falk 1977), and one in the Grand-Moreau (Alex 1982; Artz 1982; Haberman 1982; Toom 1992b). Each of these collections is relatively small. Data on specimens obtained unsystematically, or through a mixture of methods, are available for three other sites, including one in the Knife region (Ahler et al. 1993), one in the Cannonball region (Falk et al. 1984), and one in the Bad-Cheyenne region (Hurt 1953). For the Heart region, the largest, most thoroughly studied pre-1400 archaeofauna comes not from an Extended variant settlement, but from the Late Woodland Menoken site (Cruz-Uribe 2003; Falk 2003).

The data tallied in table 7 indicate that Late Woodland and Extended Middle Missouri hunters preyed mostly on bison. Bison bones dominate the coarse fraction samples (size grades 1 through 3) from each systematically obtained archaeofauna, with bones from large canids a distant second. Deer and pronghorn bones are generally uncommon, as are those of small-to-medium mammals. Bird and fish bones account for just a few percent of the coarse fraction samples. There are a couple of notable, and potentially informative, exceptions to this overall pattern, which I explore later in this section.

Two fifteenth-century assemblages from the Heart region—from Huff and Bypass villages—exhibit similar patterns (table 8). About 80 percent of the coarse fraction from these sites consists of bison bones, with all other mammals much less well represented. However, compared to most pre-1400 assemblages, fish bones are comparatively common, foreshadowing a notable feature of later Heart region assemblages.

Table 8. Proportional distribution of identified faunal remains (NISP), organized by six major taxonomic groups, in two fifteenth-century Heart region assemblages.

		Faunal Group						
Site	Sample Type[a]	Large Artiodactyl	Small Artiodactyl	Large Canid	Sm.-Med. Mammal	Bird	Fish	NISP
Bypass[b]	G1-G3	80.2	1.7	1.8	2.4	1.6	12.3	936
	G1-G4	70.5	1.5	1.8	2.6	3.0	20.6	1065
Huff[c]	G1-G3	78.0	2.6	0.9	6.8	7.3	4.4	586
	G1-G4	47.0	1.5	0.5	5.5	15.5	29.9	972

[a] G1-G3 (coarse fraction) samples include all items retained by ¼-inch mesh screen; G1-G4 samples include items retained by 1/8-inch mesh;
[b] Metcalf et al. 2000; [c]Falk 2000.

The diversity of post-1500 assemblages stands out compared to earlier archaeofauna (table 9). This diversity is expressed both in the range of mammal species taken and in the increased importance for some communities of birds and especially fish. Small artidactyls are particularly prominent components of the Scattered Village and Slant Village archaeofauna. Large canids make up roughly one-fifth of the Larson Village collection. Small-to-medium mammals are common at Larson, Double Ditch, and Scattered villages. Bird bones, including those of game species like grouse and ducks, as well as those sought for ceremonial and decorative purposes, constitute at least 5 percent of each coarse fraction sample. Two patterns are evident in the post-1500 fish bone samples. Coarse fraction samples from the east bank settlements of Larson Village and Double Ditch Village contain comparatively few fish bones. By contrast, all of the west bank settlements—Scattered, Boley, and Slant villages—produced archaeofauna rich in fish bones. Nearly one-third of the Slant Village coarse fraction consists of

Table 9. Proportional distribution of identified faunal remains (NISP), organized by six major taxonomic groups, in seven post-1500 assemblages from the northern Middle Missouri.

			Faunal Group						
Site	Region	Sample Type[a]	Large Artiodactyl	Small Artiodactyl	Large Canid	Sm.-Med. Mammal	Bird	Fish	NISP
Larson[b]	Heart	G1-G3	54.5	5.4	22.6	10.3	5.6	1.5	1498
		G1-G4	37.7	3.8	17.9	16.2	13.5	10.7	2151
Double Ditch[c]	Heart	G1-G3	55.8	7.6	12.6	10.4	10.0	3.6	10338
		G1-G4	36.3	5.0	9.0	12.4	19.0	18.4	15893
Boley[d]	Heart	G1-G3	59.9	2.5	5.5	4.7	5.0	22.3	1455
		G1-G4	35.4	1.5	3.7	6.1	11.1	42.2	2457
Scattered[e]	Heart	G1-G4	31.4	13.2	5.8	12.5	9.1	28.1	14393
Slant[f]	Heart	G1-G3	48.4	8.6	2.8	4.5	5.5	30.2	1969
Lower Hidatsa[g]	Knife	G1-G3	73.2	10.0	11.3	0.8	1.9	2.7	1551
Big Hidatsa[g]	Knife	G1-G3	65.4	4.2	18.8	2.8	3.2	5.6	500

[a] G1-G3 (coarse fraction) samples include all items retained by ¼-inch mesh screen; G1-G4 samples include items retained by 1/8-inch mesh;[b] Falk 2007; [c] Falk and Ahler 2004, 2005; [d] Falk 2006; [e] Cruz-Uribe 2002; Falk 2002; [f] Falk 1997; Schubert and Cruz-Uribe 1997; [g] Ahler et al. 1993.

identifiable fish bones. The figure for Boley Village is only slightly lower, at 22.3 percent. Fish bones make up 15.7 percent of the coarse fraction sample at Scattered Village.

Data from the Knife River region underscore the diversity of post-1500 Heart region archaeofauna and especially the comparative importance there of birds, fish, and small-to-medium mammals (Ahler et al. 1993). Fewer species are represented at Big Hidatsa and Lower Hidatsa villages, the two best-studied Knife region settlements. As is the case for Extended Middle Missouri assemblages, bison bones account for the vast majority of the identified specimens, followed by bones from large canids (table 9). Bones from birds and small- to medium-sized mammals are minor constituents. Some fish bones are present, but in proportions closer to those of the east-side villages in the Heart region than to the west-side villages.

The trend toward the use of lower-ranked species continued in the seventeenth century. This pattern is best expressed at Slant Village, where the proportion of identifiable bison remains in the coarse fraction declined from 80 percent in the earliest period of occupation to 54 percent in the latest (Schubert and Cruz-Uribe 1997). At Scattered Village, the proportion of the assemblage made up of small-to-medium mammal bones and small artiodactyl bones increased

during the seventeenth century (Cruz-Uribe 2002). The frequencies of bird and fish remains at Scattered Village also increased (Falk 2002), a trend echoed in the Knife region where fish remains steadily became more common after 1500 (Ahler et al. 1993). However, these trends are only weakly expressed at Double Ditch Village, which has produced the region's largest archaeofauna. There, the remains of bison are slightly less common in deposits post-dating 1700, but no clear temporal trends are evident in the remains of other animals (Falk and Ahler 2005).

Sampling issues complicate aspects of these interpretations. The most significant involves field recovery methods. Because the majority of fish and bird remains pass through 1/4-inch mesh screens, coarse fraction samples underestimate their occurrence. In the Double Ditch Village archaeofauna 89.7 percent of the identified mammal remains fall in the coarse fraction, but only 34.2 percent of the bird and 12.8 percent of the fish remains do. Moreover, these proportions vary among sites. At Larson Village, for instance, just 10.0 percent of the total inventory of fish bones falls in the coarse fraction, but at Boley Village 31.3 percent does. For this reason, it is not possible, for example, to directly compare proportions in various taxa recovered from the Cross Ranch site, collected mainly by dryscreening over 1/4-inch mesh screens, with those from the White Buffalo Robe site, where waterscreening over 1/16-inch mesh screen was used (table 7).

Aggregate faunal data from northern Middle Missouri sites also are affected by the uneven distribution of some remains. Perhaps the most striking example comes from the Extended Middle Missouri component at the White Buffalo Robe site. That site produced by far the highest percentage of large canid bones in the region; however, more than two-thirds of those came out of a single large undercut pit (Falk et al. 1980). At Slant Village, 60 percent of the fish bone sample comes from just three large pits (Falk 1997:139). Assemblages from well-sampled settlements, such as Double Ditch Village, show that the frequencies of some taxonomic groups, especially birds and fish, can vary significantly from feature to feature (Falk and Ahler 2004). Archaeofauna derived from a small number of contexts are, on balance, more likely to be

affected by this unevenness.

Despite these sampling issues, though, a portion of the variation evident in the bone assemblages discussed here clearly reflects household or community dietary choices. Such choices are demonstrated most clearly by data on the occurrence of fish bone at two Extended variant settlements, the White Buffalo Robe site in the Knife region and the Travis I site in the Grand-Moreau region. Both archaeofauna were obtained using similar methods and both combine coarse and fine fractions. No fish bones were recovered from any of the excavated Extended Middle Missouri features at White Buffalo Robe, even though portions of eight structures were sampled. By contrast, fish bones were observed in seven of the 11 features assigned to the Extended Middle Missouri component at the Travis I site, even though almost 90 percent of the fish bones there come from two features. Similarly, the frequent occurrence of non-bison remains in post-1500 Heart region sites, compared to sites in the Knife region, clearly reflects real differences in provisioning practices.

Ethnographic Data on Hunting Practices and Comparisons with Archaeological Data

The Mandans and Hidatsas practiced a wide variety of hunting strategies in the nineteenth century. Large-scale, organized bison hunts, sometimes involving the greater part of the community, took place in the summer, after the conclusion of the season's major religious ceremonies, and again in the fall after the ripe maize harvest. Lewis and Clark even report on a mid-winter communal hunt (Clark 2002). Smaller, informal hunting parties pursued bison, antelope, deer, and other animals near the villages throughout the year (Abel 1997; Bowers 1948, 1950; Wilson 1924). In the fall, younger men and their families travelled west to eagle-trapping sites in the broken country bordering the Heart and Little Missouri rivers where, in addition to eagle feathers, they obtained a supply of meat and hides for the winter (Bowers 1948, 1950).

Several techniques were used, depending on the number of hunters in the party and the

type of quarry sought. Verendrye reports the use of large-scale human surrounds to capture bison (Smith 1980), as does Bowers (1950:87). Corrals or pounds were also used (Bowers 1948:164, 1950:33). Wilson's informant, Goodbird, drew diagrams of two such pounds Hidatsas living at Like-A-Fishhook Village used in the nineteenth century, which incorporated posts, piles of stones, and small arroyos (Wilson 1910). Bowers's (1950:33) informants told him that the corral was equated to the Mandan's Okipa lodge, with carcasses falling on the east side allocated to the east-side moiety and those on the west allocated to the west-side moiety. Household hunting parties stalked small groups of animals closer to the settlements (Abel 1997; Bowers 1948; Brink 2004). In early winter, bison sometimes were driven onto the frozen river, where they could be mired and more easily brought down. Both large and small animals, including bison, elk, deer, and wolves, were taken in game pits, which were positioned along trails near the villages (Bowers 1948:164, 1950:97). In the spring, "float bison," animals that had fallen through the ice and drowned the previous fall and winter, were pulled from the river near the villages (Schubert and Cruz-Uribe 1997; Wood 1967:21).

Data on the relative representation of various bison skeletal elements, as well as animal age and sex data, indicate that village archaeofauna represent the remains of animals taken near the settlements (Cruz-Uribe 2002; Schubert and Cruz-Uribe 1997). Between-site similarities in the relative proportions of certain elements further suggest that Heart River hunters applied a uniform set of butchery and carcass transport practices; however, the nature of these practices is not well understood (Brink 2004; Cruz-Uribe 2002). With the possible exception of certain elements needed for tools, it is unlikely that the bones of animals taken during communal hunts or on eagle-trapping expeditions were brought back to the village. The absence in village assemblages of remains representing large-scale communal hunting means that there is no reliable way to estimate the subsistence contribution of such activities. For this reason, the apparent increase in the consumption of smaller animals, including fish and birds, may not signal a dietary transformation, but instead could indicate that over time the number of bison living

close to the Heart region towns diminished, a predictable result of the ecological impact of long-term settlement.

Nevertheless, increasing faunal assemblage diversity in the Heart region after 1500 may signal an increase in the importance of garden hunting, the taking of small game attracted to agricultural fields. Clearing and planting fields increases the diversity and abundance of certain animal taxa (Linares 1976). By preying on these animals farmers can reduce competition for their crops, and at the same time diversify their diets. Because it is embedded in routine agricultural activities, garden hunting entails relatively few costs (Neusius 1996). Farmers may obtain small animals while walking to and from their fields; children or young adults may take others while guarding crops against small mammals or birds.

Because garden hunting is an opportunistic strategy, faunal assemblages produced by garden hunters should be more diverse and include a range of lower-ranked species (Neusius 1996). Indeed, many of the smaller animals present in post-1500 Heart region assemblages include those that could be expected to frequent agricultural plots. However, specific measures designed to detect garden hunting have not been applied to Heart region archaeofauna.

Regardless of the specific reasons for their increased use, the faunal data show that small-to-medium mammals, fish, and birds contributed more to sixteenth- and seventeenth-century Heart River diets than later historical or ethnographic accounts suggest. For instance, cutmarks on large canid bones suggest that dogs were used as a food source (in addition to their many other functions), but only limited ethnographic data are available on this practice (Morey 1986; Wilson 1924). Ethnographers describe eagle trapping in some detail, but almost nothing is known about the methods used to capture upland game birds or water fowl (Wilson 1926). The use of fish traps is well documented, but the presence of bone fishhooks in village assemblages, along with bones representing species that use a variety of habitats, indicates that other methods were used as well (Falk 1997). While it is important to recognize that the overwhelming importance of bison never diminished, particularly in view of the fact that the dietary significance of

communal hunting is not reflected in village bone assemblages, the consistent presence of lower-ranked prey in post-1500 assemblages suggests that Heart region households and communities increasingly pursued a flexible, broad-spectrum strategy that is not well documented in historical and ethnographic sources.

Farming and Harvesting

Several lines of evidence attest to the long-standing and vital economic role agriculture played in the northern Middle Missouri economy. Worn and discarded farming tools, especially hoes made from bison scapulae, make up a substantial and consistent share of every site's bone tool assemblage. In the Knife region, scapula hoes comprise a third of most collections, making them the single most common type of bone tool (Weston and Ahler 1993). They are equally common at sites in the Heart region (Ahler 2005a:Table 55, Table 57).

Without question, maize was the backbone of the region's agricultural system (Adair 2003; Nickel 2007). Maize kernels and cobs are recovered from virtually every sampled archaeological context. For instance, all of the 30 pit features at Scattered Village selected for analysis contained maize cobs and kernels (Nickel 2002). Similar ubiquity rates are reported for Double Ditch Village (Nickel 2005). Seeds and rind fragments of cultivated squash, likely representing *Cucurbita pepo*, are somewhat less common but nevertheless occur in most contexts. At Scattered Village, squash remains were found in 24 of the 30 studied features and 41 percent of 242 analyzed lots. Remains of domesticated beans (*Phaseolus vulgaris*) are far less common, occurring in just 9 percent of the analyzed lots from Scattered Village. However, preparation and preservation factors likely affect their recovery.

In addition to these tropical crops, northern Middle Missouri farmers planted at least three cultigens native to eastern North America: marshelder (*Iva annua*), sunflower (*Helianthus annuus*), and tobacco (*Nicotiana rustica* and, probably, *Nicotiana quadrivalvis*) (Adair 2000,

2003; Nickel 2007). In addition, seeds large enough to represent a domesticated variety of goosefoot (*Chenopodium gigantospermum*), another eastern North America cultivar, occur at one fifteenth-century site (Nickel 2000). Among these plants, the oily seeds of sunflowers were especially important. Macrobotanical assemblages from the Heart region also include charred seeds of weedy plants (Nickel 2007). Some of these represent wild species: burweed marshelder (*Iva xanthifolia*), which currently grows in North Dakota, occurs in many assemblages, as do small-seeded weedy forms of sunflower and goosefoot (*Chenopodium berlandieri*). At Double Ditch Village, goosefoot seeds are nearly as ubiquitous as maize (Nickel 2005). Others represent partially naturalized varieties of cultivated species. Seeds spanning the lower size limit of cultivated sunflower and marshelder (sumpweed) occur in most assemblages. Northern Middle Missouri farmers supplemented these domesticated and weedy staples with a broad range of wild fleshy fruits, including plum, chokecherry, grape, buffaloberry, and dogwood (Adair 2003; Nickel 2007).

This mixture of resources suggests that the agricultural economy, though focused on the cultivation of six domesticated species, was deeply intertwined with the husbandry of both wild and naturalized species. Maize clearly was the most important crop, at least in terms of caloric yield, but Middle Missouri farmers also encouraged, protected, and perhaps cultivated weedy varieties of sunflower, marshelder, and goosefoot growing in and around their fields, along paths to the fields, or around their settlements. It seems likely that some wild fruits were similarly encouraged. This pattern seems to have been long-standing, judging by the consistent occurrence of this same botanical inventory in assemblages from Late Woodland settlements as well as Initial and Extended variant settlements (Nickel 2007).

Ethnographic Data on Farming Practices and Comparisons with Archaeological Data

Early nineteenth-century narrative accounts offer little more than anecdotal evidence

for the scale of agricultural production or the methods used. However, it is possible to make a number of general statements about nineteenth-century Middle Missouri farming, thanks largely to two remarkable early twentieth-century studies that combine historical records with ethnographic accounts and experimental data (Will and Hyde 1964; Wilson 1987).

Mandan and Hidatsa farmers planted maize on the floodplain of the Missouri, as well as along smaller tributary streams and in intermittent draws. Fields sometimes were located well away from settlements, owing to shortages of suitable land (Bowers 1950; Will and Hyde 1964:100). The Mandans measured field sizes by the number of rows of maize, with one "nupka," or Indian acre, amounting to 7 to 10 rows of indeterminate length (Will and Hyde 1964:99; Wilson 1987:25). Will and Hyde (1964:99) state that one nupka is equivalent to about one-quarter acre. Plots devoted to beans, squash, or sunflowers were not included in this measurement. Fields generally expanded slowly over time, as farmers cleared additional land by cutting and burning trees and shrubs. Fields were burned in the spring each year before planting. However, northern Middle Missouri agriculture does not fit the strict definition of a "slash-and-burn" or swidden system because fallowing, combined with annual flooding, was adequate to maintain the long-term fertility of the fields (Pugh 2009).

Several types of maize were planted, most notably a variety commonly called Northern Flint. Northern Flint plants are short, with abundant foliage, and bear ears of variable length low on the stalk. They tolerate a variety of soil conditions and are well adapted to the region's short growing season and unpredictable climate (Will and Hyde 1964:70). Will and Hyde (1964:72-73) report that seeds could be planted in April or May and in a good year the plants could mature in as few as 90 days. Pre-nineteenth century varieties likely exhibited the same growth habits and maturation period; however, varietal differences are difficult to detect in archaeological assemblages (Adair 2006:374). Like Northern Flint, most archaeological specimens exhibit 8 to 12 rows of kernels (Blake and Cutler 2001).

Historical data on maize yields are spotty. Few records predate 1850. Yield data are more

common for the second half of the nineteenth century, but by then production methods had begun to shift, affected by the introduction of new crops, such as potatoes, as well as the social policies of the U.S. government. Will and Hyde (1964:142) believe that in a good year a typical Middle Missouri field produced about 1255 kg/ha (20 bushels/ac). Sissel Schroeder's (1999) sample of historical records points to average yield of 1185 kg/ha (18.9 bushels/ac) for ten Eastern Woodland and Upper Midwest groups lacking plows. However, she thinks that a value closer to 627 kg/ha (10 bushels/ac) is a better estimate of the actual yield available for consumption. William Baden and Christopher Beekman's (2001) maize productivity model derived from environmental data for three counties in southeastern Tennessee produces somewhat lower values, estimating an optimal yield of 1129 to 1882 kg/ha (18 to 30 bushels/ac), and an average yield of 502 to 753 kg/ha (8 to 12 bushels/ac).

Recently, Wendy Munson-Scullin and Michael Scullin (2005) tested these figures in an experimental garden using cultivation methods and plant varieties described in ethnographic accounts. Their maize yields over a three-year period ranged from 2390 kg/ha (38 bushels/ac) to 1510 kg/ha (24 bushels/ac). These yields are comparable to those George Will achieved in the early twentieth century in test plots in North Dakota (Munson-Scullin and Scullin 2005:15). A large number of factors affect maize yields, both positively and negatively, but these data suggest that Mandan and Hidatsa farmers routinely produced between 1255 kg/ha (20 bushels/ac) and 1883 kg/ha (30 bushels/ac).

It is possible to calculate the amount of cropland necessary to support average sized communities during different periods by combining these yield data with simple assumptions about per-capita nutritional requirements and fallow periods (table 10). Buffalo Bird Woman, a Hidatsa Wilson interviewed in the early twentieth century, typically used a two-year planting cycle (Wilson 1987:113). Fields were cultivated for about two years, followed by a two-year fallow period. If maize contributed 50 percent of a community's calories, and assuming a maximum yield of 1883 kg/ha (30 bushels/ac), then—using Schroeder's (1999:Table 5) values

Table 10. Estimated maize yields, calculated field sizes, and minimum distances to farthest fields over time.

Time Period	Estimated Maize Yield (kg/ha)	Estimated Aggregate Field Size (ha)	Minimum Distance to Farthest Field (km)
1200-1400	1883	35.7	0.55
	1255	53.6	0.67
1400-1600	1883	101.8	0.93
	1255	152.7	1.14
1700-1830	1883	61.2	0.72
	1255	91.9	0.88

for per capita nutritional requirements—the average Extended Middle Missouri community would have needed to put about 35.7 ha (88.2 ac) under cultivation. If average yields fell to 1255 kg/ha (20 bushels/ac) then aggregate field size would have had to increase to 53.6 ha (132.4 ac). The larger communities of the 1400s and 1500s would have needed between 101.8 ha (251.5 ac) and 152.7 ha (377.3 ac) of cropland. After 1700, aggregate field size dropped to between 61.2 ha (151.2 ac) and 91.9 ha (227.1 ac). Assuming that fields were evenly distributed on the floodplain in a semi-circular arc centered on the village, and that 75 percent of the floodplain was suitable for cultivation, then the minimum distance between each Extended variant community and its farthest field would have been about 0.55 km. After 1400, that figure nearly doubled, to 0.93 km.

As with northern Middle Missouri hunting, the complexity of the region's agricultural system is not well attested in historic accounts. Nineteenth-century explorers and traders certainly recognized the importance of tropical cultigens, noting that fields of maize, squash, and beans crowded the floodplain near the settlements (Will and Hyde 1964). Some accounts mention gourds and sunflowers, but comments on North American cultivars focus mostly on tobacco. Nothing is said about the uses of wild or naturalized weedy plants and the use of wild fruits is only briefly mentioned. In the twentieth century, several scholars investigated the use of non-tropical plants, both wild and cultivated (Gilmore 1991; Will and Hyde 1964; Wilson 1987). These sources provide some data, especially on sunflowers, but say little about the role of other weedy plants. Together, these apparent omissions could signal an increased reliance

on maize and an overall simplification of the agricultural system in the nineteenth century—an interpretation supported by macrobotanical data from sites located elsewhere in the Plains (Adair 2006:374). However, the slim data on the use of weedy or wild plants may also reflect the early journalist's comparative inattention to work performed largely by women and away from the village.

Hunting and Farming in the Northern Middle Missouri

Archaeologists have long debated whether the villagers of the northern Middle Missouri should be seen as maize-farming hunters or as bison-hunting farmers (Toom 1992b). Many argue that bison meat and maize each provided roughly half of the calories consumed (Lehmer 1954). It is clear, though, that different communities or divisions pursued different subsistence strategies. The Mandans, for instance, generally have been described as dedicated farmers, less interested than many of their neighbors in communal bison hunting. By contrast, the Hidatsas proper have been seen as indifferent farmers, intent mainly on bison hunting. In addition, the relative dietary contributions of bison and maize may be difficult if not impossible to calculate from archaeological data alone, as Toom (1992b) points out. But even beyond the methodological challenge of such a calculation, the data discussed here suggest that no static estimate of the relative importance of different activities ever could paint an full picture of the region's subsistence system. Rather, the diversity and productivity of the Middle Missouri environment enabled the flexible and contingent deployment of a range of subsistence practices. Individual households or communities were able to take into account changing environmental and social conditions when making economic choices. That is, provisioning could be tailored to the labor available and to the fluctuating productivity of particular resources. Though the remarkable persistence of the bifurcated maize-bison subsistence economy has led many scholars to describe northern Middle Missouri communities as economically stable, the variability

discussed here suggests that they should instead be seen as dynamic. For this reason, the residents of northern Middle Missouri settlements are best characterized as hunter-farmers.

One measure of the success of this complex system is its capacity to accumulate surpluses. Excess maize was stored, along with other foodstuffs, tools, and other raw materials, in subterranean pits located throughout the village, both inside and outside houses. Extrapolating from geophysical data from the fifteenth-century Huff site, Kvamme and Ahler (2000:33-34) estimate the settlement contains more than 2000 storage pits, which translates into a simultaneous storage capacity exceeding 7000 bushels of maize, easily enough to feed the community's more than 1000 residents for a year. Moreover, data from sites across the northern Middle Missouri suggests that the sizes of individual storage pits increased over time, reaching as much as 3 cu. m in the eighteenth century. The capacity to produce and stockpile subsistence resources clearly contributed to the economic resilience of the region's communities, but perhaps more importantly it fueled their participation in—and control over—a far-flung trade network.

Trading

Trade was crucial to the emergence of the region's first aggregated farming communities. Later, trade and the social connections on which it depended played an equivalent role in the establishment of Extended Middle Missouri communities. Beyond these catalytic moments, though, archaeological data from sites of all ages up and down the river attest to the habitual participation of Middle Missouri tradition communities in trade of various kinds (Wood 1974, 1980). However, the relations it entailed and the routes along which it flowed changed over time.

Changes in the types of trade goods present in village assemblages point to two major shifts in regional trade relations. The first coincided with the establishment of Extended Middle Missouri communities. During early Initial variant times, in the 1000s and 1100s, a highly-structured bilateral trade network linked Mississippian towns, Initial Middle Missouri villages,

and mobile Late Woodland groups along the river corridor. With the appearance of Extended variant villages this river-focused system gave way to a geographically broader multilateral network linking hunter-farmers on the Missouri with numerous mobile groups living west, north, and east of the river valley. In addition to the collapse of the KRF trade, this shift is most obviously expressed by the changes in the content of exotic good inventories, especially marine shell. Extended variant assemblages included fewer artifacts made from Gulf Coast shell, but dentalium and olivella shells from the Pacific seem to be more common (Lippincott 1997; Ludwickson, Gunderson, and Johnson 1993; Picha and Swenson 1997). This reorientation is also evidenced by the presence of copper artifacts, likely from the upper Midwest, in a number of Extended variant assemblages, along with items made from red pipestone (Hill and Neuman 1966; Ludwickson, Gunderson, and Johnson 1993; Sperry 1995; Wood 1974).

The second shift was a broad expansion of the trade network, as well as an increase in the volume of trade, beginning during Extended variant times and intensifying in the 1400s and 1500s. Several lines of evidence attest to the reach of this emerging system. The most readily observable involves the distribution of KRF. As early as the 1400s, and certainly by the 1500s, Mortlach phase bison hunters, thought to be the ancestors of the southern Assiniboines who later played such a pivotal role in the northern fur trade, began transporting KRF northward, into the Saskatchewan River basin, primarily in the form of finished tools (Walde 2003). At about the same time, or perhaps slightly earlier, Vickers focus groups living in southwestern Manitoba were also importing KRF (Nicholson 1990, 1991). Similarly, exotic toolstone, primarily from sources located to the west and southwest of the Heart region, is present in many Extended variant assemblages (Ahler 1977a; Johnson 1999).

Occasionally, ceramic containers were exported from the villages on the Missouri as well (Johnson 1979b; Nicholson et al. 2008). But a more telling indicator of the scope of interaction is the many hybrid ceramic assemblages that appeared in a broad arc around the Middle Missouri beginning as early as the mid-1300s. These conspicuously heterogeneous assemblages include

vessels exhibiting Late Woodland manufacturing techniques and decorative conventions alongside vessels exhibiting Plains Village style and technology; in some cases, both Late Woodland and Plains Village attributes can be found on the same vessel. Assemblages of this type have been observed in eastern North Dakota (Michlovic 2008); in Manitoba (Nicholson 1990); in Alberta (Forbis 1977); in Saskatchewan (Walde 2003), and in Montana (Keyser and Davis 1982). These assemblages provide direct evidence of sustained, intimate engagement among and between hunter-farmers and hunter-gatherers.

Apart from toolstone and pottery, less durable goods also flowed along Northern Plains trade routes. Data from sites in southwestern Manitoba demonstrate that maize was regularly consumed there by about 1000, even though evidence for maize production is meager at best (Boyd et al. 2006; see also Zarrillo and Kooyman 2006). Limited trace element data bolster the conclusion that at least some of this maize was grown elsewhere (Boyd et al. 2008). Tobacco native to the Northwest (*Nicotiana quadrivalvis*) may have been cultivated in the Middle Missouri as early as the thirteenth century (Adair 2000; Haberman 1984). Certainly it was widely grown there by the latter part of the eighteenth century. By that time, bison robes were moving westward toward the Columbia Plateau; it seems likely that they also figured prominently in earlier trade relations. Though archaeologists working on the Northern Plains have not explored direct material evidence for the exchange of bison meat and hides during 1300s, 1400s, and 1500s, as have their colleagues on the Southern Plains (Creel 1991; Speth 1991; Spielmann 1983), there is no doubt that "overproduction" of bison products for exchange was a long-standing practice in the north (Brink 2008). In any case, large-scale maize-for-meat exchange seems to have been well established throughout much of the Plains by the time Coronado's chronicler observed it in 1541.

The expansion of Extended Coalescent communities in the fifteenth and especially the sixteenth century opened up new avenues for trade. There are abundant direct data confirming bilateral exchange of goods and the movement of people between Middle Missouri tradition

communities in the Heart region and Coalescent tradition communities in the Grand-Moreau region, though the relationship may have been marred at times by conflict and competition (Bamforth and Nepstad-Thronberry 2007a; Kay 2007). Pottery vessels preserve the clearest evidence of cooperative interaction. The pottery from the Demery site, the earliest as well as the northernmost Extended Coalescent settlement, combines the formal and decorative attributes of Extended Coalescent pottery, well known from numerous sites to the south, with Middle Missouri tradition attributes known from the Heart region (Woolworth and Wood 1964). By the same token, vessels produced in the Heart region in the 1400s exhibit some of the formal and decorative features found on contemporaneous Extended Coalescent pottery, especially tool-impressed braced straight rims (Ahler 2001; Mitchell, Madden, and Ahler 2007). Overall, pottery assemblages dating to the 1400s from the Heart and Knife regions are described as formally and decoratively heterogeneous (Ahler 1993a:81). That heterogeneity has been interpreted in different ways, but it certainly must reflect geographically extensive intercommunity contacts.

Fifteenth-century ceramic emulation was coupled with ceramic exchange. Trade sherds are present in both Heart and Grand-Moreau assemblages. Such exchanged vessels can be identified by the marked technological differences between them that are evident despite their formal and decorative similarities. Extended Coalescent trade sherds are present in the fifteenth-century Huff site assemblage in the Heart region (Ahler and Johnson 2000; Wood 1967:106, 136). Similarly, Demery's original investigators identified several Extended Middle Missouri vessel rims. They suggest that these vessels may represent an earlier occupation, but in view of the fact that no stratigraphic or other evidence for such an occupation was observed, in retrospect it seems plausible that these sherds in fact represent trade vessels.

This pattern of ceramic trade and emulation continued in the 1500s and 1600s. In the Heart region, southern trade vessels have been recovered from On-A-Slant Village (Speakman et al. 1997), Larson Village (Mitchell and Swenson 2008), and Chief Looking's Village (Mitchell, ed. 2010). The emulation of southern decorative motifs can be seen in the increasing popularity

of the distinctive alternating triangle design previously unknown in the Heart. In the Grand-Moreau region, northern trade vessels have been recovered from the Extended Coalescent Molstad Village (Hoffman 1967) and are present in larger numbers in the Lower Grand site assemblage. Heart region-inspired pots, especially S-rim vessels bearing cord impressions—long the signature ware of Heart region potters—are a consistent feature of Akaska focus assemblages in the Grand-Moreau region (Johnson 2007a:125), but are far less common in Extended Coalescent assemblages farther south. This type of vessel is particularly common at the Lower Grand site (Johnson 1988) and at the Anton Rygh site (Johnson 2007a). The incorporation of northern attributes in southern assemblages continues into eighteenth century at the many Le Beau phase sites in the Grand-Moreau (Johnson 2007a:141). The occurrence in post-1500 Heart region assemblages of imported toolstone from sources located to the southwest, sources that Extended Coalescent communities in the Grand-Moreau also exploited, provides additional evidence of intervillage interaction (Ahler, Minor, and Smail 1997; Ahler, Burns, and Madden 2006).

Besides evidence for ceramic trade and emulation and acquisition of toolstone, there is another conspicuous indicator of the movement of people between Middle Missouri and Coalescent tradition communities. Beginning in the 1400s, lodges built on the distinctive Coalescent four-post plan began appearing in the Heart River towns. Huff Village is the best documented case (Wood 1967). Excavation there confirmed the presence of at least one such structure, but a recent geophysical survey of the site suggests that as many as 11 may be present, amounting for nearly 10 percent of the settlement's houses (Kvamme, McKinnon, and Weiwel 2009). Interestingly, they appear to be clustered into three sectors or neighborhoods of the settlement.

Eventually, the Mandans and Hidatsas living in the Heart and Knife regions entirely replaced the gabled, long-rectangular houses they had been building for centuries with the new Coalescent architectural design. However, the transition seems to have taken some time. Chief

Looking's Village, occupied briefly about a century after Huff, seems to comprise a mixture of long-rectangular and square or circular, four-post lodges (Mitchell, ed. 2011). Though the specific social processes leading to this change are not understood, there can be little doubt that they were predicated on regular and intimate interaction between Coalescent and Middle Missouri peoples, including the transfer of people, especially women, among communities.

In addition to evidence for the small-scale movement of individuals or households, there also is evidence for larger-scale relocation. The distinctive and heterogeneous ceramic assemblage from the Elbee site in the Knife region, thought to date to the middle of the sixteenth century, appears to reflect connections to groups living some distance away. Ahler (1984a) argues that the site's residents had ties to Extended Coalescent communities in the Grand-Moreau region. Toom and others (2004; see also Toom 2004) suggest that Elbee is connected to the Northeast Plains Village complex. However, Johnson's (2007a:Figure 16) ceramic ordination study indicates that, at least on a typological basis, the Elbee assemblage is quite similar to northern Extended Coalescent assemblages dating to the late 1400s or 1500s. Elbee may represent the movement of a faction composed of several lodge groups or perhaps a small community, although the heterogeneity of the pottery suggests that multiple social processes may have been responsible, likely including intermarriage with their Knife region neighbors.

Ethnographic Data on Trade Practices and Comparisons with Archaeological Data

Colonial chroniclers paid careful attention to Native trade practices and the details of exchange events figure prominently in many fur trade-era accounts. In the Plains, much of the exchange Europeans witnessed took place in the context of the calumet ceremony, through which the social relations that made trade possible were established (Blakeslee 1975). An exchange event typically began when notice was given to a host community by advance messengers that another group planned a trading visit. Following a period of preparation, messengers informed

the hosts that the trade delegation had arrived. The host community extended an invitation to enter the village and feasts were held, along with a council to fix prices. After several days the calumet ceremony itself was held, cementing a fictive kinship relationship between leading men of each group, and by extension their followers, both men and women. The trade event concluded with social dances, dancing for gifts, and gambling. Goods changed hands at each step of this complex process.

It is worth pointing out that ethnohistorians do not agree on the nature of the goods exchanged or on the social context and significance of trade events. Joseph Jablow (1951), for instance, makes a distinction between "ceremonial tribal trade," carried out by leading men and involving exchange of horses and European trade goods, and "individual trade," carried out by women and involving the exchange of foodstuffs and Native crafts. However, based on his reading of primary historical sources, Donald J. Blakeslee (1975) disputes this distinction, arguing instead that Jablow oversimplifies what was in fact a far more complex system.

Nevertheless, the picture of exchange that emerges from historical sources omits or downplays crucial patterns evident in the archaeological data. Indeed, it is clear that, for the hunter-farmers of the northern Middle Missouri, middleman exchange of horses and guns was, to borrow Strong's (1933:285) apt term, little more than a late "veneer," important only during the second half of the eighteenth century, more than a century after European trade goods began flowing through their settlements. Judging by the consistent presence of exotic items from many distant locations, they were well experienced brokers, receiving and passing along a variety of trade goods long before the horses-for-guns trade developed. But northern Middle Missouri communities also were major producers of value-added finished goods. While it is true, as Verendrye observed, that mobile hunters brought bison meat and decorated hides to the Mandan settlements to trade for garden produce, he also noted that among the groups he encountered the Mandans themselves were "the most skillful in dressing leather, and they work very delicately in hair and feathers" (Smith 1980:56).

At the same time, the mutualistic maize-for-meat trade John Ewers and many other ethnohistorians believe was the principal mode of precolonial exchange continued to be important well into the nineteenth century. While living at Mih-tutta-hang-kush, the Mandans produced agricultural surpluses sufficient to meet their own subsistence needs as well as those of the American Fur Company traders at Fort Clark and their competitors (Anfinson 1987). Even in the 1870s, long after the collapse of the fur trade and after European goods had become widely available from a variety of sources, the exchange of subsistence goods continued at Like-A-Fishhook Village (Ewers 1954:435). Though the exchange of durable goods, including European commodities, was undeniably important to the villager's economy, agriculture and hunting always were the cornerstones of their prosperity.

Perhaps most importantly, European eyewitness accounts scarcely mention the between-village trade so well attested in the archaeological record. Intertribal exchange between settlements in the Heart and Grand-Moreau regions clearly had transformative effects in the 1500s and 1600s, but fur traders writing about the region in the 1800s failed to appreciate the scope of those interactions. Nor did the fur traders understand the importance of intra-tribal exchange among nearby farming communities.

Summary

Two crucial points emerge from the evidence considered here. First, data on settlement patterns and economic practices in the Heart region clearly document both long-term continuity and dynamic historical change during the centuries before the advent of Europeans. Second, these same data show that the documentary record Europeans produced does not adequately capture the social and economic complexity of the system they encountered, let alone the complexity of earlier periods.

To better understand the history of that earlier system I now turn to high-resolution data

on the organization of craft production. The next chapter sets the stage by describing how the analytic units used in this study were developed. Chapter 6 then explores patterns of stone tool manufacture in the 1500s and 1600s. Chapter 7 considers how pottery was produced during that same period and compares and contrasts patterns of ceramic production with patterns of stone tool production.

Chapter 5:

Building an Archive for Archaeological History in the Heart Region

Because archaeological assemblages possess two distinct temporal properties—age and duration—sample selection is a multi-dimensional process that combines chronological data with data on formation processes. The outcome of this is a set of analytic units that provide a framework for analysis and comparison by aggregating individual provenience lots sharing common spatial, depositional, and temporal properties. For instance, multiple excavation levels within a single trash-filled storage pit might be combined into a single analytic unit. Midden deposits, by contrast, might be divided into a series of analytic units, based on their content and their relationships to other features and deposits. During analysis, artifacts associated with individual analytic units can be aggregated into spatial groups (by site or excavation area), depositional groups (by deposit type), or temporal groups (by time period).

Measuring Time in the Northern Middle Missouri

Investigators working in the Knife and Heart regions consider several lines of evidence when assigning analytic units to particular time periods, including stratigraphic relationships, radiocarbon dates, and trade artifact densities. The most important stratigraphic data include observed patterns of feature superpositioning and observed or projected relationships between cultural features or deposits and natural soil horizons. Investigators also take into account the spatial and stratigraphic relationships between particular analytic units and constructed features such as fortification ditches and borrow basins.

Radiocarbon dating has been used mainly to establish the founding dates of settlements. To be meaningful, measured ages, expressed as radiocarbon years before 1950, must be converted to calendar dates. Applications for doing so use a correction or calibration curve

derived from measured radiocarbon ages of samples whose age is known independently. Unfortunately, the calibration curve for the period after about 1650 is very irregular and, as a result, radiocarbon samples younger than about 250 B.P. produce essentially uninterpretable results. Moreover, prior to 1650, the calibration curve exhibits periodic plateaus or reversals produced by short-term fluctuations in the atmospheric concentration of ^{14}C. Owing to these fluctuations, samples of different true ages incorporate equivalent ^{14}C concentrations and therefore produce equivalent radiocarbon ages. One such reversal spans all of the sixteenth century, complicating efforts to pinpoint the earliest occupation of many Heart River communities (figure 11).

Investigators use data on the density and composition of European trade goods to sequence post-1600 contexts. Some studies also consider the presence of cutmarks on butchered bone made by metal tools. Research in the Knife region reveals that European trade artifacts first appeared there sometime during the first half of the seventeenth century (Ahler and Drybred 1993; Weston and Ahler 1993). In the Heart region, the earliest trade goods consisted mostly of copper or brass items. After about 1650, iron tools became more common and the proportion of the trade artifact assemblage made up of cuprous items declined from about 80 percent to 20 percent. Glass beads appeared in larger numbers at the end of the seventeenth century. In the eighteenth century, the number of iron trade goods and glass beads increased dramatically. Within these general trends the types and densities of European trade goods vary somewhat at each site. Figure 12 illustrates the densities of metal fragments and glass beads found at two sites in the Knife region (Big Hidatsa and Lower Hidatsa villages) and at four sites in the Heart region (Boley, Double Ditch, Scattered, and On-A-Slant villages). In this figure, the logarithm of the mean density of beads and metal fragments in all size grades per cubic meter of excavated fill is plotted against each site-specific period's estimated median date; estimated dates are based on a variety of factors, including stratigraphic relationships and observations about the rate and nature of ceramic assemblage change. The correlation between estimated ages and trade good fragment

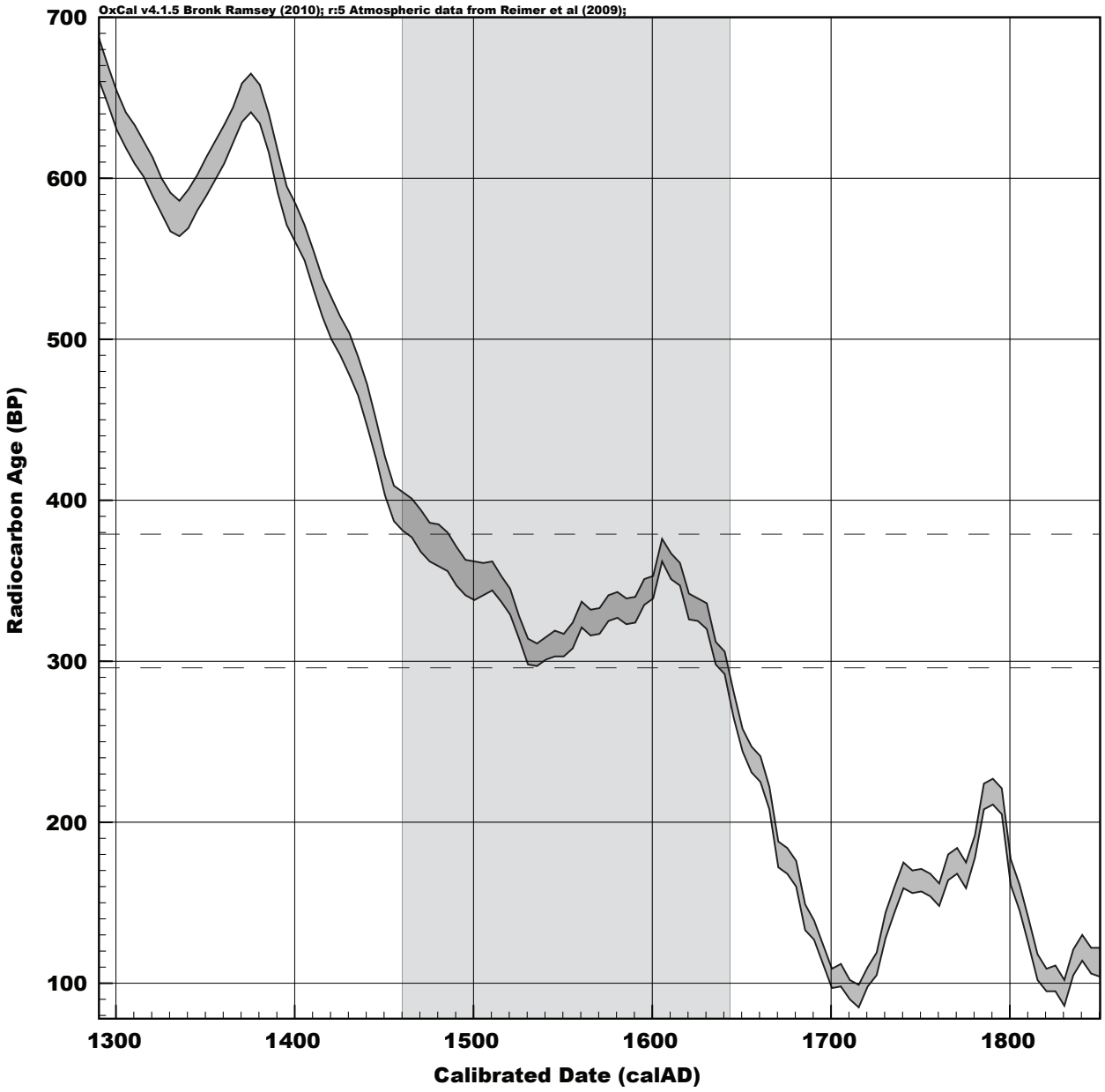

Figure 11. A segment of the IntCal09 radiocarbon calibration curve illustrating the magnitude of the sixteenth-century calibration plateau (the shaded bar) that spans the period from 1460 to 1635 or 380 B.P. to 295 B.P.

densities is reasonably strong (r^2=.82, p=0.000). Moreover, data from the Heart region agree well with similarly strong correlations obtained previously for the Knife region (Ahler and Drybred 1993).

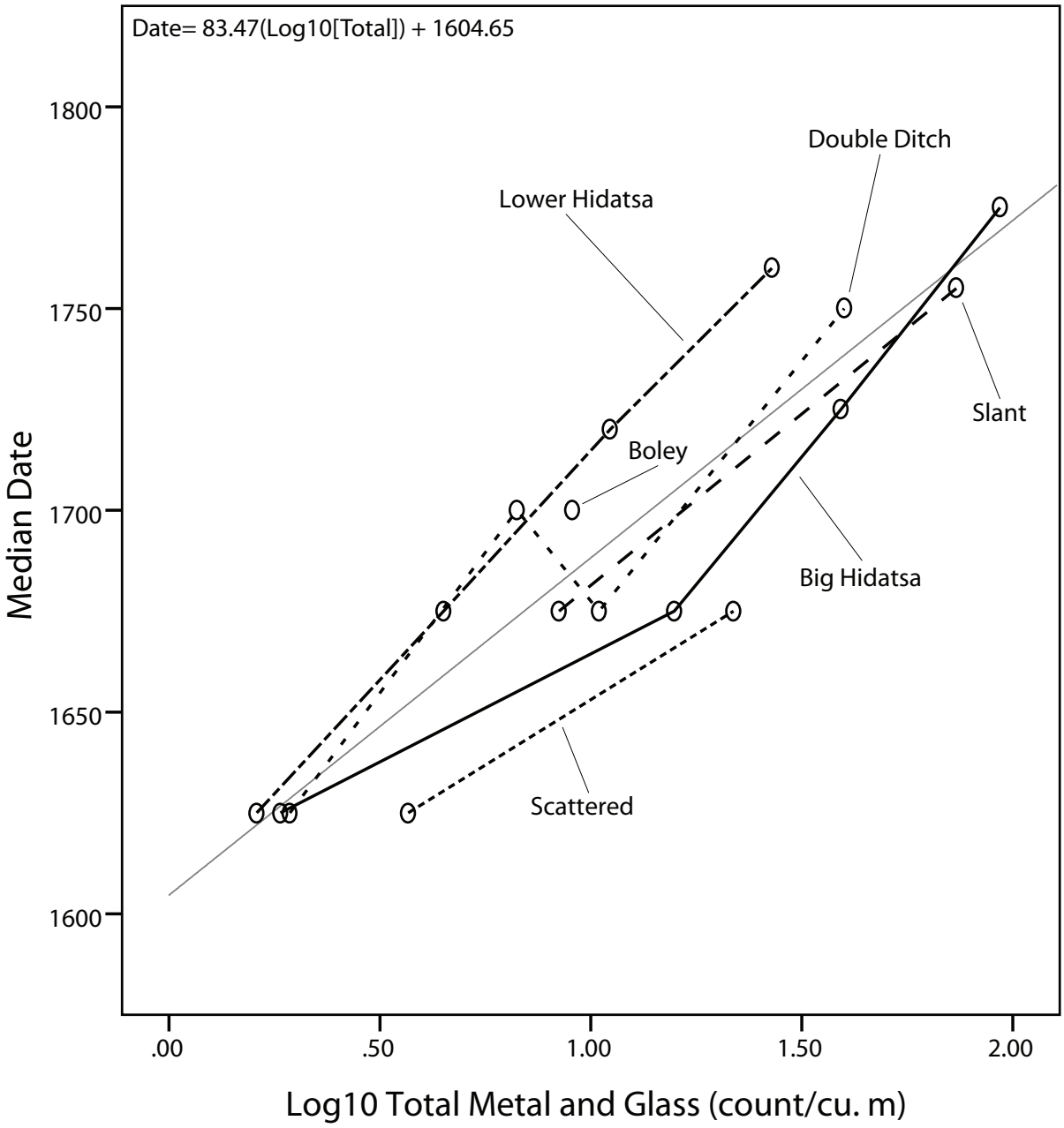

Figure 12. Changing frequencies of metal fragments and glass beads from four sites in the Heart region and two in the Knife region, plotted against estimated mean age.

It is worth emphasizing, though, that the metal and glass items used to calculate the regression illustrated in figure 12 are really just fragments of trade goods. A single beaded pipe bag or moccasin, for instance, might incorporate hundreds of glass beads. Metal fragments—

sometimes little more than flakes of iron oxide—are often too small to determine the function of the tool from which they came. This has a couple of important implications. First, because the densities of metal and glass artifacts are generally quite low (between 0.6 and 72 items per cu. m), the confidence with which a particular analytic unit can be assigned to a particular time period is partly a function of its volume. For this reason, size was an important criterion for selecting analytic units used in this study (see appendix 3). Second, the fragmented nature of trade goods effectively means that changes in their frequencies cannot stand in as a proxy for culture change, an assumption acculturation researchers commonly make. While changes in the availability or discard of European trade goods no doubt were culturally significant, Arthur Ray (1978) shows that a variety of factors, including the spatial structure of the trade system itself, affect their occurrence. For the Middle Missouri subarea specifically, Toom's (1979) research confirms the view that trade goods densities cannot be used as an index of Native culture change.

Nevertheless, the regression illustrated in figure 12 indicates that trade goods densities are an effective chronological tool. It is not necessary to have a detailed understanding of the specific mechanisms through which metal and glass items were incorporated into archaeological deposits in the Heart and Knife regions to use these data for chronological purposes. However, the absence of an unambiguous theoretical basis is a reminder that temporal assignments based on trade goods densities should be considered relative rather than absolute, even though they are expressed in terms of calendar years. Moreover, despite the fact that parallel trends characterize all of the sites in the sample, this chronological method should be used first for establishing site-specific sequences. In fact, it is at least logically possible that different communities acquired or consumed trade goods in somewhat different ways, and consequently discarded them in different ways or at different rates.

To smooth out some of the between-site differences evident in figure 12 and to enable regional comparisons, I assign each of the site-specific analytic units examined in this study to one of three broad regional time periods. The first includes units lacking trade goods and

therefore thought to pre-date 1625 or so. Stratigraphic, spatial, and radiocarbon data also were used to assess the ages of these contexts. The next regional period is made up of analytic units deposited during the seventeenth century. Site-specific units are assigned to this period based on stratigraphic and spatial data, along with the data on the composition and density of the associated trade goods assemblage. The third regional period includes units thought to have been deposited after 1700. Units assigned to this period generally contain numerous trade artifacts; in a few cases stratigraphic and other data were used to assign analytic units to this late group.

Depositional Context: Assessing Accumulation Duration

Investigators assign archaeological deposits encountered in the Heart River towns to one of three major classes: contained deposits, uncontained deposits, and mixed deposits. Contained deposits occur within discrete features, such as storage pits or small basins, and accumulated rapidly. Such contained deposits comprise discrete, basket-sized loads of domestic debris dumped into spoiled and abandoned pits. Artifacts in pits generally are larger than those recovered from other contexts, and are mixed with abundant ash, charcoal, faunal remains, and feces. Though their specific period of accumulation cannot be quantified, most large storage pits probably filled in a matter of weeks or months, given the hazards they would have presented for both children and adults. Geophysical data indicate that such features are scattered throughout each village; however, in most cases it is not possible to determine whether excavated pits originally were located inside or outside a house.

By contrast, uncontained deposits were laid down on open surfaces or in large borrow basins or trenches, including fortification ditches and house floors. The rate at which these deposits accumulated varied significantly. Many defensive features filled slowly, often through natural infilling, but domestic debris sometimes accumulated rapidly in borrow basins or catastrophically burned lodges. Some, but not all, midden mounds consist of primary refuse that

accumulated relatively rapidly. Artifacts in uncontained contexts often are smaller on average and occur in lower densities than artifacts in contained deposits. The matrix of uncontained deposits generally consists of a mixture of sediment, ash, and charcoal, interspersed with discrete basket loads of primary domestic debris. Unconformities—representing temporal gaps of unknown duration—occur more frequently in uncontained deposits, due to erosion and other processes.

Finally, mixed deposits incorporate artifacts and sediment from two or more primary or secondary depositional environments. Analytic units from mixed deposits are excluded from this study. The bulk of the chosen analytic units come from contained deposits, especially trash-filled, bell-shaped storage pits. Analytic units in the study sample from uncontained deposits include house floor fills and stratified middens composed of primary refuse.

Heart Region Sites

The stone tools, pottery, and other artifacts examined for this study come from six sites in the Heart River region (figure 13 and table 11). The oldest of the six, Bypass Village, dates to the first half of the 1400s. The largest settlement, Double Ditch Village, was founded in the late 1400s and was occupied until the 1780s (figure 14). Larson Village, a companion community located about 3.5 km north, was founded at the same time, but may have been abandoned somewhat earlier (figure 15). On-A-Slant Village (hereafter called "Slant Village"), like Double Ditch, was abandoned in the 1780s, but its founding date is less certain. Previous investigators thought it was established in the second half of the sixteenth century, but the ceramic analysis conducted for this project suggest that it may have been founded at about the same time as Larson and Double Ditch villages. The age of the fifth site, Scattered Village, is also somewhat uncertain, but it probably was established in the late 1500s and was abandoned about 1700. Of the six sites in the sample, the age and occupation history of Boley Village are the least

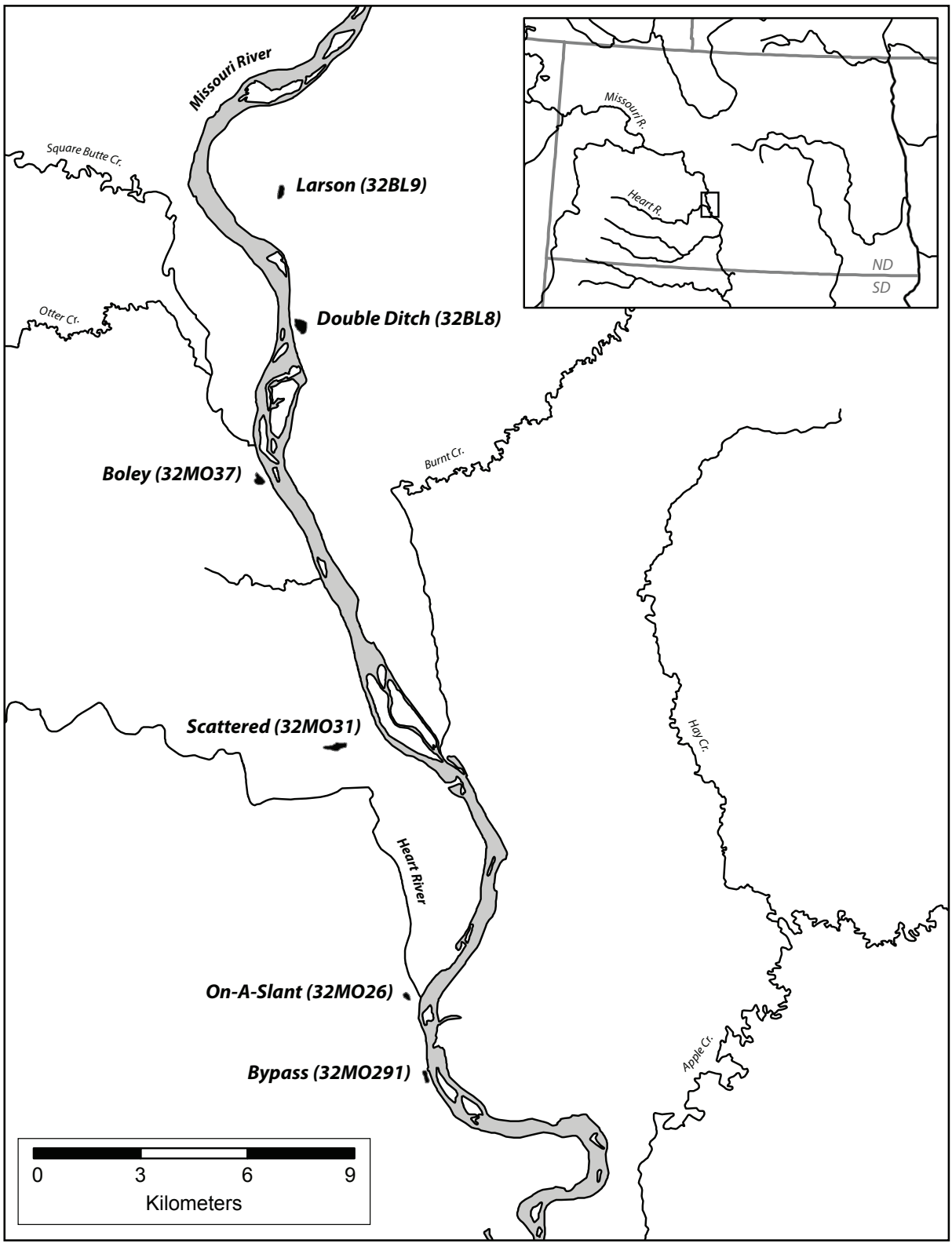

Figure 13. Map of the central Heart region showing the locations of sites included in the study.

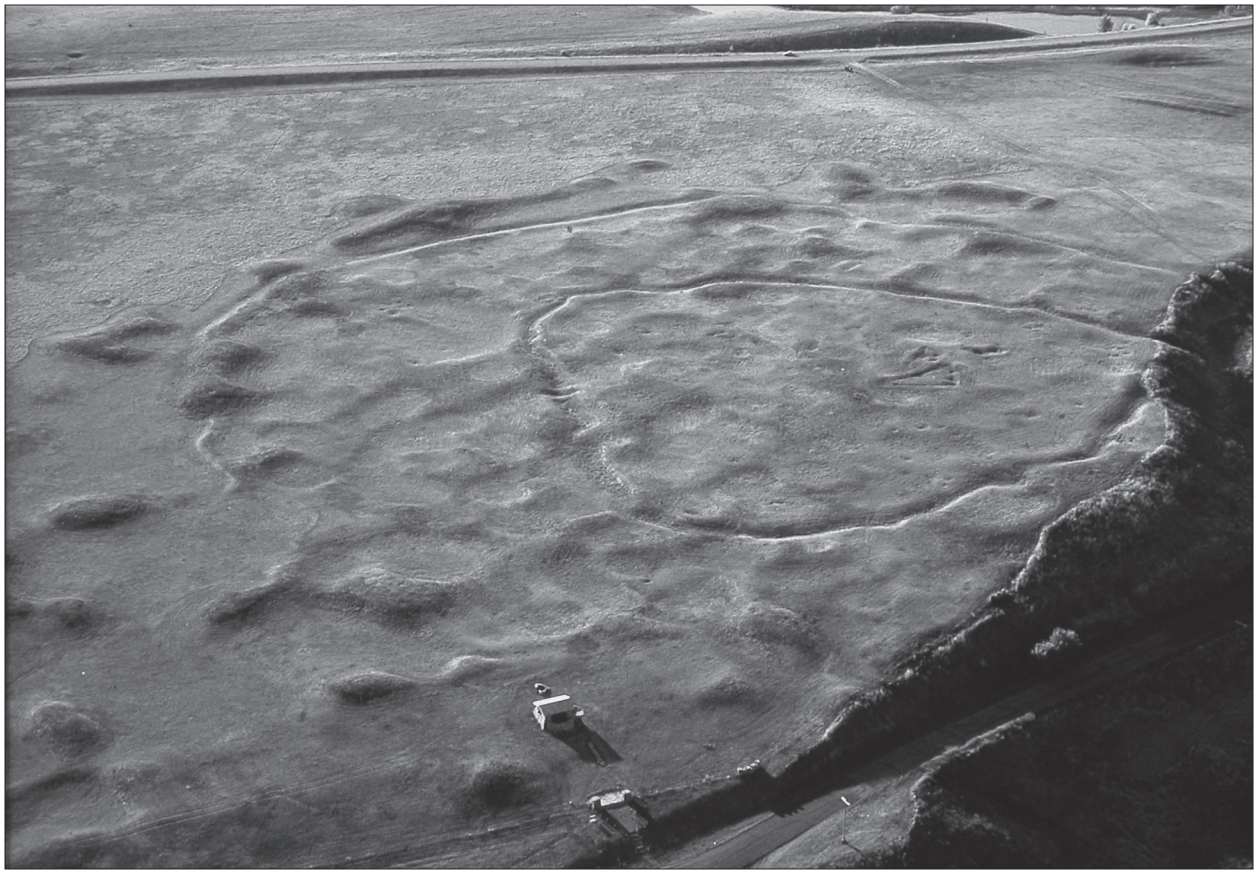

Figure 14. Double Ditch Village, looking to the southeast (photo by Russ Hanson, reproduced with the permission of the State Historical Society of North Dakota).

Table 11. Summary data on six Heart region study sites.

Site	Site Area (ha)[a]	Excavated Volume (cu. m)[b]	Primary Reference(s)
Double Ditch (32BL8)	9.7	93.8 (146.6)	Ahler, ed. 2003a, 2004, 2005
Scattered (32MO31)	n/a	42.8 (67.9)	Ahler, ed. 2002
Slant (32MO26)	3.4	12.6 (41.5)	Ahler, ed. 1997
Bypass (32MO291)	n/a	3.5 (n/a)	Ahler, Graham, and Metcalf, eds. 2000
Larson (32BL9)	5.1	12.0 (14.3)	Mitchell, ed. 2007, 2008
Boley (32MO37)	4.5	7.0 (12.2)	Ahler, ed. 2006

[a] Estimates from Swenson (2007) and Mitchell (ed. 2008).
[b] Excavated volume only includes analytic units assigned to a site-specific time period; the number in parenthesis is the total excavated volume, which includes deposits not assigned to a specific time period, disturbed deposits, and culturally sterile or pre-village deposits.

well understood. It likely was founded sometime in the 1500s and certainly was occupied in the 1700s. However, it seems to have undergone a substantial reorganization in the 1600s and

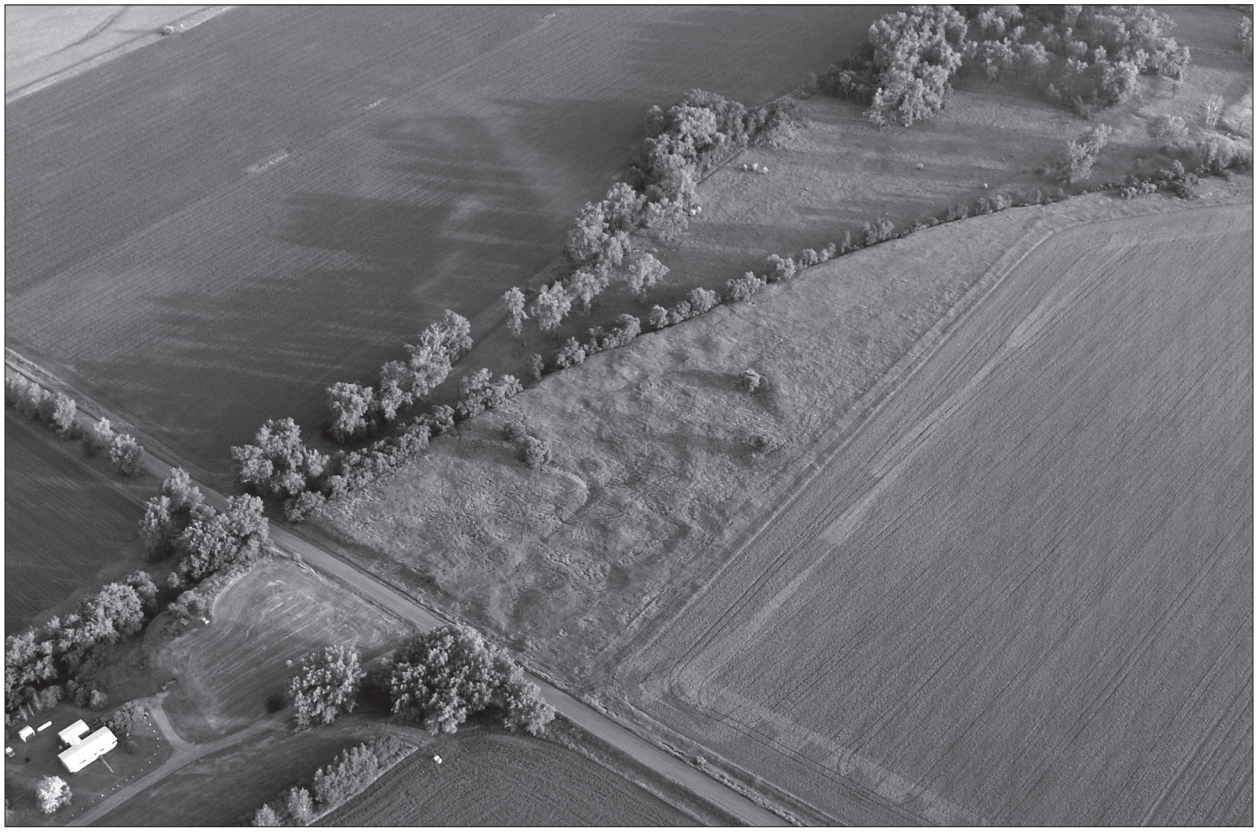

Figure 15. Larson Village, looking to the northwest (photo by Tommy Ike Hailey, reproduced with the permission of the State Historical Society of North Dakota).

could have been abandoned for a short period. Figure 16 illustrates each settlement's period of occupation. In this figure, the numbers in parentheses give the total volume in cu. m of excavated sediment assigned to each site-specific time period.

The Four-Site Subsample

A portion of the data used in this study is compiled from databases created during the original field and lab work carried out at each of the six sites in the Heart region sample; these data are used with the generous permission of the State Historical Society of North Dakota. Where appropriate, I cite specific interpretations made by the original investigators. In a few

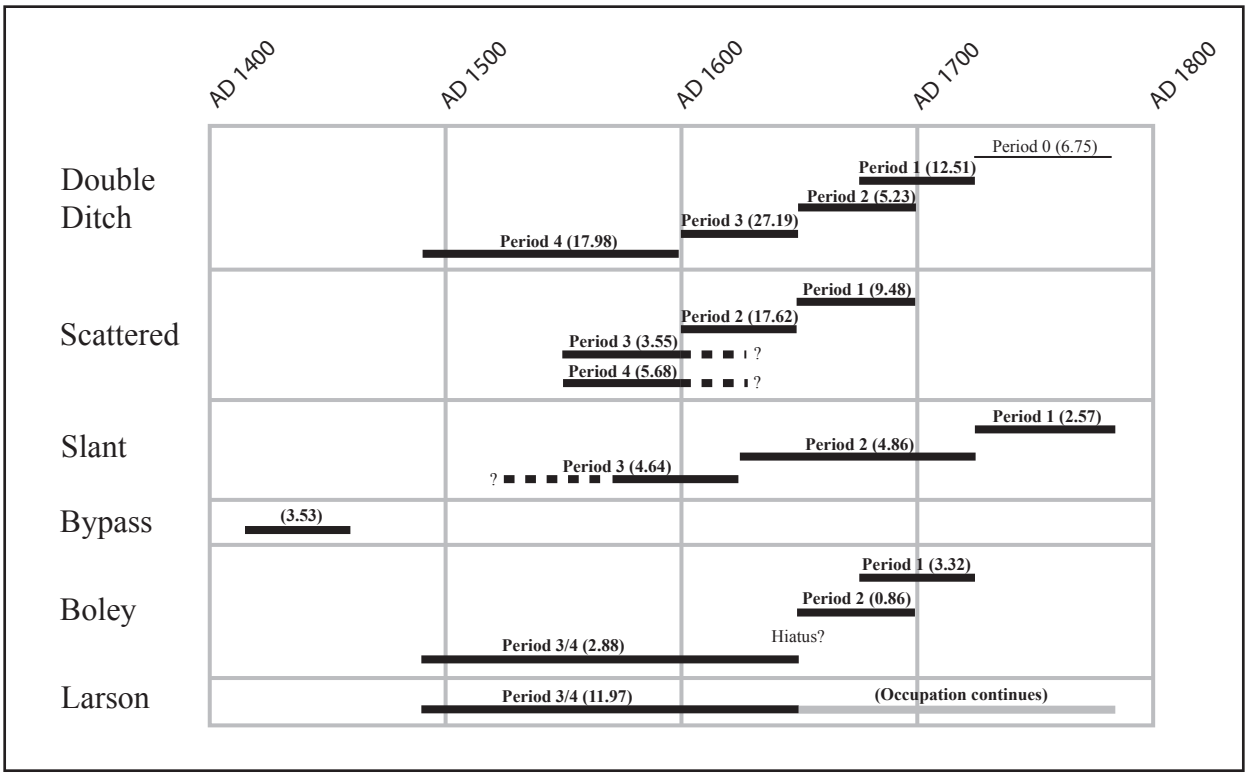

Figure 16. Temporal structure of the excavated samples from six Heart Region sites.

instances, I draw on published data from settlements in the Knife region. However, most of the interpretations I make in chapters 6 and 7 are based on new analyses of artifacts associated with a subsample of 80 analytic units from four Heart region sites—Bypass, Slant, Double Ditch, and Scattered villages. Tables 12 and 13 summarize temporal and depositional data on the analytic units included in this subsample. In all cases the units defined by the original investigator were used. However, the temporal assignments of several units from Scattered Village were adjusted to reflect data on the occurrence of bone tools exhibiting cutmarks made by metal tools, data that were made late in the project, after the chronological structure of the collection already was established (Ahler and Falk 2002:13.40-13.41).

In selecting analytic units for the study I considered chronological and depositional integrity as well as assemblage size, choosing analytic units with the most secure chronological

Table 12. Data on analytic units in the four-site subsample, organized by regional time period.

Site	Time Period	Number of Analytic Units	Total Volume (cu. m.)
Bypass	pre-1600	10	1.432
Double Ditch	post-1700	4	8.527
	1600-1700	11	14.610
	pre-1600	10	8.552
Subtotal		25	31.689
Slant	post-1700	5	2.007
	1600-1700	5	2.097
	pre-1600	9	2.896
Subtotal		19	7.000
Scattered	1600-1700	18	17.443
	pre-1600	8	4.100
Subtotal		26	21.543
Total		80	61.664

placement, the most well-defined stratigraphic relationships, and the largest associated assemblages. The inventory of study units was then adjusted slightly to achieve a spatially and temporally balanced sample. Details of the selection criteria I used, along with data on the age, size, and deposit type of the subsample units, are given in appendix 3.

The Modified Stone Assemblage

Table 14 lists sample size data on the stone tool and flaking debris assemblages making up the six-site sample. Stone tools and flaking debris aggregates not assigned to a site-specific time period are excluded, as are the few artifacts made from local, coarse-grained materials and unclassified materials. Various sampling strategies were used by the original investigators in their analyses of three of the collections to eliminate redundant or poorly controlled contexts. The Double Ditch Village assemblage only includes artifacts from “priority” or “select” contexts from the 2002 and 2003 field investigations (Ahler 2004). A similar sampling system was applied to the Scattered Village collection (Ahler 2002a). The Slant Village collection only includes artifacts recovered from “targeted” contexts (Ahler 1997). Assemblages from the other three villages include the complete collection of excavated artifacts. However, the tool counts reported

Table 13. Data on analytic units in the four-site subsample, organized by deposit type.

Site	Deposit Type	Number of Analytic Units	Total Volume (cu. m.)
Bypass	Pit	8	1.298
	Midden	2	0.134
Double Ditch	Pit	12	9.065
	Midden	6	12.912
	Midden and Earth	6	8.579
	Other	1	1.133
Slant	Pit	10	2.731
	Midden	5	2.472
	Floor/Roof	3	1.634
	Other	1	0.163
Scattered	Pit	18	11.161
	Midden	2	3.789
	Floor/Roof	5	6.459
	Other	1	0.134

in table 14 differ slightly from those reported by the original investigators because I used data collected during the detailed analysis of bifacial tools in the four-site subsample to adjust the counts of several stone tool classes in the larger six-site sample to account for minor differences

Table 14. Numbers of stone tools and waste flakes in the six-site Heart region sample. Includes stone tools in 11 technological classes in size grades 1 through 4; tools not assigned to a site-specific time period are omitted[a]. Flaking debris includes items in size grades 1 through 4; flakes made from local coarse and miscellaneous materials are excluded. Counts of size grades 1 through 3 flakes are actual counts; figures for size grade 4 flakes include estimates derived from sampling.

	Stone Tools[b,c]				Flaking Debris			
	Regional Time Period				Regional Time Period			
Site	post-1700	1600-1700	pre-1600	Total	post-1700	1600-1700	pre-1600	Total
Slant	263	694	289	1246	17648	41878	17739	77265
Scattered		3489	1127	4616		180131	48820	228951
Double Ditch	949	2453	768	4170	74399	234038	65407	373844
Boley		626	230	856		16717	11376	28093
Larson			1129	1129			54769	54769
Bypass			585	585			28133	28133
Total	1212	7262	4128	12602	92047	472764	226244	791055

[a] 20 tools from Boley, 30 from Double Ditch, and 131 from Scattered; two radial break tools (one each from Double Ditch and Scattered) are also omitted, as are 26 tools from Scattered assigned to a pre-Plains Village occupation.
[b] Count of size grade 4 tools from Double Ditch and Scattered include estimates based on sampling.
[c] Adjusted counts; adjustments affect technological classes 2 and 3 tools from Double Ditch; classes 1, 2, 3, and 12 tools from Scattered; classes 1, 2, and 3 tools from Slant; and classes 2 and 3 tools from Bypass; see text for additional information.

in the class definitions used by different analysts; a list of the affected classes is provided in the footnote to table 14. I also omitted two radial break tools from the sample, one each from Double Ditch and Scattered villages. In most cases, the flaking debris sample size data given in table 14 combine actual counts with estimates derived from sampling. In all cases, sampling is limited to size grade 4 fractions, but the extent to which it was used varies from site to site; details on specific sampling methods are provided in the site reports listed in table 11.

The numbers of bifacial tools in the four-site subsample are given in table 15. The 647 specimens from Scattered Village in the detailed study amounts to roughly 40 percent of the total inventory of bifaces from the site. The sample from Slant includes 54 percent of the total inventory while the sample from Bypass includes 58 percent. The proportion of the Double Ditch biface assemblage included in the detailed study sample cannot be calculated because technological class data only are available for a portion of the 2004 collection. However, the 1039 bifaces in the study sample probably amount to just over one-third of the total inventory.

I collected data on up to 37 variables for each of the 2,050 bifacial tools in the four-site subsample. These include eight provenience variables, 14 technological variables, ten metric variables, three morphological and functional variables, and two other variables. Because the scope of the original analyses varied, all existing data were systematically re-examined to check for accuracy, completeness, and congruency. A discussion of the specific analytic methods I used, along with descriptions of the variables considered, can be found in appendix 3.

Table 15. Number of bifacial stone tools in the four-site subsample; includes tools in three technological classes: small patterned bifaces, large patterned bifaces, and unpatterned bifaces in size grades 1 through 3 fractions.

	Time Period			
Site	post-1700	1600-1700	pre-1600	Total
Slant	69	120	46	235
Scattered		485	162	647
Double Ditch	250	519	270	1039
Bypass			129	129
Total	319	1124	607	2050

The Pottery Vessel Assemblage

Basic data on the ceramic assemblages from all six Heart regions sites are given in table 16. The bulk of the pottery data for this study come from new analyses of pottery vessels in the four-site subsample, though I also draw on prior analyses of assemblages from Larson and Boley villages. The vessels in the four-site subsample come from 71 of the 80 analytic units I used in the stone tool study; appendix 3 provides additional information on the selected units. Table 17 compiles counts of the numbers of vessels in the subsample subjected to detailed analysis, organized by site and grouped into the regional time periods defined previously.

I recorded data on up to 49 variables for each of the 1,685 vessels in the four-site subsample. These include seven provenience variables, four typological variables, 17 technological variables, and 21 variables related to aspects of form and decoration. As is true of a portion of the stone tool data, previous investigators had collected some data on a number of the variables examined in this study. However, because the definitions of several variables have shifted over time, I systematically examined each vessel to assess the consistency of the existing data. Definitions of the pottery wares and varieties found in the Heart region have shifted in particular, because each new project carried out there has documented unexpected variations in ceramic form (Ahler, Warner, and Smail 2002). For this reason, I recoded typological data on all of the vessels in the four-site subsample using a common set of type definitions, which are

Table 16. Summary data on the ceramic assemblages from six Heart region sites.

Site	Number of Body Sherds[a]	Number of Vessels
Double Ditch	263,079	4,619[b]
Scattered	174,305	1940
Slant	44,719	545
Bypass	9,898	197
Larson	31,399	502[c]
Boley	12,465	191

[a] Combines actual counts of size grades 1 and 2 sherds with actual counts and estimates of size grade 3 sherds.
[b] Classifiable rim sherds in size grades 1 and 2 from 2002 and 2003 high-priority contexts and all 2004 contexts.
[c] Classifiable rim sherds in size grades 1 and 2.

Table 17. Number of pottery vessels in the four-site subsample.

	Time Period			
Site	post-1700	1600-1700	pre-1600	Total
Slant	68	86	64	218
Double Ditch	336	316	204	856
Scattered		443	84	527
Bypass			84	84
Total	404	845	436	1685

described briefly in chapter 7. As a result, the ware frequencies reported here differ slightly from those reported by the original investigators. I also exclude vessels represented only by zone 3 rim fragments. For reasons I outline in appendix 3, this exclusion also affects the ware and variety frequencies reported here. Finally, while most of the technological variables are carried over from a pilot study of pottery from Boley Village (Ahler, Madden, and Mitchell 2006), due to subsequent changes in their definitions I have elected not to use the Boley data here. Additional information on the variables coded in this study can be found in appendix 3.

Chapter 6:

Crafting History, Part I: Stone Tool Production in the Heart Region, 1400-1750

How did the organization of craft production change in reponse to the shifts in settlement, subsistence, and trade sketched in chapter 4? What do these changes reveal about the economic and political connections among the Heart River towns? To answer these questions, I turn now to high-resolution data on the ways crafts were produced in the Heart region during the centuries spanning the advent of European trade goods. This chapter describes the manufacture of stone tools, focusing especially on spatial and temporal patterns in raw material selection, tool assemblage diversity, producer skill, and production techniques. The next chapter compares and contrasts these patterns with patterns in the organization of pottery production.

Previous Research on Northern Middle Missouri Lithic Technology

Because the results described in this chapter build directly on prior research, I first highlight certain features of the methods previous investigators have used and summarize aspects of their findings. The discussion begins with Ahler's (1975a, 1975b) study of stone tool and flaking debris assemblages from two Extended Coalescent sites in the Grand-Moreau region, the single most important study of Middle Missouri lithic technology. His pioneering work established the basic methodology used for virtually every subsequent project, including this one.

Ahler's approach features a comprehensive attribute-based system that allowed him to isolate and compare the functional, technological, and morphological characteristics of the tools in his sample. The backbone of his analysis is a functional classification based on tool morphology and use wear traces, but he also devised a technological classification based on production attributes. Each technological class represents a distinct production pathway or manufacturing trajectory defined by a sequence of stages and a set of techniques. For

instance, artifacts classified as patterned, small, thin bifacial tools are produced by controlled and sequenced bifacial pressure flaking applied to small flake blanks. Functionally, tools in this technological class can include arrowpoints, drills, and small cutting tools. Another class, unpatterned groundstone tools, is produced by pecking or grinding, but not by flaking, using a variety of raw materials. Tools in this class include hammerstones, anvils, or abrading tools lacking patterned morphology. Ahler derived his class definitions from a series of replication experiments (Ahler 1971, 1975b, 1992; Callahan 1979). Table 18 gives brief descriptions of the classes used in this study and figures 17 through 20 illustrate representative examples. Additional

Table 18. Stone tool technological class definitions.

Technological Class	Description
Small patterned biface	Produced by controlled and sequenced pressure flaking on small, thin flake blanks. When finished, artifacts in this class exhibit continuous bifacial retouch and are symmetrical in plan view and cross section. Includes arrow points, drills, and small cutting tools.
Large patterned biface	Produced by controlled and sequenced percussion flaking on various blank types. Symmetrical in plan view and cross section. Pressure flaking also is used, which sometimes obliterates evidence of earlier manufacturing stages. Includes dart points and hafted and unhafted bifacial cutting tools.
Unpatterned biface	Produced by hard hammer percussion on tabular, pebble, or flake blanks; pressure flaking is used only rarely. Tools in this class are not symmetrical and often exhibit discontinuous bifacial edging.
Patterned flake tool	Produced by pressure flaking on flake or tabular blanks. Patterned flake tools exhibit plano-convex cross sections, but are bilaterally symmetrical in plan view. Includes hides scrapers; a few hafted beak tools designed for wood or bone working also are included in this class.
Unpatterned flake tool	Produced by use-flaking or pressure-flaking on a flake blank. Edge modification is highly variable and may be discontinuous. Unpatterned flake tools lack symmetry. Includes a wide variety of tools used for many different tasks.
Large bifacial core tool	Produced by free-hand percussion on large cobble blanks of coarse material. Tools are only minimally shaped and the cutting edge outline often is sinuous. Includes choppers, planes, and other unhafted tools.
Non-bipolar core	Produced by free-hand, nonbifacial percussion on various blank types. May be irregular or symmetrical. Includes cores and tested cobbles.
Bipolar core/tool	Produced only or mainly by bipolar percussion. Irregular in plan view and cross section. Includes cores used for flake production, punches or wedges fractured during use, and tested cobbles.
Unpatterned groundstone	Produced by pecking or grinding or formed by use on various blank types. Irregular in plan view and cross section. Includes abrading tools, hammerstones, and bipolar anvils.
Patterned groundstone	Produced by pecking or grinding on various blank types. Blank form is substantially modified during the shaping process. Includes abrading tools, celts, mauls, pipes, beads and other decorative items.
Retouched plate tool	Produced by free-hand percussion flaking and pressure flaking on tabular or platy blanks. Tools in this class may exhibit unifacial or bifacial edging, but generally are asymmetrical in plan view. Includes a wide variety of tools used for many different tasks.

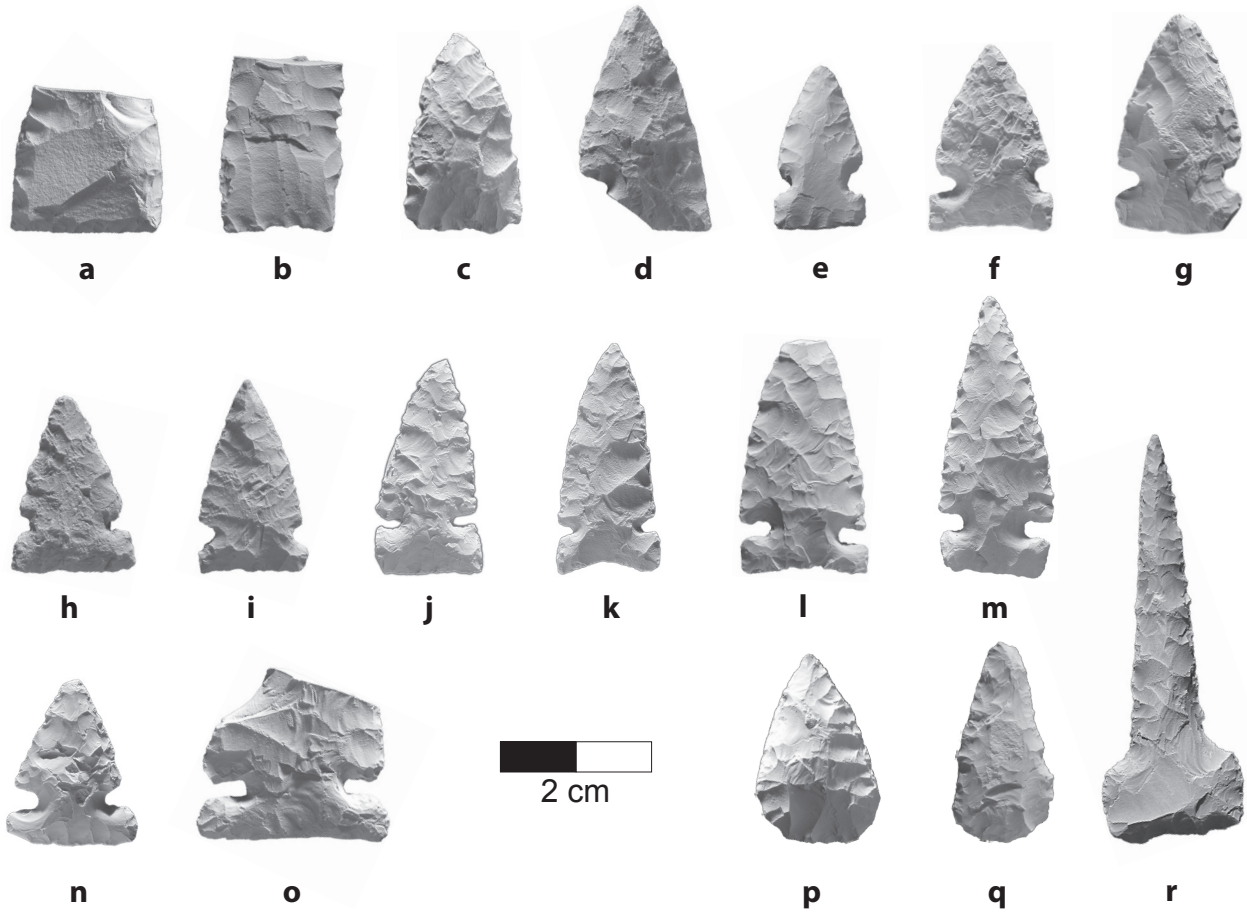

Figure 17. Small patterned bifaces (technological class 1); a-d: broken during manufacture; n: recycled arrowpoint; o: bow-lance point; p, q: cutting tools; r: drill; a-e, h, i, l, m, o-r: from Double Ditch Village; f, g, j, k, n: from Boley Village (adapted from Ahler, Burns, and Madden 2005; Ahler et al. 2005).

information on the classification can be found in Ahler, Root, and Feiler (1994), Ahler and others (2004), Root and others (1999), and in appendix 3.

In his Extended Coalescent study, Ahler found significant between-site technological differences, which he thought reflected unequal access to different raw materials. Flintknappers living at the Lower Grand site appear to have performed many of the initial stages of tool production away from the village, while those living at Walth Bay performed more of this work in the village, using local materials (Ahler 1975a:346-347). He also documented marked

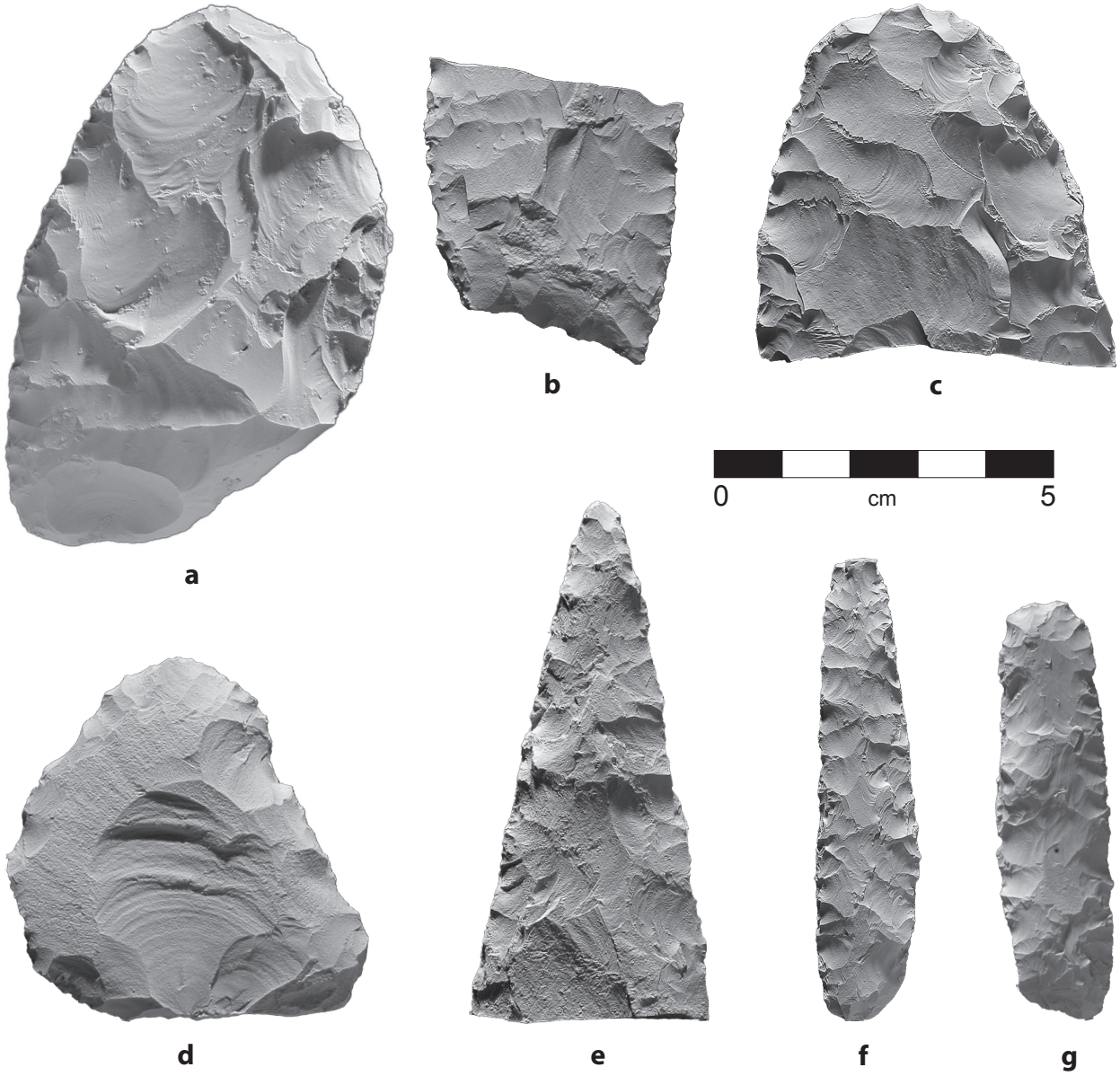

Figure 18. Large patterned bifaces (technological class 2); c, d: broken during manufacture; a: from Boley Village; b-g: from Double Ditch Village (adapted from Ahler, Burns, and Madden 2006; Ahler et al. 2005).

between-site functional differences, which, along with technological and other differences, he argued cast doubt on the widely held view that an equivalent set of activities was carried out at every village in the Middle Missouri and that they were therefore economically and politically

autonomous (Ahler 1975a:361). Finally, his study identified inter-household differences at the Walth Bay site, in the form of caches of unfinished tools, which among other things suggested to him the possibility that specialists produced some tools (Ahler 1975a:346).

Ahler also pioneered the use of what is now generally called aggregate analysis to study the technological characteristics of flaking debris assemblages. Aggregate analysis relies on observations on the attributes of debris samples, rather than of individual flakes (Ahler 1975a:30, 1989a; Hall and Larson 2004). The specific approach Ahler took, which he called mass analysis, uses counts and weights of size-graded debris assemblages to estimate the mix of technological processes responsible for a particular aggregate. As with the definition of stone tool technological classes, the interpretation of mass analysis data is based on controlled replication experiments (Ahler 1989b). Ahler's analysis of debris aggregates from Lower Grand and Walth Bay reveals the presence of localized activity areas within sites and buttresses the stone tool data showing significant between-site differences in reduction strategies. The idea that specialists were responsible for a portion of the tool assemblage is not well supported by the mass analysis data, although interpretation is hindered by differences in the recovery methods used in different site areas.

Ahler recognized that chipped stone raw material selection affected the patterns of technological variation he documented. In his Extended Coalescent study he considered raw material variation to be an aspect of stylistic variation, but in a subsequent study he linked raw material selection to what he called "culturally imposed patterns of resource exploitation" (Ahler 1977b:147). Comparing data on tools and flaking debris from four adjacent settlements on the Missouri in northern South Dakota, Ahler showed that the lithic resource utilization patterns of Middle Missouri tradition communities differed fundamentally from those of their Coalescent tradition contemporaries. Specifically, Middle Missouri communities used more Knife River flint from western North Dakota, while Coalescent tradition communities made greater use of toolstone sources to the south and west. Though he declined to offer a specific

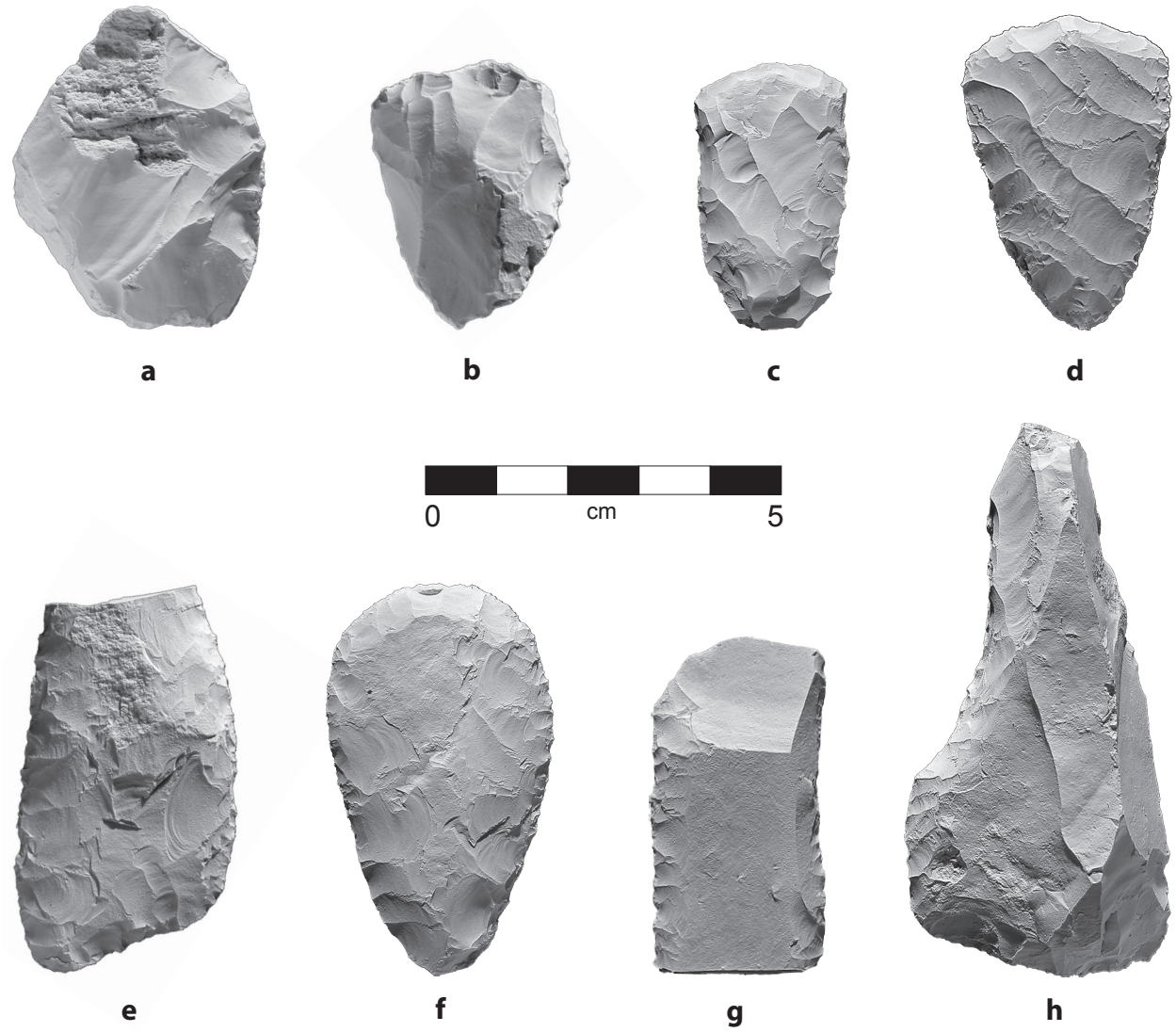

Figure 19. Stone tools; a, b: unpatterned bifaces (technological class 3); c, d, f: scrapers (technological class 4); e: large patterned biface (technological class 2); g, h: unpatterned flake tools (technological class 5); a, b: from Boley Village; c-h: from Double Ditch Village (adapted from Ahler, Burns, and Madden 2006; Ahler et al. 2005).

explanation for this pattern he did note that it was both widespread and persistent. He also noted that raw material usage patterns were expressed differently in different technological classes and suggested that those differences could reflect gender-specific "spheres of activity" (Ahler 1977b:148).

Several investigators have pursued this line of research further. Craig Johnson's (1984) analysis of stone tools from nineteen Plains Village sites supports Ahler's overall conclusion that Middle Missouri and Coalescent tradition communities exploited distinct resource zones, but he also documents other aspects of inter- and intra-tradition variation. He shows, for instance, that in contrast to Initial Middle Missouri communities that relied consistently on KRF, use of that stone by Extended Middle Missouri communities declined with distance from the primary quarry area (see also Johnson 1984, 1999, 2007b). He argues, too, that the patterns of landscape use signified by lithic raw material differences represent long-term historical patterns (Johnson 1999:72). Similarly, for the Big Bend region of central South Dakota, Dennis Toom (1984) documents differences between Initial and Extended Coalescent lithic assemblages indicative of a shift in landscape use over time. In contrast to Initial Coalescent raw material use, represented by a small assemblage from the Whistling Elk site, Extended Coalescent groups made much greater use of local raw materials, a shift indicative of the latter's greater familiarity with local resources.

In the late 1970s and 1980s, Ahler and other researchers applied the basic methods he developed for his study of Extended Coalescent lithic technology to numerous collections from the Knife River region. The most important Knife region datasets come from Big Hidatsa and Lower Hidatsa villages, two large settlements with complex occupation histories located near the mouth of the Knife River in the Knife River Indian Villages National Historic Site (KNRI), and from the White Buffalo Robe site, a multicomponent settlement a short distance downstream (Ahler and Swenson 1985a; Ahler and Weston 1981; Lovick 1980). Ahler and Toom (1993) integrate and summarize data from these and other Knife region sites.

In addition to the questions Ahler broached in his Extended Coalescent analysis, work in the KNRI also considered several other topics relevant to the study of the organization of stone tool production. One of the most informative was an analysis of the spatial and temporal distribution of heat treatment of stone tool raw materials. Heat treatment improves the

performance of many raw materials, but it also represents an additional step in the production process, one that requires specialized knowledge. KNRI investigators also sought to assess the impact of the introduction of metal tools during the seventeenth century on the technological and functional characteristics of chipped stone assemblages. Overall, research in the KNRI focused mostly on temporal patterns, rather than on the kinds of spatial patterns that structured the Extended Coalescent work, although some attention was given to between-site differences.

Data from the Knife region reveal significant changes in raw material use over time. In the 1200s, Extended Middle Missouri communities (known in the Knife region as the Clark's Creek phase) made extensive use of Knife River flint from the primary quarries. They also used stone from distant sources located to the west. In the 1300s, Extended Middle Missouri flintknappers began making greater use of southern, downriver sources, a pattern that became more prominent in the 1400s and 1500s. About 1600, Knife region communities reverted to their thirteenth-century emphasis on Knife River flint and western sources. In the late eighteenth and nineteenth centuries, local raw materials became increasingly important. Ahler and Toom (1993) attribute these patterns to changing relationships with distant groups, to changing land use, to the migration into the Knife region of two Hidatsa subgroups, and, for the latest period, to constraints competing groups imposed on Hidatsa mobility.

The study of heat treatment in Knife River flint tools reveals both temporal and spatial patterns. Heat treatment is comparatively uncommon in Extended Middle Missouri assemblages in the Knife region, but increases steadily afterward. Ahler and Toom (1993) hypothesize that this pattern was a result of interaction between Hidatsa communities on the Knife and Mandan communities in the Heart region. Marked and persistent differences also exist between Knife region assemblages, a pattern Ahler and Toom (1993:254) believe points to the existence of localized "technological subtraditions."

Finally, KNRI data indicate that the initial introduction of metal tools had only minor effects on stone tool technology, though more substantial changes took place in the 1700s as

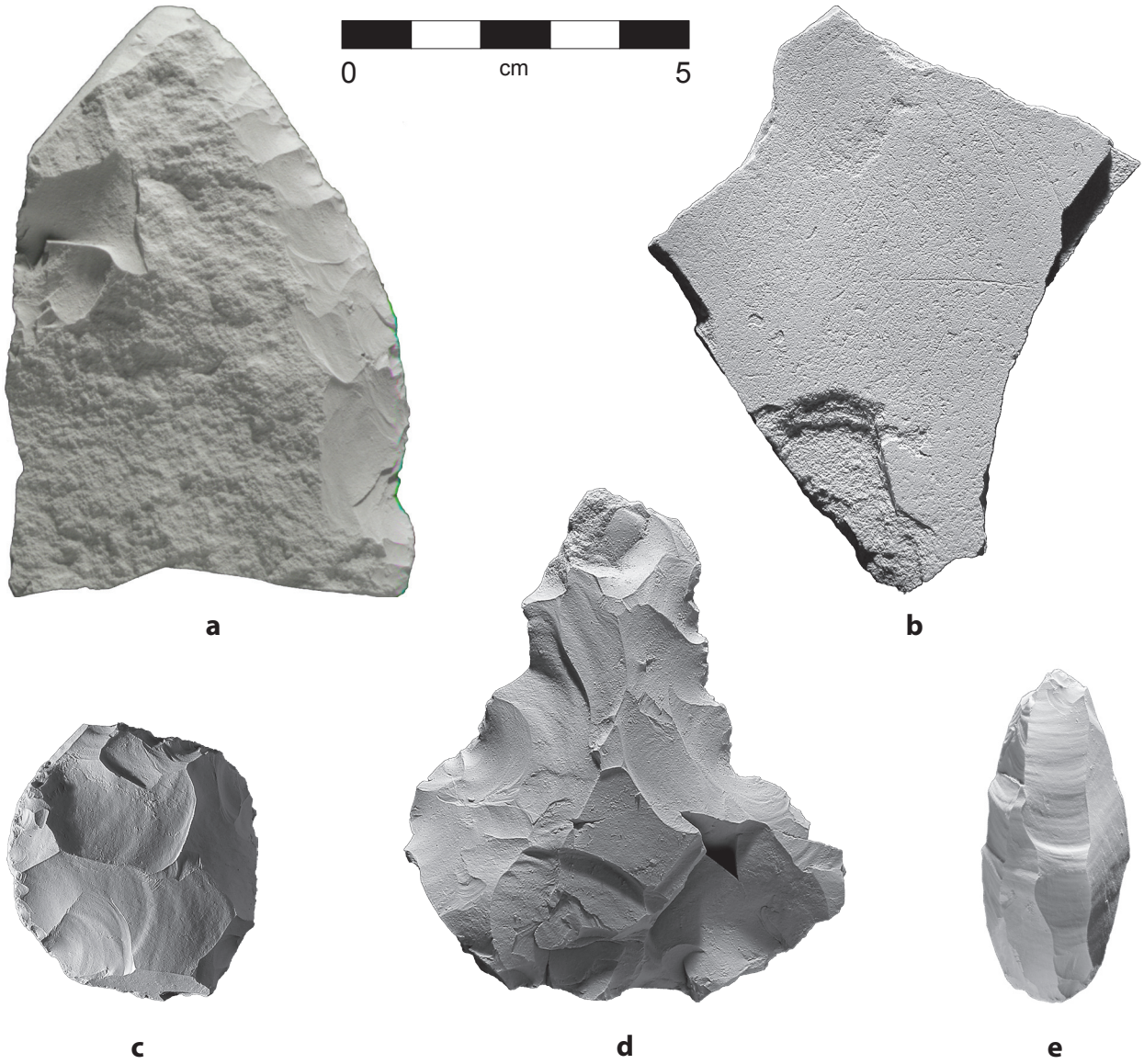

Figure 20. Stone tools; a: retouched plate tool (technological class 12); b: unpatterned groundstone tool (technological class 9); c, d: non-bipolar cores (technological class 7); e: bipolar core/wedge (technological class 8); a-d: from Double Ditch Village; e: from Boley Village (adapted from Ahler, Burns, and Madden 2006; Ahler et al. 2004; Ahler et al. 2005).

European trade goods became more common. At that time, simple, unpatterned tools became more common, along with tool forms "indicative of marginal knapping skills/interests" (Ahler and Toom 1993:255). Tool recycling also became more evident in the 1700s. However, it was not

until the closing decades of the eighteenth century that a major transformation occurred. After the pandemic of the early 1780s, the frequency of small patterned chipped stone tools steadily declined. In the nineteenth century, flaked stone technology disappeared almost entirely, although the production and use of groundstone tools continued.

Several major investigations of raw material procurement strategies and tool production modes have been carried out at quarry sites in the Knife River flint primary source area (Ahler 1986; Root 1992). This work documents the tremendous amount of labor people expended to obtain the high-quality material available there. The extent and depth of many quarry pits suggests that sizeable cooperative work parties mined flint. Matthew Root's (1992) analysis of production rates and production efficiency, along with other data, indicate that part-time specialists produced KRF tools for exchange during the Paleoindian and Late Archaic periods. No direct evidence for this type of production by Plains Village groups has been documented in the primary quarry area, but the sample of excavated contexts dating to this time period is modest. Ahler and Julieann VanNest (1985) argue that Plains Village reduction strategies were less specialized than those of earlier groups.

Research in the primary quarry area also focused on the evaluation and further development of mass analysis techniques. Archaeological analysis, coupled with experimental studies, showed that the ratio of size grade 4 flakes to size grades 1 through 3 flakes is particular useful for measuring technological variation in debris assemblages (Ahler 1986). However, work on quarry and workshop collections also demonstrated that the problem of technologically mixed assemblages is more serious than Ahler originally believed (Root 2004). To tackle this problem many investigations now combined mass analysis with individual flake analysis.

In the Heart region, technological classification of stone tool and flaking debris assemblages began in the 1990s with an analysis of a collection recovered from Slant Village during excavations carried out by the University of North Dakota in 1980 (Ahler, Minor, and Smail 1997). This work integrated methods previously used in the KNRI work with those used in

the Knife River flint studies as well as several other projects undertaken in 1980s. The analyses considered many of the questions that framed the KNRI investigations, including patterns of raw material use and the use of heat treatment. To gauge differences between Mandan and Hidatsa technological traditions the investigators also paid special attention to differences between technological practices represented by the Slant Village assemblage and those represented by assemblages from Big Hidatsa and Lower Hidatsa villages.

A comparison of raw material utilization patterns indicates that the Mandans at Slant Village and the Hidatsas at the Knife River villages made use of largely mutually exclusive territories, with the Hidatsas exploiting a broad region to the west and the Mandans exploiting an adjoining region to the west and southwest. Overall, the Mandans made greater use of exotic tool stone, likely reflecting their wider connections with mobile groups living away from the river. Ahler, Minor, and Smail (1997) also documented technological differences between the Slant assemblage and the KNRI assemblages. Flintknappers at Slant Village produced more arrowpoints and bipolar tools and used more heat treated stone. Hidatsa flintknappers, by contrast, produced more flake tools and scrapers.

Within the Slant Village assemblage, the analysis documented strong material type preferences for certain technological operations. Smooth gray TRSS was selected for early-stage core reduction by percussion flaking and was preferred for unpatterned, expedient flake tools. KRF was preferred for the production of patterned tools produced by pressure flaking. By contrast, Hidatsa flintknappers used KRF for a much broader range of technological operations. The investigators also documented a strong temporal shift in raw material usage, from smooth gray TRSS to KRF, a shift they believed represented increased interaction over time with the Hidatsas at Knife River. Later in this chapter I examine these interpretations in more detail.

Overall, the results of these projects demonstrate that northern Middle Missouri modified stone assemblages were technologically heterogeneous. This heterogeneity is expressed at several different scales. Patterns of lithic raw material utilization reflect durable differences

between archaeological traditions in access to different resource areas, differences that are likely connected to long-term land use histories. Between-community differences in the organization of production suggest differences in access to raw materials, economic differences, or the localization of certain types of production. Within-community variation suggests that households may have produced different types of tools or that production was affected by a variety of social factors, such as gender, age, or status.

Raw Material Selection

Craft production begins with the procurement of raw materials; any characterization of the organization of production must therefore begin with an assessment of how and where those materials were obtained. Source analysis is relatively straightforward for the Heart region because many of the materials flintknappers working there used are both visually distinctive and occur in relatively well-defined localities. Archaeologists have identified 29 different types of toolstone in the six Heart region assemblages considered here, but to simplify inter-assemblage comparisons I collapse these 29 types into five raw material groups (table 19). (For clarity, I omit from the analysis locally available, poor-quality raw materials such as metaquartize, granite, and basalt. Flakes made from these materials amount to just 1 or 2 percent of the debris assemblage from each site). Each raw material group is defined by the direction of and distance to their principal source areas. Locations of the most important sources are illustrated in figure 21.

Near-local raw materials include those that can sometimes be found in surface lag or

Table 19. Heart region raw material groups and raw material types.

Raw Material Group	Constituent Raw Material Types
Near-Local Southwest	Smooth gray Tongue River silicified sediment; gray silcrete
Near-Local West	Yellow/brown chalcedony; clear/gray chalcedony; brown chalcedony; silicified wood
Near-Local Northwest	Knife River flint
Exotic Southwest	Orthoquartzite; jasper/chert; dendritic chert (Hartville); plate chalcedony; White River Group silicate
Exotic West	Porcellanite; obsidian; moss agate; nonvolcanic natural glass; Rainy Buttes silicified wood

Figure 21. General locations of chipped stone raw materials used by Heart region flintknappers.

alluvial deposits within a few km of the Heart River towns, but that are most abundant 30 to 80 km away (Ahler et al. 2002:12.6). Locally available pieces often are small; larger, higher-quality pieces can generally be obtained from more distant locations. Heart region flintknappers had access to three such near-local groups, each with its own largely exclusive spatial distribution.

The Near-Local Southwest group consists mainly of smooth gray Tongue River silicified sediment (TRSS), an opaque stone superficially similar to fine-grained quartzite that derives from the Rhame Bed of the Bullion Creek formation (Ahler 1977a; Keyser and Fagan 1987; Root et al. 1999). Coarse silcrete, a geologically related material exhibiting moderately conchoidal fracture, is also included in this group. The only documented TRSS quarry locality is in northwestern South Dakota (Keyser and Fagan 1987), although it is certain that high-quality TRSS can be found across a broad area west and south of the Heart region (Ahler 1977a), perhaps including localities within a few km of the villages on the Heart (Ahler et al. 2002:12.3).

The Near-Local Northwest group is made up exclusively of Knife River flint (KRF), a dark brown translucent stone with excellent flaking properties (Ahler 1977a, 1986; Clayton, Bickley, and Stone 1970; Root et al. 1999). Extensive KRF quarries, often described as the primary source area, are located some 80 to 100 km west-northwest of the Heart region. KRF also occurs as smaller pieces in surface lag and alluvial deposits just 30 km west of the villages at the Heart, as well as in alluvial gravels along the Missouri, extending as far south as Buffalo County, South Dakota (Ahler 1995; Clayton, Bickley, and Stone 1970). Michael Gregg (1987) also reports the occurrence of small but usable KRF cobbles in several portions of eastern North Dakota. KRF from this region exhibits a distinctive cortex; however, no study of KRF cortex morphology has yet been undertaken in the Heart region.

The third near-local group (Near-Local West) includes a suite of apparently geologically related materials, including silicified wood and translucent, gray, yellow, and brown chalcedonies, that can be found in surface lag deposits in parts of southwestern North Dakota and northwestern South Dakota, and in alluvial deposits on the tributaries of the Heart, Little Heart, and Cannonball rivers. The distribution of these materials overlaps to some extent with those of KRF on the north and TRSS on the south and east. Some of the materials included in the Near-Local West group grade into KRF, creating the possibility of misclassification for a small fraction of the collections considered in this study. Together, the three near-local groups make up the vast

majority of the raw material Heart region flintknappers used.

In contrast to near-local raw materials, exotic materials only can be obtained from sources much farther away to the west and southwest. Exotic materials from western sources in present-day Montana, northern Wyoming, and western North Dakota include porcellanite, moss agate, non-volcanic natural glass, and obsidian (Ahler et al. 2002). A second exotic raw material group combines toolstone from sources to the southwest, including cherts and orthoquartizes from the Hartville Uplift in eastern Wyoming (Reher 1991) and from the Black Hills in Wyoming and South Dakota (Ahler 1977a). These materials also show up in Missouri River gravels below the mouth of the Cheyenne River (Johnson 1984). Some orthoquartzites also could derive from western sources, but are conventionally included in the southwestern group because they occur more commonly there (Ahler et al. 2002). Plate chalcedony and White River Group silicates from the Big Badlands of southwestern South Dakota and northwestern Nebraska round out the Exotic Southwest group. Distances to these exotic sources range from as little as 200 km to as much as 800 km.

Table 20 tallies data on the proportions of each of the five raw material groups present in the six flaking debris assemblages. Both synchronic and diachronic patterns are evident. First, the extent to which contemporaneous communities used different sources varies. For instance, among pre-1600 contexts, flaking debris from Near-Local Southwest sources varies from as much as 59 percent of the Bypass Village assemblage to as little as 15 percent of the Scattered Village assemblage, even though these two villages only are about 10 km apart and both are likely close to suitable quarry areas. Interestingly, the frequency of TRSS at Larson Village is also high, despite the fact that it is located farther than any of the other six settlements from likely TRSS quarries, albeit only slightly. Similarly, in the pre-1600 sample Near-Local West toolstone, primarily silicified wood, ranges from less than 7 percent at Bypass Village to more than 22 percent at Boley Village. The frequencies of exotic materials vary even more. Across all time periods, Exotic West sources account for less than 1 percent of the flaking debris at nearly

Table 20. Composition of flaking debris assemblages from six Heart region sites, organized by regional time period.

		Raw Material Group					
Site	Time Period	Near-Local SW	Near-Local West	Near-Local NW	Exotic SW	Exotic West	Total
Bypass	pre-1600	58.6%	6.9%	33.5%	.1%	.8%	28133
Larson	pre-1600	39.3%	12.4%	47.2%	.8%	.3%	54769
Boley	1600-1700	6.3%	27.6%	51.0%	5.3%	9.8%	16717
	pre-1600	21.2%	22.4%	43.3%	10.0%	3.2%	11376
Double Ditch	post-1700	13.6%	6.4%	78.4%	1.2%	.4%	74399
	1600-1700	18.6%	7.6%	72.0%	1.6%	.3%	234038
	pre-1600	32.3%	7.6%	58.1%	1.7%	.3%	65407
Scattered	1600-1700	18.5%	16.0%	57.1%	6.8%	1.7%	180131
	pre-1600	15.6%	14.1%	60.8%	8.6%	.9%	48820
Slant	post-1700	26.1%	12.6%	55.7%	4.9%	.7%	17648
	1600-1700	29.0%	11.6%	53.5%	5.2%	.8%	41878
	pre-1600	38.3%	9.8%	45.9%	5.4%	.6%	17739
Total		180692	87885	486478	28572	7458	791055

every village except Boley, where they make up almost 10 percent of the seventeenth-century assemblage. Exotic Southwest stone varies from 0.1 percent in the pre-1600 assemblage from Bypass Village to 10 percent in the pre-1600 assemblage from Boley Village.

Some of these raw material utilization patterns remained stable over time. The frequencies of flakes of exotic stone at Double Ditch and Slant villages vary within narrow limits, though they are roughly three times as common at Slant. Similarly, the use of Near-Local West stone at Double Ditch is relatively constant. However, several temporal trends are evident as well. The use of smooth gray TRSS (Near-Local Southwest group) steadily decreases at both Slant and Double Ditch villages, concurrent with an increase in the frequency of KRF. An even more dramatic drop in the use of smooth gray TRSS is apparent at Boley. By contrast, the Scattered Village assemblage exhibits the opposite trend, with the proportion of smooth gray TRSS increasing slightly over time at the expense of KRF. At Slant Village, the increasing importance of KRF was accompanied by an increase in the use of Near-Local West materials, but at Double Ditch the use of those materials remained low. Given the distribution of these two materials, this difference suggests that these two villages may have obtained their KRF from

different source areas.

These raw material use patterns can be explored further by comparing the frequencies in table 20 with the frequencies of each raw material group used to produce bifacial tools in the four-site study sample (table 21). It should be noted that a size-dependent classification bias can affect such a comparison (Ahler 1977a; Ahler, Minor, and Smail 1997:268; Ahler 2002b). Because most of the flaking debris is relatively small it sometimes cannot confidently be assigned to a particular material type. By contrast, material type assignments are more accurate for chipped stone tools because they generally are larger. However, many of the specific sources most subject to misclassification are grouped here into the same raw material group. Investigators have observed several instances of between-group misclassification (Ahler 2002b),

Table 21. Distribution of raw material groups across three artifact classes organized by site. Data from all time periods combined. Shading indicates data discussed in text.

		Artifact Class		
Site	Raw Material Group	Flaking Debris	Small Patterned Biface	Large Patterned Biface
Slant	Near-local SW	30.5%	33.9%	30.8%
	Near-local West	11.4%	17.9%	11.2%
	Near-local NW	52.3%	37.5%	54.2%
	Exotic SW	5.2%	8.0%	3.7%
	Exotic West	.7%	2.7%	0%
Subtotal		77265	112	107
Scattered	Near-local SW	17.9%	16.0%	12.9%
	Near-local West	15.6%	44.9%	18.2%
	Near-local NW	57.9%	27.7%	60.4%
	Exotic SW	7.1%	7.8%	5.7%
	Exotic West	1.5%	3.5%	2.8%
Subtotal		228951	256	318
Double Ditch	Near-local SW	20.0%	21.8%	21.3%
	Near-local West	7.4%	8.4%	5.2%
	Near-local NW	70.9%	66.8%	70.9%
	Exotic SW	1.5%	1.8%	2.1%
	Exotic West	.3%	1.2%	.5%
Subtotal		373844	509	422
Bypass	Near-local SW	58.6%	59.3%	59.0%
	Near-local West	6.9%	5.6%	11.5%
	Near-local NW	33.5%	24.1%	23.0%
	Exotic SW	.1%	1.9%	6.6%
	Exotic West	.8%	9.3%	0%
Subtotal		28133	54	61

but these do not appear to affect the overall patterns expressed in table 21.

Two patterns are evident among the three near-local raw material groups. First, in most cases, the proportions of each material are roughly constant across all artifact classes, suggesting that flintknappers made equal use of the raw materials available to them for producing different types of tools. This is most apparent in the Double Ditch assemblage. However, in two cases, highlighted by shaded rows in top two registers of table 21, clear raw material preferences are evident. At Scattered Village, flintknappers preferred Near-Local West raw materials for the production of arrowpoints but favored KRF for making knives and other large bifaces. The same patterns are evident, though somewhat less prominent, at Slant Village. The significance of these preferences is not clear, but they could indicate that flintknappers in different communities obtained raw materials in different ways. Alternatively, they may indicate that, in some communities, different producers—who had access to different kinds of raw materials—produced different types of tools.

Patterns in the use of exotic raw materials are more complex. In several cases, exotic toolstone is less common in flaking debris assemblages than it is in tool assemblages. Classification bias could play a role in these differences. However, they also could indicate that tools made from exotic raw materials were obtained through trade in finished or nearly finished form. This interpretation may explain the especially marked differences evident in the Bypass Village collection (shaded rows in bottom register in table 21). However, the fact that, in the four-site subsample, unfinished, discarded arrowpoints made from exotic stone are nearly as common, overall, as unfinished arrowpoints made from near-local sources suggests that Heart region flintknappers acquired exotic toolstone, whether through trade or direct procurement, mainly in the form of partially finished blanks rather than as finished tools.

In addition to these patterns, flaking debris data collected by other investigators show that Heart region flintknappers acquired and used the two most abundant raw materials—smooth gray TRSS and KRF—in different ways (Ahler et al. 2003; Ahler et al. 2002; Ahler and Smail 2000;

Ahler, Minor, and Smail 1997; Crawford and Mitchell 2007). To begin with, some variation is evident in the ways these two materials were acquired. Flintknappers working at Scattered, Slant, and Double Ditch villages acquired smooth gray TRSS from quarry localities, where they roughed out large, multi-directional cores or early-stage bifaces. Evidence from the one documented smooth gray TRSS quarry suggests that heat treatment also took place there (Keyser and Fagan 1987). The fact that early-stage reduction took place away from the village suggests to Ahler and others (2004) that flintknappers in the Heart region enjoyed regular and direct access to the quarries; however, the number and distribution of those quarries is not known.

KRF was acquired in at least two different ways. Flintknappers at Slant and Scattered villages obtained much of the KRF they used directly from quarries in the primary source area. KRF arrived in these settlements in the form of partially worked blocks or cobbles, multi-directional cores, or tool performs. For the most part, the KRF pieces brought to the villages were smaller than pieces of smooth gray TRSS. By contrast, flintknappers at Double Ditch Village acquired KRF in the form of smaller cobbles or tabular pieces. The quality of much of the KRF at Double Ditch is lower than at Slant or Scattered. The sources Double Ditch flintknappers tapped are not known, but at least a portion of it may derive from nearby alluvial or lag deposits; some may also derive from eastern North Dakota. That flintknappers at Double Ditch had comparatively limited access to the main KRF quarries dovetails with their overall limited access to raw materials from distant western or southwestern sources.

Different reduction strategies were applied to KRF and smooth gray TRSS after they arrived in the villages. Percussion techniques were more often applied to smooth gray TRSS, which was preferred for making unpatterned flake tools. KRF was more often selected for the production of arrowpoints, scrapers, and other small patterned tools. A mixture of reduction techniques, including soft-hammer percussion, bipolar percussion, and pressure flaking, was applied to KRF. At Double Ditch, all phases of the production process seem to have taken place within the village, whereas flintknappers at Scattered and Slant emphasized late stage

reduction of partially finished tool performs. These differences in reduction strategy help explain the previously noted decrease over time in the use of smooth gray TRSS in favor of KRF. As I discuss later in this chapter, this shift in raw material usage is accompanied by a shift in the kinds of tools produced, from unpatterned flake tools, which were made mainly from TRSS, to arrowpoints and scrapers made from KRF.

Diversity within Temporal Groups

The large number of contexts investigated at Double Ditch Village presents an opportunity to explore within-site spatial variation and its effect on the composition of site-wide temporal groups. Table 22 presents data on the frequencies of each of the five raw material groups in 58 analytic units. The units are grouped by regional time period and are sorted within each period according to the percentage of KRF in the unit. The total number of flakes associated with each unit is given in the right-hand column; for clarity, I omit five containing fewer than 200 flakes each.

Within the post-1700 group, the frequency of KRF varies from just over 69 percent to 83 percent. The frequencies of other raw materials vary within similarly narrow ranges, despite the fact that the analytic units assigned to this period are scattered across the site. More variability is evident in the seventeenth century sample. Among these units, frequencies of KRF vary from about 30 percent to about 88 percent. In certain units, raw material group frequencies deviate substantially from the overall period mean. For instance, in the Ash F606 sample flakes from the Near-Local West group are more than three times as common as the seventeenth-century average. While this particular sample is comparatively small, flakes from Near-Local West sources are nearly as numerous in several larger samples, such as that from Mound E. By the same token, the seventeenth century sample includes analytic units with few flakes from these sources. Positive and negative deviations from the period mean of similar magnitude can be seen

Table 22. Frequencies of flakes assigned to five raw material groups in 58 analytic units from Double Ditch Village, organized by regional time period and sorted within each time period according to the frequency of Knife River flint (Near-local Northwest group). Shading indicates units included in the four-site subsample.

	Raw Material Group					
Analytic Unit	Near-local SW	Near-local West	Near-local NW	Exotic SW	Exotic West	Total
Pit F612	21.3%	8.2%	69.4%	1.1%	.0%	696
Md. P1,UP	20.1%	6.5%	71.4%	1.7%	.3%	7437
Md. B,X1819	17.2%	5.0%	75.4%	1.9%	.5%	9839
Md. B,X675	14.9%	7.1%	76.7%	.9%	.3%	8071
Md. B,X1213	12.9%	8.0%	77.6%	1.0%	.5%	14258
Md. JJw	12.7%	5.1%	81.0%	1.0%	.1%	9413
Md. JJe	10.8%	6.7%	81.2%	1.1%	.3%	12584
Md. I2	10.4%	5.4%	83.0%	1.0%	.3%	15190
Post-1700 Mean	13.6%	6.3%	78.6%	1.2%	.3%	77488
Post-1700 Subsample Mean	13.2%	6.3%	79.0%	1.1%	.3%	46298 (60%)
Pit F707	56.7%	5.4%	30.3%	7.6%	.0%	1163
Pit F708	52.3%	7.3%	38.5%	1.6%	.3%	11211
Pit F314	54.0%	3.6%	39.8%	2.6%	.0%	1356
Pit F705	40.9%	10.6%	46.8%	1.5%	.3%	1162
Pit F333	39.6%	4.9%	47.6%	7.9%	.1%	1051
Pit F610	31.5%	14.9%	52.1%	1.2%	.3%	679
Md. H	32.0%	4.7%	61.5%	1.8%	.1%	3948
Ditch 4NE	30.6%	4.6%	61.8%	2.6%	.4%	1107
Md. G	31.2%	3.9%	63.3%	1.3%	.4%	12374
Ash F606	11.2%	24.1%	63.5%	1.3%	.0%	715
Pit F623	22.1%	9.8%	65.9%	1.9%	.4%	4102
Pit F615	24.7%	7.4%	66.9%	.7%	.3%	299
Pit F605UP	15.9%	14.3%	68.8%	.7%	.3%	8035
Md. Y	22.8%	5.3%	70.2%	1.4%	.3%	22791
Md. V,UP	20.0%	7.3%	70.6%	1.8%	.2%	38580
Pit F602LO	14.6%	9.6%	71.8%	3.5%	.5%	22321
Md. E,UP	8.8%	17.8%	72.3%	.8%	.2%	7292
Ditch 3, UP	16.2%	8.6%	73.2%	2.0%	.0%	7222
Pit F620	21.4%	4.8%	73.6%	.3%	.0%	5912
Md. E,LO	11.6%	10.3%	76.3%	1.6%	.3%	4925
Pit F706	13.8%	8.4%	77.2%	.5%	.0%	4353
Md. A3	15.3%	5.4%	78.2%	.9%	.2%	21041
Md. I1	13.0%	6.9%	79.1%	.7%	.2%	6162
Pit F614	12.7%	6.0%	80.3%	.8%	.2%	11851
Md. D1w,UP	8.6%	9.3%	80.8%	.9%	.3%	7371
Md. F,UP	8.6%	7.9%	81.4%	1.9%	.2%	5163
Pit F602UP	11.8%	3.9%	82.0%	1.5%	.8%	6388
Md. D1e,UP	8.1%	7.4%	83.1%	.9%	.5%	11338
Md. C1	6.2%	5.0%	87.8%	.9%	.1%	18170
1600-1700 Mean	18.5%	7.4%	72.3%	1.5%	.3%	248082
1600-1700 Subsample Mean	18.9%	7.4%	72.1%	1.4%	.2%	117564 (47%)
Pit F703	57.1%	5.7%	33.0%	3.3%	.8%	1635
Pit F611	47.5%	14.4%	36.9%	1.0%	.2%	623

Table 22. Frequencies of flakes assigned to five raw material groups in 58 analytic units from Double Ditch Village, continued.

	Raw Material Group					
Analytic Unit	Near-local SW	Near-local West	Near-local NW	Exotic SW	Exotic West	Total
Ditch 4	56.3%	4.2%	37.9%	1.4%	.3%	1799
Pit F332	49.7%	6.8%	41.9%	1.1%	.5%	2899
Pit F412	50.9%	4.7%	41.9%	2.0%	.5%	403
Pit F616	43.5%	7.7%	47.4%	1.3%	.1%	6137
Pit F702	22.7%	13.4%	49.9%	11.5%	2.6%	768
Md. V,LO	37.2%	7.9%	51.3%	3.2%	.4%	11714
Pit F605LO	30.4%	16.0%	52.8%	.4%	.4%	250
Pit F701	41.0%	4.5%	52.9%	1.4%	.2%	2802
Pit F426	36.6%	5.8%	54.7%	2.8%	.0%	1180
Pit F320	35.2%	6.8%	55.8%	1.9%	.3%	1702
Ditch 3, LO	37.2%	4.7%	57.2%	.8%	.1%	7610
Pit F605MD	22.3%	12.4%	64.6%	.5%	.2%	1503
Pit F319	28.3%	3.6%	65.0%	2.1%	1.0%	775
Pit F618	25.4%	7.2%	65.8%	1.3%	.3%	1109
Pit F704	27.3%	5.7%	66.6%	.3%	.0%	5309
Md. F,LO	21.5%	9.6%	66.7%	2.0%	.3%	2852
Md. D1w,LO	15.7%	11.3%	71.7%	1.0%	.2%	4507
Pit F202	22.9%	2.6%	73.2%	1.0%	.3%	1406
Md. D1e,LO	13.3%	7.7%	77.6%	1.1%	.3%	15804
Pre-1600 Mean	30.5%	7.3%	60.3%	1.6%	.3%	72787
Pre-1600 Sample Mean	29.0%	7.2%	61.9%	1.6%	.3%	51400 (71%)

in exotic materials from southwestern sources. Finally, the frequencies of TRSS (Near-Local Southwest) and KRF (Near-Local Northwest) vary somewhat less in the pre-1600 sample, but the ranges for Near-Local West and Exotic Southwest materials are nearly as great as they are among seventeenth-century units.

These differences among archaeologically contemporaneous samples can be explained in a couple of ways. First, some of the units may simply be temporally misclassified. In the specific case at hand, the raw material signature of the large sample from Mound D1 East/Lower is much more like post-1700 samples than the pre-1600 samples to which it is currently assigned and, in fact, a chronological reassessment of that context may be warranted. Second, some units may be more temporally precise than others, in that their content may reflect a smaller number of activities carried out over a shorter period of time, perhaps by a smaller number of

people. In that case, particular analytic units might not reflect overall patterns of raw material use broadly characteristic of a particular time period. Third, such differences could be caused by differential disposal practices or by a variety of post-depositional factors. For instance, attempts to clean up flaking debris by sweeping may leave very small flakes behind. Similarly, if different technological practices are habitually applied to different raw materials, then simple flake counts may not accurately reflect their relative frequencies of use. Differences in brittleness or in material-specific recycling patterns could also affect the frequencies of different materials.

Some of these processes could enrich one type of artifact or material, while others may deplete them. Certain types of archaeological remains may be particularly susceptible to such effects. For instance, a particular type of seed might be either overrepresented or underrepresented in a sample of charred plant remains, relative to its dietary importance, for a variety of reasons, including its susceptibility to wind transport, its combustibility, or its resistance to decomposition in particular types of soils. Small samples are particularly prone to stochastic effects.

Nevertheless, the content differences shown in table 22 can also reflect substantive differences in the types of resources people used or in how they used them. In some cases, such differences may point to real, though unresolved, temporal variation. For those instances a sufficiently precise chronology might reveal important small-scale trends. Content differences can also reflect real synchronic variation. If so, mean frequencies, representing an aggregate of small scale resource use decisions, best represent community-wide patterns during a particular period.

For large, complex assemblages, combinations of all of these factors probably are in play. The question, however, is not whether misclassification or post-depositional biases can be removed from the dataset, leaving only substantive temporal or spatial variation, but whether the documented differences significantly affect the trends observed and interpretations drawn at the timescale of interest. One way of answering that question is to compare mean values drawn

from different subsamples assigned to the same time period. Along with frequency data for each analytic unit, table 22 also includes mean percentages for the total sample from each temporal period and for the subsample of analytic units I chose for the detailed four-site study. I use shading to identify the units included in the subsample. As I mentioned, the loci included in the detailed analysis were chosen mainly on the basis of stratigraphic and chronological criteria, not specific content. In nearly every case the means for the subsample differ from the means for the larger sample only by a few tenths of one percent. The largest difference is just 1.6 percent.

This congruence of means suggests that, at the scale of the temporal framework used in this study, the patterns observed in the samples reflect overall patterns characteristic of those periods and therefore that the variations between time period groups in fact represent real temporal trends. Incidentally, this result also suggests that the number of analytic units in the Double Ditch Village sample is adequate to address the questions posed here. In fact, for a common artifact type like flaking debris, a smaller number of loci may well capture salient patterns. While the absolute number of analytic units needed to draw valid interpretations cannot be established *a priori*, and in fact may differ for different material classes, these results warrant confidence in the observed temporal trends. This result further suggests that comparisons among similarly well-sampled sites, such as Scattered Village, are equally warranted. Whether a similar level of confidence can be placed in conclusions drawn from a smaller number of analytic units is unknown. In this connection, it is interesting to note that, while the flaking debris sample from Boley is less than one-tenth as large as the sample from Double Ditch, loci from Boley independently judged to be similar in age exhibit similar material frequencies.

Tool Assemblage Diversity

As Ahler (1975a) demonstrated for the two Extended Coalescent collections he studied, between-site technological differences may point to differences in the location or scheduling of

production. But such differences also can reflect differences in the kind of production carried out in different settlements. In turn, assessing the degree to which certain craft production practices are concentrated is important for understanding the social relations underlying the transmission of technical knowledge and for gauging the form and extent of inter-community exchange.

A couple of caveats underlie this assessment of technological diversity. First, technological data on production practices only imperfectly reflect the actual uses to which stone tools were put. For instance, end scrapers—defined in technological terms as patterned flake tools—can be used for a variety of specific tasks, including hide preparation, wood working, and so forth. Second, the Heart region data considered here are best suited, with a couple of revealing exceptions, to analyses of community-level production, rather than household- or neighborhood-level production.

Table 23 gives the frequencies of different technological classes in the Heart region sample. Definitions of each of the 11 tool classes are provided in table 18. As I noted in chapter 5, the frequencies in table 23 have been normalized against data collected on the bifaces in the four-site subsample to account for minor differences in class definitions different investigators used. Cells exhibiting standardized residual values greater than +2.0 are shaded to highlight the most pronounced differences among the assemblages.

Tools representing the full range of technological practices are present in each assemblage, but the relative weight placed on different types of production varies significantly. The most striking difference among the six communities is the large number of bipolar tools in the Scattered Village collection. There, bipolar tools occur three to sixteen times more frequently than they do in any other sample. This technological class includes objects that could have been used either for bipolar flake production or as tools (punches, wedges, or chisels) in addition to objects that, due to their small size or form, could only have been used as tools. However, previous typological analysis of the coarse-fraction flaking debris assemblage from Scattered Village demonstrates quite clearly that the bipolar artifacts there were used almost exclusively

Table 23. Distribution of tool technological classes according to site, with artifacts from all temporal periods combined. Shading indicates cells with standardized residuals >+2.

	Technological Class											
Site	Small Patterned Biface	Large Patterned Biface	Unpatterned Biface	Scraper	Flake Tool	Large Bifacial Core-Tool	Non-Bipolar Core/Tool	Bipolar Core/Tool	Unpatterned Ground Tool	Patterned Ground Tool	Retouched Plate	Total
Bypass	17.9%	16.2%	3.6%	3.1%	29.2%	.5%	12.8%	1.0%	8.4%	5.6%	1.5%	585
Boley	14.3%	13.0%	2.6%	12.5%	24.4%	1.1%	8.8%	4.4%	10.6%	1.1%	7.4%	856
Double Ditch	18.5%	11.8%	2.0%	3.6%	40.4%	.3%	8.6%	.8%	11.8%	.7%	1.4%	4170
Larson	15.9%	9.3%	4.5%	2.8%	37.0%		6.5%	.9%	18.1%	1.2%	3.8%	1129
Scattered	16.9%	14.5%	3.2%	6.1%	23.5%	.4%	4.8%	13.0%	11.5%	1.2%	5.0%	4616
Slant	19.2%	13.7%	2.2%	4.2%	38.5%	1.5%	7.1%	2.1%	9.7%	1.4%	.4%	1246
Total	17.4%	13.0%	2.8%	5.1%	32.1%	.5%	7.1%	5.6%	11.8%	1.3%	3.3%	12602

as tools rather than as cores (Ahler et al. 2002). Bipolar flakes make up a small proportion of the total debris assemblage, comparable to the proportions observed in other Heart River assemblages where bipolar tools are far less common. I consider the function of these tools more at the end of this chapter.

Data on tool recycling patterns also highlight the disproportionate occurrence of bipolar tools at Scattered Village (table 24). Among large patterned bifaces in the four-site subsample, bipolar recycling is at least four times as common at Scattered Village. Among unpatterned bifaces bipolar recycling is documented only at Scattered.

Table 24. Frequency of recycled stone tools in the four-site subsample, organized by technological class and recycling type.

		Site			
Technological Class	Recycling Type	Scattered	Slant	Double Ditch	Bypass
Small Patterned Biface	Bipolar	.4%			3.7%
	Non-bipolar	1.2%	2.7%	3.5%	
Large Patterned Biface	Bipolar	12.5%	2.8%	.7%	1.6%
	Non-bipolar	.9%		.2%	
Unpatterned Biface	Bipolar	7.2%			
	Non-bipolar				

Returning to table 23, end scrapers (patterned flake tools) are two to six times more common in the Boley Village sample than they are in the other samples. Because the Boley assemblage is comparatively small, and is dominated by the contents of one especially rich pit feature, it is not clear how representative these data are of the site as a whole. However, scrapers are common in five of Boley's six excavated features, where they make up 6 to 18 percent of the chipped stone tool assemblage. These features date to at least two different periods, indicating that this pattern persisted through time (Ahler et al. 2006). Interestingly, the Boley Village assemblage also includes a comparatively large number of bipolar tools, while the Scattered Village assemblage includes a comparatively large number of scrapers, hinting at the possibility that scrapers and bipolar objects may have been used together in some way. The fact that the

assemblages with the fewest scraping tools—from Larson, Double Ditch, and Bypass villages—also contain the fewest bipolar tools bolsters this connection.

Arrowshaft abraders made from coarse, porous sandstone, an exotic raw material, and stone beads made from locally available siltstone account for the large number of artifacts assigned to the patterned ground stone class at Bypass Village. There, ten abraders were recovered from eight different features scattered across the site. By contrast, only four such tools are present in the Double Ditch Village collection, even though it is nine times larger. Just ten grooved abraders are present in the Scattered Village collection, which is eight times larger. Stone beads very similar to those in the Bypass Village assemblage also were found at Slant Village, suggesting that a suitable source may be located nearby.

Differences in the frequencies of retouched plate tools indirectly reflect patterns of raw material usage. In the northern Middle Missouri, such tools are made almost exclusively from KRF and petrified wood, both of which commonly occur as thin plates or slabs. Flintknappers at Boley and Scattered villages, where tools of this type are most common, also made extensive use of Near-Local West sources, which consist mainly of petrified wood and various chalcedonies. The distribution of these materials also overlaps with surface lag and alluvial deposits containing KRF nodules and plates that typically are smaller and of lower quality than those found in the primary quarries. Thus, the high frequency of plate tools in these assemblages confirms the use by these communities (and perhaps Larson as well) of the lithic resource zone located due west of the Heart region. At the same time, the relative dearth of plate tools, as well as Near-Local West flaking debris, at Double Ditch bolsters the idea discussed previously that flintknappers there obtained much of their KRF from local gravel deposits, in the Missouri itself, or perhaps from sources farther east.

As with the patterns of raw material use I considered previously, many of these technological patterns remained stable over time (table 25; data from Larson and Bypass villages are omitted from this table because their assemblages only date to a single time period).

Table 25. Distribution of tool classes in the Heart region sample, organized by time period. Shading indicates cells with standardized residuals >+2.

		Technological Class											
Site	Period	Small Patterned Biface	Large Patterned Biface	Unpatterned Biface	Scraper	Flake Tool	Large Bifacial Core-Tool	Non-Bipolar Core/Tool	Bipolar Core/ Tool	Unpatterned Ground Tool	Patterned Ground Tool	Retouched Plate	Total
Boley	1600-1700	14.7%	13.3%	3.0%	14.7%	21.2%	1.3%	9.3%	4.3%	9.7%	1.3%	7.2%	626
	pre-1600	13.0%	12.2%	1.3%	6.5%	33.0%	.4%	7.4%	4.8%	13.0%	.4%	7.8%	230
Double Ditch	post-1700	18.5%	11.8%	1.6%	4.2%	38.6%	.5%	8.5%	.6%	14.2%	.5%	.8%	949
	1600-1700	19.7%	11.9%	2.0%	3.4%	39.7%	.2%	8.6%	.9%	10.9%	.8%	1.8%	2453
	pre-1600	14.6%	11.2%	2.6%	3.4%	44.9%	.1%	8.7%	.7%	12.0%	.8%	1.0%	768
Scattered	1600-1700	17.3%	13.5%	3.0%	6.1%	22.5%	.3%	4.9%	14.2%	11.9%	1.3%	5.1%	3489
	pre-1600	15.9%	17.7%	3.7%	6.0%	26.4%	.4%	4.4%	9.4%	10.1%	1.0%	4.9%	1127
Slant	post-1700	17.5%	11.8%	3.0%	6.5%	33.5%	1.5%	9.9%	3.8%	10.3%	1.5%	.8%	263
	1600-1700	20.7%	16.0%	2.3%	3.5%	39.2%	1.2%	6.8%	1.6%	7.3%	1.4%	.0%	694
	pre-1600	17.0%	10.0%	1.0%	3.8%	41.5%	2.4%	5.2%	1.7%	14.9%	1.4%	1.0%	289

At Double Ditch, few bipolar tools were produced during any time period, but they remained abundant throughout the entire sequence at Scattered Village. Equally stable patterns can be observed in the frequencies of retouched plate tools at Boley and Scattered villages and large patterned bifaces at Double Ditch Village. However, a number of clear temporal trends are present in the data as well. Arrowpoint production was especially prominent during the seventeenth century. At all four study sites, the proportion of small patterned bifaces increased after 1600. However, arrow point production decreased slightly after 1700 at the two sites for which data are available.

At all four of the sites listed in table 25, the frequency of unpatterned flake tools declined steadily over time while the number of small patterned bifaces and end scrapers increased. Again, this pattern appears to be linked to the regional shift in raw material use from smooth gray TRSS to KRF, the latter of which was preferred for the production of patterned tools. Interestingly, even though the proportion of the Double Ditch tool assemblage made from smooth gray TRSS fell over time, the frequency of arrowpoints made from smooth gray TRSS increased, further indicating that the arrow production steadily became more important over time (Ahler et al. 2004:Table 41, 217).

Data on bifacial tools in the four-site study sample can be used to examine these patterns in more detail (table 26). Significant differences are apparent among communities, with flintknappers at Double Ditch and Slant placing greater emphasis on arrowpoint production and those at Bypass and Scattered villages producing more large bifacial cutting tools. A regional

Table 26. Frequency of bifacial tool types in the four-site subsample, organized by site.

	Technological Class			
Site	Small Patterned Biface	Large Patterned Biface	Unpatterned Biface	Total
Slant	47.7%	45.5%	6.8%	235
Scattered	39.7%	49.6%	10.7%	647
Double Ditch	49.5%	40.8%	9.7%	1039
Bypass	41.9%	48.1%	10.1%	129
Total	45.7%	44.6%	9.7%	2050

Pearson Chi-square=18.958; *df*=6; p=0.004

temporal trend also is evident in this sample. Over time, the frequency of small patterned bifaces increased from under 42 percent to over 51 percent, while the frequency of large patterned bifaces declined from over 47 percent to under 40 percent (table 27). The frequency of unpatterned, expedient bifaces remained roughly constant.

Table 27. Frequency of bifacial tool types in the four-site subsample, organized by regional time period.

	Technological Class			
Time Period	Small Patterned Biface	Large Patterned Biface	Unpatterned Biface	Total
post-1700	51.4%	39.5%	9.1%	319
1600-1700	46.3%	44.5%	9.3%	1124
pre-1600	41.7%	47.4%	10.9%	607
Total	45.7%	44.6%	9.7%	2050

Kendall's tau-b=.057; Approximate T=2.791; Approximate p=0.008

Within-Site Variation in Stone Tool Technology

Data from Scattered Village can be used to assess the strength of the most pronounced inter-community difference discussed in the preceding section. The frequencies of 11 technological classes present in 36 features there are given in table 28. Features containing fewer than 10 tools each are omitted. The cases are sorted in descending order according to the frequency of bipolar tools. These data demonstrate that the high frequency of bipolar tools in the Scattered Village assemblage is not due simply to the presence of a few "outlier" features. Instead, bipolar tools are ubiquitously distributed throughout the site, indicating that a large fraction of the settlement's residents were using—and very likely making—them. Coupled with the temporal persistence of bipolar technology, it is clear that the activities carried out with them were a distinctive feature of the community throughout its history.

Table 28. Frequencies of 11 tool classes in 36 pit features at Scattered Village. Table is sorted according to the frequency of bipolar tools. The dashed line indicates the regional six-site mean (5.6 percent); the dotted line indicates the regional mean with Scattered Village excluded (1.4 percent).

	Technological Class											
Feature Number	Patterned Small Biface	Patterned Large Biface	Unpatterned Biface	Scraper	Unpatterned Flake Tool	Large Core-Tool	Non-Bipolar Core	Bipolar Core/ Tool	Unpatterned Ground	Patterned Ground	Retouched Plate	Total
130	20.5%	5.1%	5.1%		20.5%		2.6%	33.3%	7.7%		5.1%	39
173		30.0%		20.0%	20.0%			30.0%				10
120	11.1%	9.2%	1.1%	5.7%	29.8%		6.1%	23.7%	7.6%	1.1%	4.6%	262
73	16.7%	22.9%		10.4%	20.8%		2.1%	22.9%	4.2%			48
67	7.8%	9.8%	2.0%	5.9%	17.6%		7.8%	19.6%	9.8%		19.6%	51
99	15.4%	7.7%	3.8%	3.8%	11.5%			19.2%	19.2%	11.5%	7.7%	26
168	11.5%	7.7%	7.7%	15.4%	7.7%		7.7%	19.2%	15.4%		7.7%	26
132	21.5%	13.3%	5.1%	5.7%	12.0%		5.7%	17.7%	13.3%	1.3%	4.4%	158
124	11.8%	14.1%	3.5%		17.6%		5.9%	17.6%	15.3%		14.1%	85
58	8.7%	21.7%	13.0%	4.3%	30.4%	4.3%		17.4%				23
47	28.8%	11.0%	4.1%	4.1%	15.1%		8.2%	15.1%	8.2%	2.7%	2.7%	73
97	10.0%	10.0%			55.0%			15.0%			10.0%	20
175	10.7%	7.7%	3.0%	11.2%	11.2%		3.6%	14.8%	27.2%	5.3%	5.3%	169
115	13.3%				46.7%		20.0%	13.3%	6.7%			15
127	19.0%	13.8%	.9%	7.8%	14.7%	1.7%	6.9%	12.9%	10.3%	4.3%	7.8%	116
26	14.8%	12.0%	4.9%	7.0%	25.4%		6.3%	12.7%	9.2%		7.7%	142
66	7.3%	17.1%		12.2%	24.4%		4.9%	12.2%	19.5%		2.4%	41
4	20.0%	20.0%		12.0%	20.0%		4.0%	12.0%			12.0%	25
68	12.0%	32.0%			28.0%			12.0%	12.0%	4.0%		25
106	1.3%	14.3%	2.6%	5.2%	29.9%		5.2%	11.7%	18.2%		11.7%	77
178	10.0%	20.0%	1.7%	3.3%	35.0%		6.7%	11.7%	5.0%		6.7%	60
108	27.2%	12.0%	4.4%	2.5%	21.5%		3.8%	11.4%	8.9%	1.3%	7.0%	158
14	13.0%	16.7%	3.7%	9.3%	29.6%		4.6%	11.1%	8.3%		3.7%	108
52	13.0%	25.9%	5.6%	3.7%	31.5%		1.9%	11.1%	3.7%		3.7%	54
170		30.0%	10.0%	10.0%	20.0%			10.0%			20.0%	10
8	9.1%	9.1%			36.4%			9.1%	27.3%		9.1%	11
133	12.2%	8.2%	4.1%	14.3%	30.6%	2.0%	4.1%	8.2%	10.2%	2.0%	4.1%	49
17	18.9%	24.3%		8.1%	29.7%		2.7%	8.1%	2.7%		5.4%	37
101	20.4%	19.0%	6.6%	5.1%	27.7%		2.2%	8.0%	4.4%		6.6%	137
104	20.5%	19.7%	3.3%	2.5%	22.1%		10.7%	7.4%	7.4%		6.6%	122
119	3.0%	21.2%	3.0%		33.3%		3.0%	6.1%	18.2%	3.0%	9.1%	33
57	3.3%	10.8%	2.5%	10.0%	42.5%		5.8%	5.0%	15.8%	1.7%	2.5%	120
7	14.7%	17.6%	2.9%	2.9%	44.1%		2.9%	2.9%	8.8%		2.9%	34
142	5.6%	13.0%	1.9%	5.6%	25.9%	1.9%	9.3%	1.9%	33.3%	1.9%		54
55		5.9%	5.9%	5.9%	23.5%		23.5%		35.3%			17
163	27.3%	9.1%			27.3%		9.1%		18.2%		9.1%	11

Production Errors and Product Uniformity

Descriptions of the organization of craft production must consider spatial and temporal patterns in the time or effort individual producers devote to their craft. One way to gauge this dimension of production is to assess producers' proficiency or adeptness. Clark (2003; see also Ahler 1989b; Bamforth and Finlay 2008; Shelley 1990) argues that producer skill is a function of experience: the more one produces, the better one becomes. Flintknappers who devote more time to their craft produce better tools more efficiently. Archaeologists use a variety of measures to assess proficiency or skill, including artifact size, width-to-thickness ratios, length-to-width or length-to-thickness ratios, design complexity, plan view symmetry or formal regularity, precision or regularity of finishing, product uniformity, failure or error rates, and the use of complex, patterned multistage reduction strategies (Bamforth and Finlay 2008). Some of these measures are aesthetic in nature and relate primarily to the technical excellence of the finished product. Such "artisanal" skill (Andrews 2003) often is expressed in "elaborate knapping activities" (Pelegrin 1990), or in the creation of objects meant to indicate high status or wealth. Other measures gauge "efficiency" skill (Andrews 2003), the ability of a producer to consistently and economically manufacture a serviceable product.

For this study, I collected data on the frequency of knapping errors observed on a sample of bifacial tools, along with data on their morphological and metric properties. I focused on bifaces because they best express producer skill. A number of studies demonstrate that both error rates and product uniformity are correlated with producer skill. For instance, Shelley (1990) uses experimental data to show that inexperienced producers commit certain types of errors, notably the frequency of stepped or hinged flake terminations and the degree of biface edge sinuosity, more frequently. Ahler (1989b) demonstrates differences in the types of flakes novice and experienced flintknappers produce. Using archaeological, historical, and experimental data, Clark (2003) shows that error rates and product uniformity are inversely correlated and, moreover,

that skill as expressed by low error rates and high uniformity is correlated with experience or producer output.

Each biface in the four-site sample was assigned to one of four ordinal skill groups or, in the case of especially fragmented or burned specimens, to an indeterminate group. Because most of the tools in the detailed study sample are represented only by fragments, I use several different criteria to assess the flintknapping skill required to produce them. Objects assigned to each skill group share most, but not necessarily all, of the identified criteria and no single criteria is necessary or sufficient to determine membership. Tools assigned to the lowest skill group exhibit the greatest number of knapping errors and likely were produced by flintknappers with limited skills. Those assigned to the highest skill group exhibit no technical errors and, additionally, a high degree of plan and cross-section symmetry and flake scar regularity, indicative of well-controlled flake removals. Tools in the average skill group may exhibit minor technical errors along with a generally symmetrical form, while those in the moderate skill group exhibit significant flaking errors and limited symmetry. Thus, the skill groups used here combine "efficiency" criteria with "artisanal" criteria.

Some of the observed production errors led to the abandonment of an objective piece before it was finished. Other types of errors did not prevent the completion of production, but likely limited the utility or use-life of the tool. Generally, I assigned tools exhibiting knapping errors significant enough to have hindered its intended function to the lowest skill group. Tools exhibiting errors affecting its use-life were assigned to the moderate skill group. Knapping errors characteristic of tools in the average skill group affected neither their function nor use-life. More information on the definitions of these groups can be found in appendix 3.

Assessments of production errors are based on explicit models of production that identify the steps and stages required to produce a particular type of artifact as well as on the specific methods and tools employed at each stage. Thus, skill in the production of arrowpoints, which are produced by pressure flaking, is expressed differently than skill in the production bifacial

knives, which are produced mainly by soft-hammer percussion. Moreover, because different tools and techniques are used at different points in the production sequence (Callahan 1979), skill at one stage in the process may be expressed differently than skill at another. About half of the tools examined for this study represent production failures, meaning that they were discarded before they were finished. By definition, such artifacts exhibit at least one crucial production error. The other half were finished and were used until they were exhausted or broke during use or during resharpening or recycling. Additionally, some large patterned bifaces were put to use before they had passed through all of the potential stages of production. For all of these reasons, large patterned bifaces were assigned to one of Callahan's (1979) manufacturing stages before production skill was evaluated. Small patterned bifaces were assigned to one of the stage classes that Ahler (1992) defines. Both Callahan and Ahler discuss and illustrate characteristic types of errors made at each stage in the process. Common errors include poor blank selection, incorrect platform placement or preparation, incorrect platform isolation, incorrect edge thickness, or incorrect curvature of the face. Such errors may be marked by overshot, hinged, or stepped flake terminations, perverse fractures, excessively thick tool margins, longitudinal fractures, and so forth. To help assess both production stage and producer skill, a cluster of interrelated variables were coded for each tool, including completeness, use-phase, and reason for failure. Additional information on these variables is given in appendix 3.

Complete, or nearly complete, tools permit more rigorous application of the skill evaluation criteria because they exhibit more of the relevant variables. The effects of artifact completeness on skill determinations are most easily observed in the sample of large patterned bifaces (table 29). Unsurprisingly, margin fragments are less likely to be assigned either to the lowest or the highest skill groups. Complete and nearly complete artifacts are more likely to be assigned to the lowest skill group. A slightly different pattern is evident among small patterned bifaces. Margin fragments and indeterminate fragments are less likely to be assigned to the highest skill group, while complete artifacts are somewhat more likely to be assigned to the

Table 29. Skill expression in small and large patterned bifaces, organized by artifact completeness classes.

		Skill Group				
	Completeness Class	Limited	Moderate	Average	High	Total
Small Patterned Bifaces	Complete	5.1%	24.8%	62.8%	7.3%	137
	Nearly Complete	2.3%	14.8%	60.2%	22.7%	128
	Distal End	.9%	14.1%	75.3%	9.7%	227
	Proximal End	.4%	12.6%	70.0%	17.0%	230
	Medial Fragment	.0%	21.8%	61.8%	16.4%	55
	Indeterminate Fragment	2.3%	27.9%	67.4%	2.3%	43
	Margin	.9%	26.4%	70.8%	1.9%	106
Subtotal		15	166	633	112	926
Large Patterned Bifaces	Complete	18.6%	35.6%	40.7%	5.1%	59
	Nearly Complete	12.2%	58.5%	19.5%	9.8%	41
	Distal End	4.5%	31.8%	59.1%	4.5%	22
	Proximal End	5.3%	15.8%	73.7%	5.3%	19
	Medial Fragment	4.1%	37.1%	54.6%	4.1%	97
	Indeterminate Fragment	5.9%	40.0%	47.8%	6.3%	270
	Margin	2.0%	35.9%	60.9%	1.2%	345
Subtotal		45	323	451	34	853

lowest skill group. However, these differences only can affect spatial or temporal comparisons to the extent that sites or time periods exhibit different tool completeness signatures, which are a function of what broadly can be considered site formation processes. Although the proportions of tools in various completeness categories do vary somewhat among villages, I detect no systematic bias.

Metric Characteristics of Skill Groups

The reliability of the production skill classification can be evaluated by comparing the resulting groups across independently measured metric variables. A total of 10 measurements was taken on arrowpoints in the four-site sample; details on where these measurements were made are provided in appendix 3. For eight of the 10 measures, the skill group means differed significantly from one another and, more importantly, the differences were in the direction a skilled flintknapper would expect (table 30; I exclude from this table three arrowpoints assigned

to the lowest skill category). For instance, the notches on points assigned to the highest skill group are both deeper and narrower than those assigned to the average skill group, which in turn are deeper and narrower than those assigned to the moderate skill group. Arrowpoints in the high skill group are broader and longer than those in the lower skill groups, but no thicker on average. Moreover, distal haft element lenght, one of the two measures for which no significant difference in the skill group means was observed, actually reflects artifact style rather than producer skill.

Arrowpoints assigned to the highest skill group also are more uniform than those in

Table 30. Metric data on arrowpoints organized by skill group. Only arrowpoints assigned to morphological classes 172 and 175 are included.

Measure	Skill Group	*n*	mean (mm)	s.d. (mm)	C.V.
Blade Base Width	Moderate	24	12.75	2.05	16.1
F=3.626, p=0.015	Average	73	13.29	2.04	15.4
	High	43	14.29	2.06	14.4
Blade Length	Moderate	21	14.54	3.77	25.9
F=6.234, p=0.001	Average	61	17.33	4.13	23.8
	High	30	19.26	3.96	20.5
Notch Depth	Moderate	29	2.47	0.97	39.3
F=13.678, p=0.000	Average	123	3.14	0.83	26.5
	High	60	3.46	0.78	22.5
Notch Width	Moderate	25	2.69	1.07	39.9
F=4.901, p=0.003	Average	87	2.40	0.88	36.4
	High	43	2.18	0.69	31.9
Distal Haft Element Width	Moderate	29	8.38	1.68	20.1
F=3.289, p=0.022	Average	118	7.82	1.32	16.9
	High	57	7.61	1.59	20.9
Length	Moderate	17	21.78	4.49	20.6
F=3.142, p=0.029	Average	54	24.02	4.09	17.0
	High	22	25.64	4.87	19.0
Proximal Haft Element Width	Moderate	23	13.63	2.10	15.4
F=5.506, p=0.001	Average	87	14.76	1.83	12.4
	High	42	15.38	2.11	13.7
Width	Moderate	25	13.75	2.01	14.6
F=8.162, p=0.000	Average	90	14.70	1.86	12.7
	High	45	15.50	2.20	14.2
Thickness	Moderate	23	3.06	0.96	31.3
F=1.950, p=0.123	Average	100	3.34	0.52	15.4
	High	52	3.23	0.55	17.2
Distal Haft Element Length	Moderate	24	6.11	1.37	22.5
F=1.274, p=0.408	Average	104	6.16	1.08	17.6
	High	52	6.27	1.15	18.4

the lower skill groups. For four of the eight measures with significantly different means, the coefficient of variation (c.v.), a standardized measure of artifact variability (Clark 2003), decreases steadily with increasing skill (table 30, right-hand column). For three of the four others, the variability of artifacts assigned to the moderate skill group is greater than the variability of artifacts assigned to the two highest skill groups. Even for the two measures for which no significant difference among the skill groups was observed, flintknappers exhibiting moderate skill produced more variable products than did those exhibiting average or high skill. These data demonstrate that the error rate assessments embodied in the defined ordinal skill groups are well correlated with the metric properties of the tools. Whether measured against morphology or uniformity, the classification accurately reflect real differences in flintknapping ability. In this connection it is worth observing that, in addition to the ordinary arrowpoints in the four-site subsample, the collection includes nine well-made, oversized points that originally were fixed to bow-lances, ceremonial weapons used to count coup, in courting, and in certain rituals (Weitzner 1979:236). Seven of the nine (78 percent) exhibit the highest level of skill; the other two exhibit average skill.

Skill in Small Patterned Biface Production

Functionally, about 90 percent of the small patterned bifaces in the four-site sample are arrowpoints or arrowpoint preforms. Another 3 percent are drills. The remainder consists of various types of small cutting tools. Table 31 shows significant differences among the study assemblages in the proportions of these tools assigned to each skill group. The Scattered Village sample contains the highest frequency of high-skill tools, as well as the lowest frequency of low skill tools. The opposite pattern—a low number of high-skill tools and a high number of low-skill tools—is evident in the Slant Village sample. Double Ditch and Bypass villages exhibit intermediate values. Overall, though, the clearest difference among the samples is in the

Table 31. Skill expression in small patterned biface production, organized by site.

	Skill Group				
Site	Limited	Moderate	Average	High	Total
Slant	2.7%	19.8%	72.1%	5.4%	111
Scattered	.4%	13.7%	69.8%	16.1%	255
Double Ditch	2.0%	20.2%	66.1%	11.8%	510
Bypass	1.9%	13.0%	75.9%	9.3%	54
Total	1.6%	18.0%	68.4%	12.0%	930

Pearson chi-square=17.537; *df*=9; p=0.041

proportion of high-skill tools.

Temporal trends in the frequencies of the skill groups are even stronger (table 32). The proportion of the assemblage exhibiting average production skill did not change, but over time the proportion of tools exhibiting the highest degree of production skill increased steadily. At the same time, tools exhibiting lower skill became less common. This trend is event at all three of the study sites for which diachronic samples are available. For instance, at Double Ditch the proportion of high-skill tools more than doubled, from 8.0 percent to 16.7 percent, in the latest period compared to the earliest. Over the same time, moderate-skill tools decreased from 23.0 percent to 14.3 percent. Comparable changes can be seen in the samples from Slant and Scattered villages. Thus, even though the Slant assemblage contains the fewest high-skill tools overall, the frequency of skilled production there nevertheless increased over time. Overall, these data show that the pattern of skill expression in small patterned bifaces is linear, both temporally and spatially: assemblages containing more high-skill tools also contain fewer low-skill tools.

Notably, temporal change in the prevalence of skilled production is confined almost

Table 32. Temporal trends in the skill of small patterned biface production.

	Skill Group			
Time Period	Moderate	Average	High	Total
post-1700	13.0%	71.4%	15.5%	161
1600-1700	18.8%	67.8%	13.4%	506
pre-1600	20.6%	71.8%	7.7%	248
Total	18.3%	69.5%	12.2%	915

Kendall's tau-b=-0.084; Approximate T=-2.894; Approximate p=0.004

exclusively to tools made from KRF. The frequency of high-skill KRF arrowpoints increased from 6.6 percent in the earliest period to 18.7 percent in the latest. Moderate-skill KRF arrowpoints decreased over the same period from 23.6 percent to 13.1 percent. By contrast, the proportions of smooth gray TRSS arrowpoints in each skill group remained essentially constant over time. This pattern—increasing skill exhibited in KRF arrowpoints, but not in those made from smooth gray TRSS—is replicated at each of the sites for which diachronic data are available and bolsters the data presented previously on the different reduction strategies applied to these two raw materials and on their changing frequencies of use over time.

Skill in Large Patterned Biface Production

Various kinds of cutting tools make up the sample of large patterned bifaces. Functionally, nearly 72 percent are classified simply as generalized bifacial cutting tools; however, this category also includes, by definition, unfinished tools. Most of the remainder consists of a variety of light- and heavy-duty cutting tools. A small number of bifacial scraping tools also are present.

Significant differences in the proportions of tools assigned to each of the skill groups exist among the study sites, but the pattern of skill expression is rather different than that observed for small patterned bifaces (table 33). For small bifaces there is an inverse relationship between the highest and lowest skill groups: assemblages with more high-skill tools also contain

Table 33. Skill expression in large patterned biface production, organized by site.

	Skill Group				
Site	Limited	Moderate	Average	High	Total
Slant	11.2%	38.8%	43.9%	6.1%	98
Scattered	2.8%	35.2%	58.2%	3.8%	287
Double Ditch	6.3%	40.4%	49.4%	3.9%	411
Bypass		33.3%	65.0%	1.7%	60
Total	5.3%	38.0%	52.8%	4.0%	856

Pearson chi-square=23.204; *df*=9, p=0.006

fewer low-skill tools. By contrast, for large patterned bifaces there is a weak positive relationship between high- and low-skill tools. The site with the highest proportion of large bifaces in the high skill group, Slant Village, also contains the highest proportion of bifaces in the limited skill group. The opposite pattern is evident in the Bypass Village assemblage, which includes only one high-skill knife and no low-skill knives. Thus, for large patterned bifaces, high- and low-skill tools tend to co-occur. In practical terms this means that a broader range of flintknapping ability is expressed at Slant and Double Ditch villages than at Scattered and Bypass villages.

Regionally, the frequencies of large patterned bifaces assigned to the limited and moderate skill groups increased over time, while those assigned to the average skill group declined over time (table 34). The frequency of tools in the high skill group remained roughly constant at about 4 percent of the subsample assemblage. Leaving aside the comparatively small sample from Bypass Village and focusing on the three lowest skill groups, this aggregate decline in the quality of large patterned bifaces is replicated at each of the three post-1500 sites in the subsample, meaning that the mix of skills represented in each site assemblage is relatively stable. During each period, the Slant Village sample includes the highest frequencies of both high- and low-skill tools, while the Scattered Village sample has the lowest values in each time period. No differences were observed in the skill exhibited by tools made from different raw materials.

Table 34. Temporal trends in the skill of large patterned biface production, organized by regional time period.

	Skill Group			
Time Period	Limited	Moderate	Average	Total
post-1700	7.7%	45.3%	47.0%	117
1600-1700	5.9%	39.5%	54.6%	438
pre-1600	3.7%	37.1%	59.2%	267
Total	45	325	452	822

Kendall's tau-b=0.076; Approximate T=2.339; Approximate p=0.019

Production Sequences

To measure variability in the manufacturing techniques used by flintknappers living in different communities, I collected data on two key steps in the production process. The first is the use of heat treatment on various types of tools made from KRF. The second is the type of edge grinding used to finish arrowpoints.

Heat Treatment of Knife River Flint

Though KRF is a high-quality raw material, controlled heat treatment further improves its flaking properties by reducing the force required to detach flakes and by increasing the frequency of feathered flake terminations (Ahler 1983; Domanski and Webb 2007). Ahler (1983:5) notes that pressure flaking errors are less common in properly heated KRF, but that percussion flaking of heated stone is more challenging, from which he concludes that it should be used mainly in the production of small patterned bifaces. The process of heat treatment itself requires specialized knowledge, since improperly heated stone can be rendered unusable; heating KRF above about 275 °C produces harmful changes, including crazing, loss of tensile strength, and excessive brittleness. Physical evidence of heat treatment includes a waxy luster, abundant small-scale ripple marks on fresh flake scars, decreased translucency, and distinct color changes (Ahler 1983; Domanski and Webb 2007). However, replication experiments show that heat treatment does not always produce all of these changes. Specimens exhibiting unmistakable evidence of heat treatment are therefore assigned to the "certain" heat treatment group, while those exhibiting ambiguous indications are assigned to the "possible" heat treatment group. Heart region flintknappers likely used heat treatment to improve the performance of raw materials other than KRF, but with the exception of petrified woods and chalcedonies, no one has yet established criteria for reliably differentiating treated from untreated stone; for that reason my analysis is

limited to artifacts made from KRF.

As Ahler predicted, heat treatment rates vary by technological class (table 35). More than 40 percent of all small patterned bifaces were made from heat treated (or possibly heat treated) stone, while only half as many unpatterned bifaces were. Again, because heat treatment reduces the amount of force required to detach flakes, it is particularly beneficial for the production of tools requiring well-controlled removal of small flakes. However, some large patterned bifaces and unpatterned bifaces were made from heated stone. Pressure flaking was sometimes used to make these tools, but in general they were produced by percussion flaking. This somewhat counterintuitive finding may indicate that various types of tool blanks, including flakes and small cobbles or partially prepared cores, were heated together.

Table 35. Comparison of heat treatment rates among three technological classes.

	Heat Treatment Class			
Technological Class	None	Possible	Certain	Total
Small Patterned Biface	58.4%	10.8%	30.8%	435
Large Patterned Biface	70.9%	7.7%	21.4%	519
Unpatterned Biface	80.3%	6.0%	13.7%	117
Total	66.9%	8.8%	24.4%	1071

Pearson chi-square=27.651; *df*=4; p=0.000

Regionally, heat treatment rates varied over time for small patterned bifaces but not for large patterned bifaces (table 36). More than two-thirds of the small bifaces produced before 1600 were made from unheated stone. After 1700, only about half were. At the same time, the proportion of large bifaces made from unheated stone remained stable. Data presented in table 37 show that heat treatment rates do not vary significantly among Heart region assemblages. At Slant, Scattered, and Double Ditch villages, between one-half and two-thirds of the small patterned bifaces made from KRF were produced from unheated stone. The small sample from Bypass Village suggests that heat treatment was far less common before 1500, an interpretation bolstered by the complete absence of evidence for heat treatment in a small sample of tools from

Table 36. Temporal trends in heat treatment rates in small and large patterned bifaces.

	Technological Class							
	Small Patterned Biface				Large Patterned Biface			
	Heat Treatment Class				Heat Treatment Class			
Time Period	None	Possible	Certain	Total	None	Possible	Certain	Total
post-1700	50.5%	10.7%	38.8%	103	75.3%	9.9%	14.8%	81
1600-1700	57.6%	13.0%	29.4%	231	66.6%	7.5%	26.0%	208
pre-1600	68.3%	5.9%	25.7%	101	78.5%	6.9%	14.6%	130
Total	58.4%	10.8%	30.8%	435	70.9%	7.7%	21.4%	519

Table 37. Heat treatment rates for small patterned bifaces.

Site	Possible and Certain Heat Treatment	Total
Slant	34.1%	41
Scattered	47.1%	70
Double Ditch	41.9%	313
Bypass	27.3%	11
Total	41.6%	435

Pearson chi-square=2.760; *df*=3; p=0.430

Huff Village, which dates to the mid-1400s (Ahler 2000).

The apparent uniformity of post-1500 assemblages masks several interesting site-specific patterns. At Slant Village, heat treatment rates for small and large patterned bifaces are roughly equivalent and no temporal pattern is evident. By contrast, at Scattered Village, small patterned bifaces more frequently were made from treated stone and heat treatment rates for both small and large bifaces increased over time. Flintknappers at Double Ditch Village also prefered to make small patterned bifaces from heat treated stone, and the frequency of heat treatment increased steadily there, the treatment rate for large bifaces declined somewhat.

To better appreciate the role of heat treatment in Heart River stone tool production these data can be compared to data from Hidatsa sites in the KNRI, some 100 km upstream. As in the Heart region, flintknappers in the Knife more commonly applied heat treatment to the production of arrowpoints and other small patterned bifaces, though they too used treated stone to make other kinds of bifaces (Ahler and Weston 1981:Table 123). In both regions the rate of heat treatment of small bifaces increased over time, probably reaching a peak in the

Table 38. Heat treatment rates in small patterned bifaces for two sites in the Knife region, organized by time period.

Site	Time Period	Possible + Certain Heat Treatment	Total
Lower Hidatsa	1740-1790	60.9%	23
	1700-1740	72.2%	36
	1650-1700	53.1%	98
	1600-1650	50.0%	36
Big Hidatsa	1740-1790	18.8%	69
	1700-1740	37.0%	54
	1650-1700	28.9%	45
	1600-1650	27.3%	11

Data from Ahler and Toom (1993:Table 18.7 and Table 18.8).

first half of the eighteenth century. However, in contrast to the pattern in the Heart region, contemporaneous assemblages in the Knife region exhibit markedly different heat treatment rates (table 38). Flintknappers at Lower Hidatsa Village, for instance, used heat treatment about twice as frequently as flintknappers at Big Hidatsa Village throughout the seventeenth and eighteenth centuries.

Table 39 shows that, in the four-site Heart region subsample, heat treatment of KRF is strongly correlated with production skill. More than half of the tools in the highest skill group exhibit evidence of heat treatment, while only about 20 percent of the tools in the lowest skill group do. The relationship between skill and heat treatment is nonlinear: heat treatment rates for specimens exhibiting moderate or average skill are comparable, while the rate for those exhibiting high skill is nearly twice as great. The use of heat treated stone by flintknappers

Table 39. Heat treatment rates in Knife River flint tools, organized by producer skill.

	Heat Treatment Class			
Skill Group	None	Possible	Certain	Total
Limited	79.7%	5.8%	14.5%	69
Moderate	69.6%	8.3%	22.1%	326
Average	65.2%	9.5%	25.3%	549
High	43.8%	10.0%	46.2%	80
Total	65.9%	8.9%	25.2%	1024

Pearson chi-square=28.344; *df*=6; p=0.000

possessing only limited skills could signal the production of practice pieces by apprentice producers. The association between producer skill and heat treatment is also confined entirely to small patterned bifaces. About two-thirds (66.3 percent) of the small bifaces in the moderate skill group exhibit no evidence of heat treatment, while only about one-third (38.3 percent) of those in the high skill group do. By contrast, no differences are evident in heat treatment rates in the sample of large patterned bifaces, with 60 to 70 percent of the tools in each skill group exhibiting no evidence of heat treatment.

Because heat treatment facilitates pressure flaking, it is conceivable that patterns of heat treatment could unduly magnify the increase in the frequency of skilled production discussed previously. However, this is not the case: the regional increase over time in production skill can be seen in both treated and untreated KRF arrowpoints (table 40). The fact that the change over time in skill expression is roughly similar in small patterned bifaces made from heated and unheated stone, but that the most skilled flintknappers preferred treated stone, suggests that the knowledge and skill required for successful heat treatment was itself a component of skilled production.

Table 40. Comparison of skill expression in small patterned bifaces made from heated and unheated KRF, organized by regional time period.

		Skill Group			
Heat Treatment Class	Time Period	Moderate	Average	High	Total
No Heat Treatment	post-1700	18.4%	67.3%	14.3%	49
	1600-1700	24.4%	64.9%	10.7%	131
	pre-1600	23.2%	73.9%	2.9%	69
Possible + Certain Heat Treatment	post-1700	5.9%	70.6%	23.5%	51
	1600-1700	18.8%	60.4%	20.8%	96
	pre-1600	25.0%	59.4%	15.6%	32

Arrow Manufacturing Techniques

Another aspect of production sequences examined in this study is the frequency of various methods of arrowpoint haft element preparation. Four distinct modes can be identified among the 276 finished arrowpoints in the four-site sample that are sufficiently complete to observe the type of haft preparation. About 19 percent exhibit basal grinding, which typically is rather extensive, often producing a smooth, rounded edge along the length of the base. Another 17 percent show grinding on the lateral margins of the half element, but not on the base. This type of grinding is generally much lighter than basal grinding. On some artifacts falling into this category, especially those from Bypass and Scattered villages, a row of basal thinning flakes was removed from the base after the haft element was ground. This suggests that this haft element preparation class could in fact combine two slightly different production methods; additional experimental work would clarify this situation. A third type of haft preparation, used on about 16 percent of the arrowpoints in the sample, involved extensive grinding on both the base and the lateral edges of the haft element. The remaining artifacts, amounting to slightly less than 50 percent of the sample, exhibit no grinding at all. (The evidence suggests that haft grinding was the last step in the production process; however, a small number of incomplete points could inadvertently have been placed in this last, unground category, even though a variety of criteria unrelated to basal preparation were used to determine whether an arrowpoint had been completed.) The origins and significance of the differences among these four haft preparation methods are not known. However, it seems likely that they were linked in some way to different methods of arrow manufacture, especially to the way arrowpoints were attached to the arrow shaft. It is not known whether these manufacturing differences were associated with functional differences.

Like heat treatment of KRF, haft element grinding is associated with skilled production (table 41). Three-quarters of the arrowpoints in the moderate-skill group have unprepared

Table 41. Frequency of arrowpoint haft preparation techniques, organized by producer skill.

	Haft Preparation Technique				
Skill Group	No Grinding	Basal Grinding	Lateral Grinding	Basal and Lateral Grinding	Total
Limited	100.0%				3
Moderate	75.8%	9.1%	9.1%	6.1%	33
Average	47.9%	17.0%	16.4%	18.8%	165
High	34.7%	28.0%	22.7%	14.7%	75
Total	133	52	47	44	276

Pearson chi-square=22.190; *df*=9; p=0.008

haft elements, while just over one-third of those in the high-skill group do. The frequencies of all three types of haft grinding increase with the skill of production, suggesting that equally accomplished arrow makers used distinct production methods. The spatial distribution of these three methods sheds additional light on the organization of arrow production. Table 42 presents data on the prevalence of different haft preparation methods in the four-site subsample. All four methods were used at Double Ditch Village, whereas arrowmakers at Slant Village used just three methods. Two methods were dominant at Scattered and Bypass villages. Whether individual arrow makers produced more than one type of arrow is not known, but the distribution of arrowpoints made with combined basal and lateral grinding supports the notion that they did not. This method is all but absent from every assemblage except the Double Ditch Village assemblage, where it was used to produce more than one in four arrowpoints. Apparently, this production method, or perhaps the particular type of arrow it was used to make, was made almost

Table 42. Frequency of arrowpoint haft preparation techniques, organized by site.

	Haft Preparation Technique				
Site	No Grinding	Basal Grinding	Lateral Grinding	Basal and Lateral Grinding	Total
Slant	66.7%	20.8%	12.5%		24
Scattered	68.4%	2.6%	23.7%	5.3%	76
Double Ditch	33.8%	28.6%	11.7%	26.0%	154
Bypass	59.1%	4.5%	36.4%		22
Total	133	52	47	44	276

Pearson chi-square=68.288; *df*=9; p=0.000

exclusively at Double Ditch.

Regionally, the frequencies of the four haft element preparation methods changed little over time. During each period, about half of the arrowpoints exhibit unground bases. The frequencies of the three types of ground hafts vary somewhat, with basal grinding increasing and lateral grinding decreasing. However, this generally stable pattern masks some interesting inter-site differences. At Double Ditch, no temporal trends are evident. There, in each time period 30 to 40 percent of the arrowpoints exhibit unground bases and all three types of haft element grinding are well represented. By contrast, at Scattered Village, almost 90 percent of the arrowpoints made before 1600 have unground hafts. In the seventeenth century, lateral grinding became more common and two new preparation methods were introduced. While this pattern is based on a relatively small sample, it may signal an increase in the number of skilled arrow makers at Scattered Village, or may indicate that new production methods had been acquired from neighboring communities.

Discussion

The most striking features of the data presented here are the marked differences between villages and the fact that several different forms of stone tool production coexisted in the Heart region. To begin with, patterns of exotic raw material use suggest that different communities interacted with mobile groups living in different regions, whether they obtained those materials directly or through trade taking place at their villages or at distant rendezvous. For instance, the residents of Boley Village maintained regular connections with groups to the west and southwest, connections that apparently were unavailable to the residents of Double Ditch and Larson villages, judging by the very limited use flintknappers at those sites made of exotic raw materials from those areas. Instead, these east-bank communities may have interacted to a greater degree with mobile groups living to the north or east, where stone tool raw materials are comparatively

scarce. At Scattered and Slant villages, stone tool producers enjoyed access to exotic raw materials from sources to the southwest, but not from sources to the west. One can speculate that these interaction networks may also have afforded access to different types of plant or animal resources endemic to the different regions where these stone sources are located.

Utilization patterns of near-local raw materials complement this picture of land use diversity and suggest that different Heart region communities used distinct, though partly overlapping, resource zones. Flintknappers at Scattered and Slant villages obtained much of their KRF from the quarries, while flintknappers at Double Ditch made greater use of secondary sources located relatively nearby. Access to petrified wood and chalcedony from western North Dakota seems also to have been limited for the residents of Double Ditch. These Near-Local West sources were used extensively at Scattered, Slant, and especially Boley villages. By contrast, all of the villages appear to have had direct access to one or more smooth gray TRSS quarries. The fact that these patterns appear largely to have been in place when these sites were founded, coupled with the fact that they persisted into the eighteenth century, indicates that village resource zones were relatively stable.

Some of these differences in raw material use imply diversity in the organization of procurement. The fact that nodules of smooth gray TRSS were partly reduced, and perhaps heat treated, away from the villages suggests that they were obtained by dedicated task groups who spent several days camped near the quarries. The residents of Scattered and Slant villages probably organized KRF procurement in the same way. By contrast, flintknappers at Double Ditch seem to have obtained KRF from lower density sources, bringing small, unworked nodules back to the village for processing. Given the relatively widespread occurrence of Near-Local West toolstone, for most or all of the Heart River settlements procurement of those resources likely was embedded in other tasks. In any case, the size and composition of task groups engaged in such embedded procurement was probably quite different than the size and composition of focused stone quarrying groups. It seems likely, too, that the social relationships between stone

tool producers and the people who obtained raw materials varied in each case.

These interpretations are consonant with the conclusions drawn by other investigators who have considered such differences at larger scales. Not only did communities associated with different cultural traditions claim different resource zones, as Ahler and others (1997) found in their comparison of Mandan and Hidatsa assemblages, or as Ahler (1977a) and Johnson (1984) found for the Coalescent and Middle Missouri traditions, but so did communities sharing a common cultural background. This finding echoes work Steve Holen (1991) carried out on Pawnee assemblages from the central Plains. Using ethnographic and archaeological data he shows that strong differences in the raw material make up of flaking debris assemblages from two Pawnee communities reflect differences in their customary bison hunting ranges. He also uses raw material frequency data to show that over the course of the eighteenth century some Pawnee villages altered their lithic procurement practices, reflecting changes in their resource use areas. Such spatial changes likely entailed shifts in the content, context, and frequency of inter-group exchange, as researchers working with collections from the KNRI have argued (Ahler and Toom 1993).

However, it is worth pointing out that patterns of raw material use reflected more than landscape use or exchange relations. Because certain materials were preferred for producing certain kinds of tools, raw material selection also reflects the demands of production. This is seen in the regional shift from TRSS to KRF that accompanied the shift from flake tool production to patterned tool production. Regionally, the use of smooth gray TRSS declined from the sixteenth to the eighteenth centuries and with it the production of unpatterned flake tools. Over the same period these declines were matched by increases in the use of KRF and the production of small patterned bifaces, mainly arrowpoints, and to a lesser degree end scrapers. This shift is most evident at Double Ditch and Slant villages, but took place at Scattered and Boley villages as well.

Technological diversity among Heart region assemblages points to the existence of

several different forms of production. The distribution of bipolar tools provides an example of what commonly is called community-level craft specialization. Tools made by this technique account for 13 percent of the assemblage from Scattered Village and are distributed ubiquitously across the site. By contrast, at Double Ditch Village they make up less than one percent of the assemblage. The function or functions of bipolar tools are not well understood (Hayden 1980; Le Blanc 1992; Shott 1989). Indeed, uncertainly about their function is expressed in the large number of terms that have been used to describe them, including punch, wedge, chisel, and core. However, data on bone and antler artifacts from Scattered Village provide clues to their function (Ahler and Falk 2002). Many of the bison scapula hoes and split rib tools there bear telltale impact fractures suggesting they were produced using bipolar stone tools. In addition, bipolar stone tools may also have been used as wedges or as grooving or slotting tools in the production of antler bracelets, chokers, and wrist guards. Manufacturing debris, especially from antler bracelet production, is notably common in the Scattered Village collection. The apparent association between bipolar tools and scrapers may indicate that both were used for antler ornament production, a hypothesis that could be tested against use-wear data on scrapers. These intercommunity differences persisted over time, indicating that the emphasis different communities placed on different types of production was a durable feature of the regional economy, one that was well established by the time the Heart River towns were founded.

Other aspects of tool assemblage diversity also point to the localization or concentration of certain kinds of craft production, but the scale of that localization is not clear. Scrapers are common at Boley Village, suggesting that hide production (or perhaps woodworking or bone and antler tool production) may have been an important activity there. Abraders used in arrow manufacture are notably common at Bypass Village. Finished stone beads, as well as manufacturing debris, are disproportionately abundant at Slant Village. Several lines of evidence from Larson Village suggest that greenstone celts may have been manufactured there (Mitchell and Swenson 2008). Whether or not these patterns would hold up in the face of

additional evidence from these sites is not known. But even if they did not, the inter-assemblage comparisons made here nevertheless hints at the possibility that individual households or perhaps groups of households produced different kinds of tools or carried out specific productive tasks.

In fact, data on the rate of manufacturing errors bolsters the view that certain types of production were localized at the household or neighborhood level. Flintknappers working at Scattered Village and Double Ditch villages produced higher-quality arrowpoints that those at Slant or Bypass villages. These skilled producers used heat treatment more often and produced arrowpoints that were longer, broader, and more uniform than their less-skilled contemporaries. Of course, this evidence does not mean that arrowpoints (and presumably arrows) were produced only by a small number of people, or that those who produced them always turned out high-quality products. Rather, it indicates that different flintknappers devoted varying levels of effort to their craft. Presumably those who devoted more time to arrow production consequently had less time for other kinds of tasks. Moreover, data on arrowpoint haft preparation techniques indicates that local communities of practice existed in each Heart region settlement. Interestingly, skill seems to cross-cut these "technological subtraditions," as Ahler and Toom (1993:254) call them, indicating that each community of practice incorporated individuals with varying abilities.

Trends in the rate of production errors, in product uniformity, and in the use of heat treatment indicate that, regionally, the proficiency of arrowpoint production increased over time. This suggests that the amount of time some producers spent making arrows increased over time. It could also mean that the number of producers diminished over time, although the increase in the relative frequency of arrowpoints argues against this interpretation. Thus, over time, arrow manufacture in the Heart region became more localized or concentrated as a smaller number of producers were increasingly responsible for the total output. Interestingly, this trend can even be seen in communities such as Slant Village where production was likely never highly concentrated. This increase in skilled arrowpoint production stands in marked contrast with the pattern for cutting tools, which declined in quality over time. Thus, production of some tools

became more concentrated while the production of other kinds of tools became more widespread or dispersed.

The congruent increases in the skill of arrow production and in the number of arrows produced suggest that the demand for arrows increased over time. Whether that demand was fueled by war, by hunting, or by both is not known. In the twentieth century, Hidatsa informants told Gilbert Wilson that arrows meant for war and those meant for hunting were fitted with different points (Weitzner 1979:240). However, the arrows then in use had metal points and similar morphological differences have not been documented among stone arrowpoints from earlier periods. I can note, though, that the regional expansion of arrowpoint manufacture is matched by a modest increase in the number of scrapers, likely used mainly for hide preparation. In any case, the fact that the ratio of finished to unfinished arrowpoints is stable over time suggests that the increase was due to local production and consumption, rather than to importation or production for exchange. As an aside, the apparent increase in the diversity of haft preparation types at Scattered Village could point to an increase in the frequency of food exchange or cooperative hunting. If finished arrowpoints mainly entered the Heart River towns embedded in animal carcasses, then the low-level occurrence of arrowpoints with uncommon haft element types may indicate the existence of multi-community hunting parties or intercommunity food sharing, perhaps facilitated by clan relationships. Intercommunity arrow exchange also could produce a similar in pattern.

In sum, then, these data indicate that different Heart region settlements maintained connections with different mobile groups; that they obtained different raw materials in different ways; that the production of different types of tools was organized in different ways; that the production of some kinds of tools was concentrated in certain communities or households; and that the concentration or localization of some types of production increased over time. In the next chapter I compare these patterns and trends to data on the organization of pottery production.

Chapter 7:

Crafting History, Part II: Pottery Production in the Heart Region, 1400-1750

How does the organization of Heart region pottery production compare with the patterns of stone tool production laid out in the last chapter? Are the intercommunity technological differences evident in the manufacture of stone tools also discernable in pottery manufacture? Do changes in the skill of pottery production parallel changes in the skill of arrowpoint production? Before addressing these questions I briefly review the findings of prior pottery technology studies.

Previous Research on Pottery Technology in the Northern Middle Missouri

Like most parts of North America, typological classification of pottery assemblages has been the backbone of culture historical archaeology in the Middle Missouri subarea. The system Middle Missouri archaeologists commonly use was developed initially by Lehmer (1954:41-42; see also Calabrese 1977). The highest-order unit in Lehmer's system is the pottery "ware," which he defines as a set of types sharing a variety of basic, and largely technological, properties, including their clay body or paste, vessel shape, rim form, and surface treatment. Many, but not all, of the defined wares in turn include one or more types (usually called "varieties" or "subwares"), which are distinguished by differences in decorative technique and decorative pattern or motif. In the Middle Missouri, all analysts now make a fundamental distinction between two kinds of wares: straight-rim wares, in which the upper rim of the vessel is vertical or flares outward, and S-rim wares, in which the upper rim curves inward.

In the late 1960s and 1970s, archaeologists began to recognize that the use of this system had "gotten badly out of hand" in the Middle Missouri (Calabrese 1977; Johnson 1980; Lehmer 1971:23; Lehmer and Caldwell 1966). In some cases, different names were given to similar or

even identical forms. In others cases, distinct forms shared a common name. A number of wares were defined on the basis of a single assemblage or even a mere "handful of sherds" (Lehmer 1971:23). In response to these problems, researchers working with collections from the KNRI and other sites in the Knife and Heart regions began developing an attribute-based analysis system that integrated typological information with nominal and interval data on ceramic form, decorative techniques, design motifs, and manufacturing technology (Ahler and Swenson 1985b).

The KNRI investigators had in mind two general kinds of questions about ceramic style and technology. The first paralleled the kinds of questions they were asking about stone tool technology: how did the advent of Europeans affect pottery production and ceramic technology? When were its effects first felt? This topic had interested scholars working in the northern Middle Missouri for some time. Some attributed the apparent nineteenth-century decline in the quality of the Mandan and Hidatsa pottery—embodied in the technical properties of Knife River ware, the principal pottery ware of the time—to competition from metal containers supplied by the fur trade (Will and Hecker 1944: 69-70). Others suggested that the quality of ceramic cooking pots declined because the large-scale epidemics that swept through the Middle Missouri in the eighteenth and nineteenth centuries led to the deaths of skilled potters. The effect of their deaths was compounded by a simultaneous increase in the time women devoted to producing surplus hides for exchange (Wilson 1977). Still others framed technological differences between early and later pottery types largely in terms of ethnicity rather than in terms of colonial interaction (Ahler and Swenson 1993; Speakman, Ahler, and Breakey 1997). Attribute analysis of collections from the KNRI and other sites in the Knife and Heart regions indicates that, while all of these factors likely contributed, the effects of epidemic disease and the availability of metal containers really only affected ceramic technology after the middle of the 1700s (Ahler and Swenson 1993:160-161).

The second set of questions was culture historical. KNRI investigators wanted to know

whether aspects of ceramic style and technology could be used to distinguish between ancestral Mandan and Hidatsa communities. Prior to the KNRI project many scholars argued that Mandan and Hidatsa material culture was all but indistinguishable. Again, the attribute analysis applied to collections from the KNRI and other Knife and Heart region sites demonstrated that, on both technological and decorative grounds, ethnic based potting traditions could be discerned, traditions that were in place at least by 1600 (Ahler and Swenson 1993:160).

Perhaps the most sophisticated technological analysis was undertaken to resolve a somewhat different culture historical problem (Ahler 1984a). Excavations at the Elbee site in the KNRI produced a stylistically distinct pottery assemblage exhibiting attributes evocative of Extended Coalescent assemblages found far to the south. To further investigate the possibility that the Elbee site represents a migration of Coalescent peoples, Ahler collected data on the technological attributes of the ceramic assemblage, including temper size and abundance, paste color and porosity, and so forth. He also collected data on production skill, which he measured in terms of vessel wall compaction, the frequency of surface flaws, firing quality, and overall technical quality. If the residents of Elbee were immigrants, Ahler argues, the assemblage would include non-local as well as local pottery. He also argues that the collection should be technologically heterogeneous, owing to a lack of familiarity with local ceramic resources, but that a set of consistently applied forming and finishing methods should nevertheless be evident. The analysis supports some of these expectations, although he argues that the technological heterogeneity of the sample likely is due to a number of factors, including variable producer skill.

A distinctive feature of the KNRI attribute analysis is the use of multivariate statistical techniques. These methods maximize the utility of the large datasets generated by attribute analysis, revealing assemblage-wide patterns of variation that ordinarily are masked by typological approaches. More recently, Craig Johnson has extended multivariate analysis of pottery assemblages to a much larger sample of sites located mainly in South Dakota (Johnson

2007a).

In the Heart region, data on pottery manufacturing techniques have been used to study interactions between Late Woodland bison hunters and Middle Missouri tradition farmers. Using a *chaine operatoire* approach tied to defined ceramic landmarks, Richard Krause (2007) finds that pottery from the thirteenth-century Menoken site exhibits production techniques characteristic of Woodland tradition practices as well as techniques used by Middle Missouri tradition potters. Krause interprets this fusion of manufacturing practices as evidence of the acculturation experienced by Late Woodland hunters who were in contact with Initial Middle Missouri tradition farmers, a process discussed in chapter 4.

Technological analysis of Plains Village-age pottery collections from the Heart region began in 2004. Initially applied to selected samples from Double Ditch Village, and later to a larger sample from Boley Village, this work built directly on the comprehensive attribute system developed for ceramic research in the KNRI (Ahler and Swenson 1985b). The newly developed technological component of the pottery coding system includes 22 variables developed during two workshops sponsored by Paleocultural Research Group. The variables are designed to document methods of vessel construction and finishing, paste characteristics, firing characteristics and so forth. The Boley Village project, along with several other pilot studies, demonstrated a series of significant correlations between stylistic variation and technological variation, including upper and lower rim construction techniques and surface treatment (Ahler, Madden, and Mitchell 2006:Table 35).

Heart Region Pottery Types

Despite the recent emphasis given to attribute analysis, typological classification remains important to the study of northern Middle Missouri ceramics, in part because the effort necessary to apply the full attribute coding system is considerable. However, the current Middle

Missouri ceramic typology encodes considerable technological data, because Lehmer's ware and type system is based primarily on variables related directly to the steps and stages of pottery production. Aspects of pottery style enter mainly into the definition of varieties.

With the exception of some nineteenth-century assemblages, all Middle Missouri pottery collections include both straight-rim and S-rim forms and archaeologists consider paired sets of straight-rim and S-rim wares to be characteristic of particular time periods. Twelve ceramic wares are present in the four-site Heart region subsample. Nearly three-quarters of the study assemblage consists of Knife River ware (a straight-rim ware) and Le Beau ware (an S-rim ware), the paired set characteristic of Knife and Heart region collections dating to the 1500s, 1600s, and 1700s. Another four percent consists of Stanton ware (straight-rim) and Sanger ware (S-rim), which together are characteristic of fifteenth century assemblages. Just 11 vessels in the study assemblage are classified as Riggs (straight-rim) or Fort Yates (S-rim) ware, which define Extended Middle Missouri collections dating to the 1200s and 1300s. Detailed consideration of Heart region ceramic wares can be found in Ahler (2001), Ahler and Stanford (2004), Ahler, Warner, and Smail (2002), and Mitchell, Madden, and Ahler (2007).

S-Rim Wares

Seven S-rim wares are present in the four-site subsample, three of which are illustrated here (figures 22, 23, and 24). Fort Yates ware was the dominant S-rim form in the Heart region until around 1400. It is distinguished by a comparatively tall upper rim (zone 3) and an angular juncture with the lower rim (zone 2). Cord impression is the dominant decorative technique. Cords are large and widely spaced. The most common decorative pattern consists of 3 to 6 horizontal impressions, broken by four or more angular designs arranged symmetrically around the rim. Lips are generally flat rather than rounded.

Sanger ware was first produced around 1400 and is distinguished by a subangular to non-

angular lower zone 3. On most Sanger ware vessels, the height of zone 2 is roughly equivalent to the height of zone 3. Cord impression also is the dominant decorative technique, but horizontal cord impression frequency is higher, cord diameter is smaller, and the cords are more closely spaced than on Fort Yates vessels. Many Sanger ware vessels bear four equally-spaced sets of chevron-shaped cord impressions. Often these chevron or angular rainbow patterns are centered on a node attached to the rim at or just below the lip. Lip shapes are more variable in Sanger ware than in Fort Yates ware. Production of Sanger ware ceased by about 1525.

Le Beau ware first appeared in the northern Middle Missouri about 1500 or perhaps a

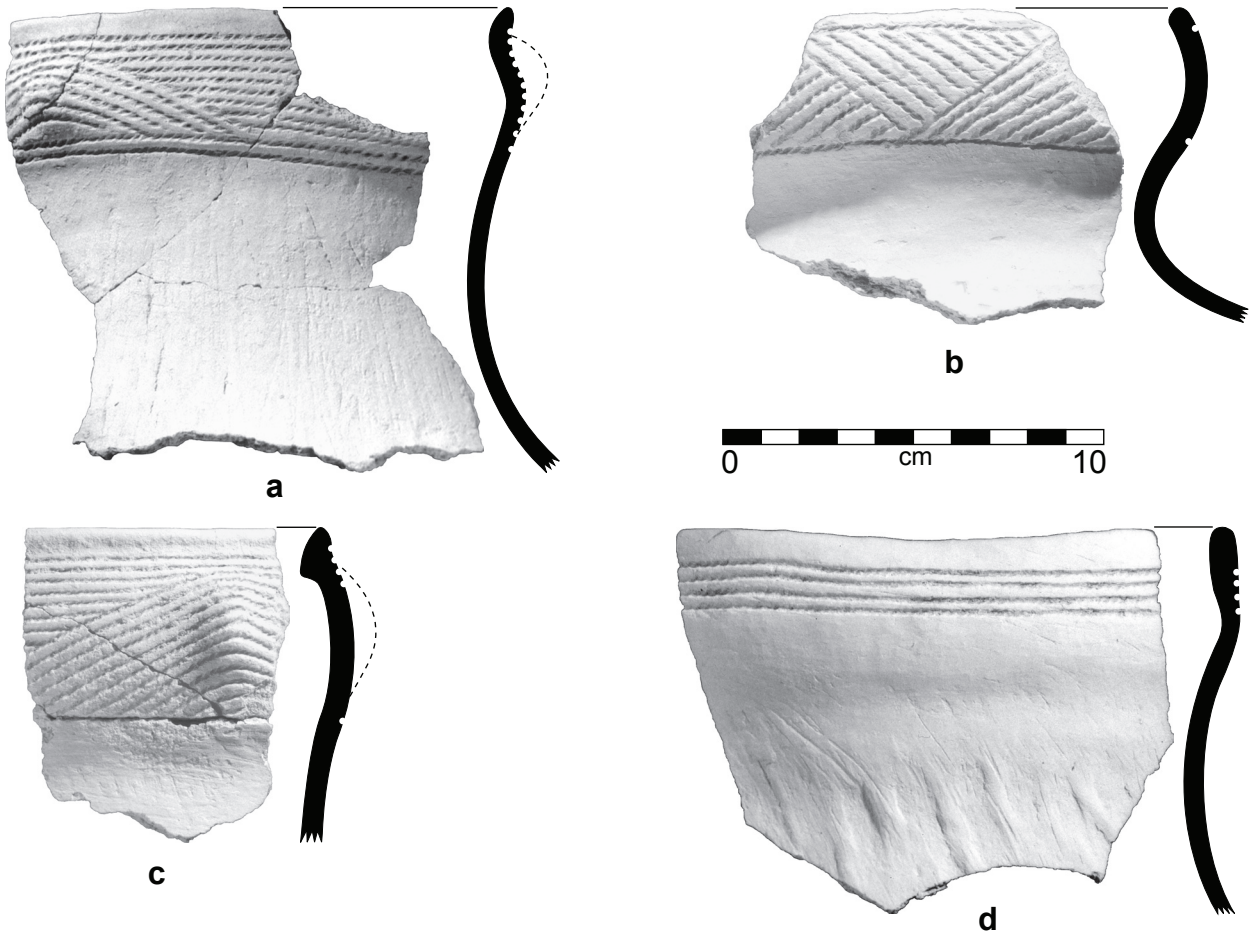

Figure 22. S-rim wares from the Heart region. a: Le Beau Recurved variety; b, c: Le Beau Classic variety; d: Sperry ware; vessel exteriors to right (adapted from Ahler and Madden 2005).

little earlier. On Le Beau ware vessels the height of zone 3 usually is markedly shorter than the height of zone 2 and the juncture between the upper and lower rim is smoothly curved. Cord impressing remains the dominant decorative technique, but impression spacing is narrower and cord size is smaller. Decorative patterns often consist of many closely-spaced horizontal cord impressions (up to 18), broken by four curvilinear "rainbow" motifs arranged symmetrically around the vessel and centered on a small node. Another common zone 3 decorative pattern consists of a bounded zone filled with diagonal or zoned-triangle cord lines. A number of lip forms occur and interior or exterior bracing is common in some assemblages. In this study, Le Beau ware is partitioned into six varieties based on rim form details and decorative technique.

Overall, the shift from Fort Yates ware to Sanger ware to Le Beau ware was gradual and continuous. Key features of the shift include a steady reduction in the angularity of the juncture between upper and lower rim, a decrease in the height of the upper rim relative to the lower rim, and a decrease in the diameter of the cords used in decoration.

Four other minor S-rim wares are also present in Heart region assemblages. Le Beau Fine ware vessels are morphologically similar to Le Beau ware vessels, but are much smaller and sometimes are more elaborately decorated. Some vessels in this group are well made and may have served special non-culinary functions, but others clearly are "practice pieces" made by children or novices. Overall, they are widely distributed but generally rare.

Sperry ware used to be considered a variety of Le Beau ware, owing to its S-rim form, but Sperry vessels differ significantly from Le Beau vessels both morphologically and decoratively (figures 22 and 23). Sperry ware is distinguished by a subtle but distinctive subangular lower zone 3, which is expressed most clearly on the exterior. Cord impression is the only known decorative technique. The decorative pattern generally consists of 4 (rarely, 3 or 5) horizontal cord impressions on the upper rim, with no use of curvilinear "rainbow" motifs. Nodes, handles and other appendages have not been recorded on Sperry vessels, but interior bracing is common, as is a "wavy" vessel orifice created by periodic deformation of the lip and

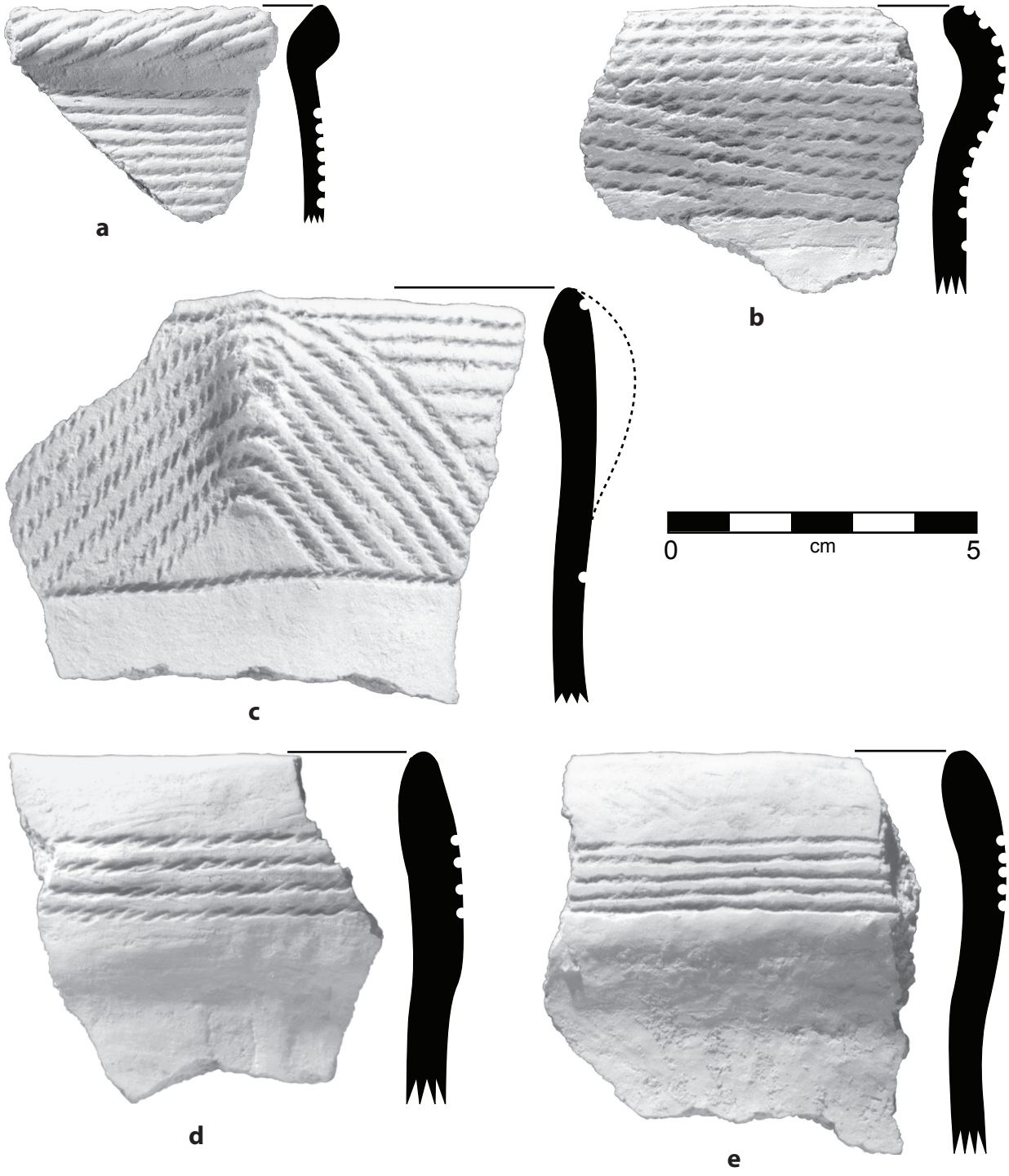

Figure 23. S-rim wares from the Heart region. a: Le Beau Recurved variety; b: Le Beau High Rim variety; c: Le Beau Classic variety; d, e: Sperry ware; vessel exteriors to right (adapted from Ahler and Madden 2005).

upper rim. Both interior and exterior vessel surfaces commonly are burnished.

Transitional ware combines the S-rim form of Le Beau ware with the bold exterior brace and decorative pattern of Knife River ware (see below) (figure 24). The brace is generally so large that it covers the entire upper rim. Decoration generally consists of diagonal cord impressions on the brace, with a row of finger or tool impressions at the juncture between the brace and the exterior vessel wall. First identified in studies of Hidatsa sites in the Knife region, Transitional ware has sometimes been considered a companion to Knife River ware. Transitional ware was produced over a long period of time and can be found at many sites in both the Knife and Heart regions, though nowhere can it be considered abundant.

Unclassified S-rim ware is a catch-all category that includes vessels that do not fall into one of the other S-rim classes. Vessels in this category include those exhibiting rare or unique decorative techniques, rim forms, or decorative patterns.

Straight-Rim Wares

Five straight-rim wares are present in the four-site subsample, two of which are illustrated in figure 24. The earliest, which is associated with Extended Middle Missouri sites and is paired with Fort Yates ware, is known as Riggs ware. Riggs ware rims are tall, with straight, everted, or sometimes flared profiles. The juncture between the rim and the vessel body is angular. The rim is usually robust, but commonly tapers toward the top. Decoration, usually consisting of repetitive tool marks or finger impressions, is confined to the top or outer edge of the lip or sometimes to a fillet on the upper rim.

Stanton ware began to replace Riggs ware in the later 1300s and was particularly popular, along with Sanger ware, its companion S-rim form, between 1400 and 1525. Stanton ware is a straight rim form that sometimes has a small exterior brace or a fillet. The rim is typically shorter than Riggs ware rims. The upper rim may be gently curved or straight and the rim-body junction

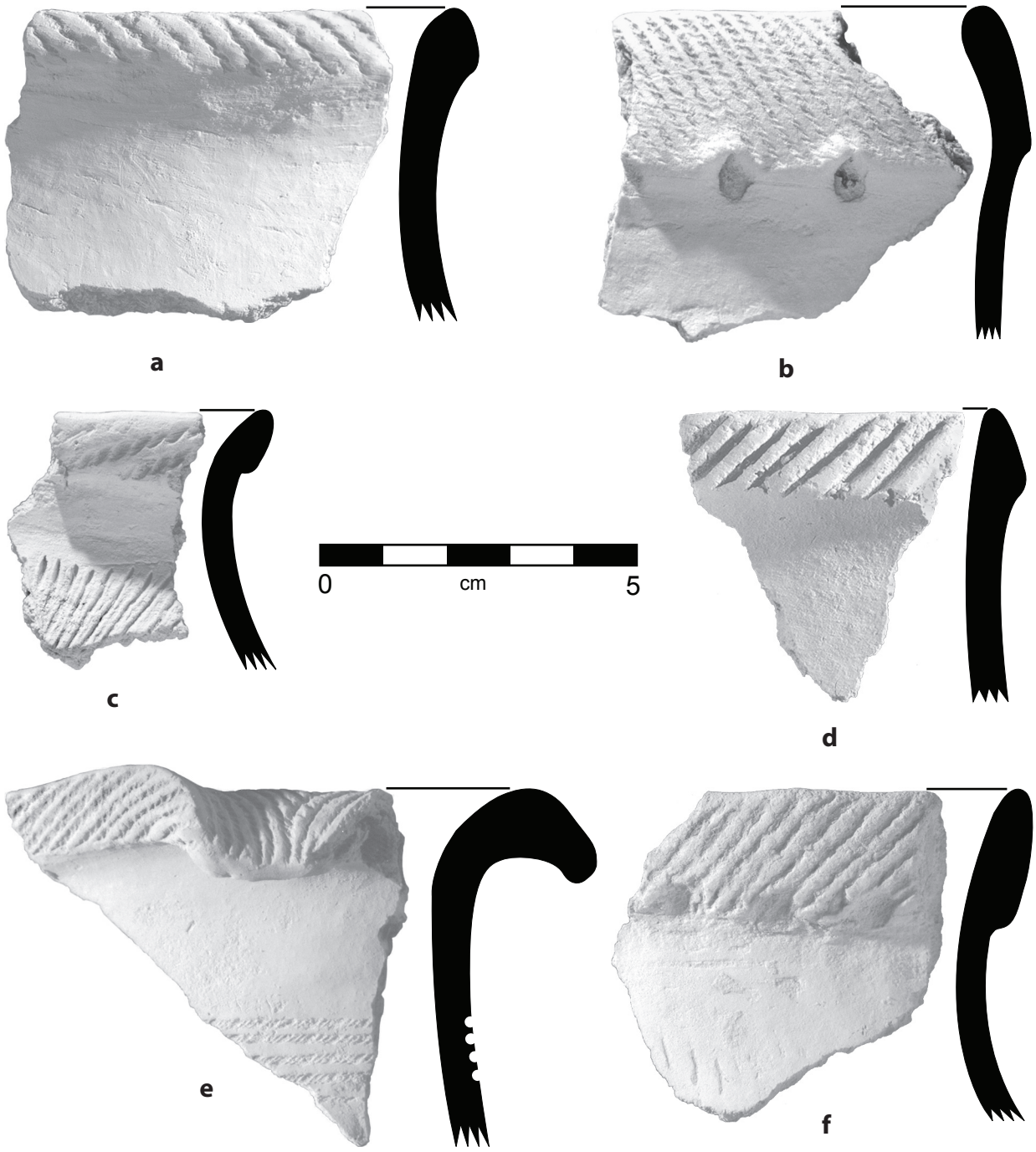

Figure 24. Straight rim and S-rim wares from the Heart region. a, d, e, f: Knife River ware; b: Transitional ware; c: Knife River Fine ware; vessel exteriors to right (adapted from Ahler and Madden 2005).

is usually less angular than is the case for Riggs ware. Particularly in the Knife region, the lips of

Stanton ware vessels are heavily modeled, with T-shaped, L-shaped, beaded, and inslanted forms common. Stanton ware vessels usually are decorated with repetitive tool impressions on the lip or upper rim.

Knife River ware developed out of Stanton ware around 1500 and is distinguished by a high, gently and evenly curving rim to which a more-or-less prominent brace was added. Lips usually are round and the brace shape is curved or, less commonly, wedge-shaped. Cord impressing is the dominant decorative technique, though other techniques sometimes were used. Decorative pattern commonly consists of diagonal impressions on the brace and lip. In some cases, parallel horizontal cord impressions occur in zone 2. Later examples frequently includes spouts, handles, castellations, and other appendages.

Knife River Fine ware is also a braced straight-rim form, but is distinguished from Knife River ware by its small size and elaborate decoration. Decorations generally incorporate both the rim and the upper body; shoulder decorations are generally incised while decoration elsewhere consists of cord impressions. Many Knife River Fine vessels have angular shoulders, creating a nearly horizontal upper body. Like some Le Beau Fine vessels, Knife River Fine pots are well made and may have been used for special purposes. They are widely distributed but generally rare in both the Knife and Heart regions.

Finally, Unclassified Straight-rim ware is, like Unclassified S-rim ware, a catch-all category that includes both braced and unbraced rims bearing unusual decoration or other features precluding their assignment to a better-defined ware.

The Fifteenth-Century Technological Transformation

For the stone tool analysis, I combined artifacts from mid-fifteenth century contexts at Bypass Village with artifacts produced in the late fifteenth and sixteenth centuries at Slant, Double Ditch, and Scattered villages. For the most part, the technological and formal differences

between the assemblage from Bypass Village and those from the three other sites are modest. However, this is not the case for the pottery sample. Rather, it is clear that a major transformation took place in Heart River pottery technology and form in the later 1400s, a transformation that largely defines what has come to be known as the Heart River phase (Wood 1986a) or Heart River complex (Ahler 1993a). Table 43 summarizes the typological differences between the Bypass Village sample and the samples from later sites. A few Riggs ware and Fort Yates ware vessels, the defining types of thirteenth- and fourteenth-century Extended Middle Missouri assemblages, are present in the Bypass Village collection but are absent from later collections. Stanton ware and Sanger ware, the dominant types at Bypass Village, are common in mid-1400s assemblages throughout the Knife and Heart regions, but by 1500 or 1525 had largely disappeared (Ahler 2001; Mitchell, Madden, and Ahler 2007).

The Bypass Village collection also stands out technologically (tables 44 through 46). Compared to later vessels, bracing is uncommon on straight-rim vessels from Bypass Village and is entirely absent on S-rim vessels (table 44). Fillets appear on some straight-rim vessels at Bypass, but not in later Heart region collections. Table 45 illustrates differences in the basic construction techniques used to form the upper rim. More than half of the vessels in the

Table 43. Frequencies of pottery wares in the four-site subsample.

	Site				
Ware	Slant	Scattered	Double Ditch	Bypass	Total
Unclassified Straight-rim	4.6%	5.7%	5.1%		84
Stanton	.5%			22.6%	20
Unclassified S-rim	5.0%	.8%	5.4%	2.4%	63
Sanger			.1%	61.9%	53
Riggs				10.7%	9
Fort Yates				2.4%	2
Le Beau	72.0%	58.6%	53.7%		926
Knife River	8.7%	24.1%	18.6%		305
Knife River Fine	4.1%	5.3%	2.8%		61
Transitional	1.8%	3.4%	2.5%		43
Sperry		.4%	8.6%		76
Le Beau Fine	3.2%	1.7%	3.2%		43
Total	218	527	856	84	1685

Table 44. Frequencies of rim form classes in the four-site subsample.

	Site				
Rim Form Class	Slant	Scattered	Double Ditch	Bypass	Total
bowl	.9%		.4%		5
straight rim	2.3%	4.7%	3.9%	25.0%	84
straight rim, brace	13.8%	29.8%	22.1%	4.8%	380
straight rim, fillet				3.6%	3
s-rim	31.2%	28.3%	47.1%	66.7%	676
s-rim, exterior brace	16.1%	10.1%	4.2%		124
s-rim, fillet		.4%			2
recurved s-rim	21.6%	8.2%	3.9%		123
recurved s-rim, exterior brace	5.5%	5.7%	.9%		50
straight rim, interior brace	.5%	.4%	.2%		5
s-rim, interior brace	8.3%	12.5%	15.8%		219
recurved s-rim, interior brace			1.3%		11
s-rim, interior and exterior brace			.1%		1
bowl, brace			.2%		2
Total	218	527	856	84	1685

Table 45. Frequencies of upper rim construction techniques used to produce pottery vessels in the four-site study sample. Data only includes vessels for which confidence in the construction determination was coded as "moderate" or "high."

	Period				
Upper Rim Construction	post-1700	1600-1700	pre-1600	1400-1450	Total
no addition	7.1%	6.7%	4.4%	56.0%	140
exterior coil	32.9%	38.6%	35.2%	22.6%	557
interior coil	27.7%	27.4%	25.7%	2.4%	402
exterior coil, smoothed			.6%		2
lip coil	26.6%	18.3%	26.7%	17.9%	342
two exterior coils	1.1%	1.9%	.6%		21
two interior coils		.5%			4
exterior coil, raised	.3%	.1%		1.2%	3
interior coil, raised	.3%				1
modified lip coil	.3%	1.1%	1.6%		15
two exterior coils, smoothed	.3%				1
interior and exterior coils	1.4%	1.9%	1.9%		26
two lip coils	1.9%	3.3%	3.2%		43
complex	.3%	.1%			2
Total	368	792	315	84	1559

Bypass Village sample were built without adding coils of clay to the upper rim. By contrast, the vast majority of all later vessels incorporate one or more straps or coils in a wide variety of configurations. Fifteenth-century firing methods differed as well. Table 46 presents data on the frequency of eight core color classes organized by temporal unit. Compared to later periods, vessels from Bypass Village exhibit buff or red interiors, often with diffuse gray cores,

Table 46. Frequencies of eight interior color classes in size grade 1 vessel fragments in the four-site subsample.

	Core Color Class								
Period	red or buff, no core	red or buff, diffuse core	red or buff, sharp core	dark interior	light interior	gray, no core	black, no core	variable	Total
post-1700		14.2%	1.9%	18.9%	2.8%	33.0%	20.8%	8.5%	106
1600-1700	1.3%	16.8%	2.2%	15.9%	3.9%	30.2%	17.7%	12.1%	232
pre-1600	.9%	19.8%	2.7%	10.8%	9.9%	34.2%	5.4%	16.2%	111
1400-1450	15.8%	42.1%				26.3%	2.6%	13.2%	38
Total	10	92	10	69	23	153	70	60	487

Kendall's tau-b=-0.092; Approximate T=-2.369; Approximate p=0.018

indicative of incomplete firing in an oxidizing firing atmosphere. Later vessels more commonly exhibit black interiors, likely indicative of a reducing firing atmosphere. The occurrence of color gradients (with either dark or light interiors) in later assemblages suggests that an entirely different firing method may have been used after 1500, at least for some types of vessels. Clearly, different methods were used to produce vessels made in the 1500s and later than those used to make vessels in the 1400s and earlier, though the extent to which the Bypass Village assemblage captures the range of variation in earlier Extended Middle Missouri pottery technology is an open question. Nevertheless, here I remove the 10 analytic units at Bypass Village from the pre-1600 group and put them instead into a separate early fifteenth-century group.

Post-1500 Ceramic Diversity

To begin characterizing the organization of pottery production I first consider stylistic and technological differences among assemblages. The previous chapter interpreted spatial and temporal diversity in stone tool production technology in terms of differential access to raw materials and in terms of the localization or concentration of some types of production. Here, I incorporate data on artifact style and re-frame the discussion of both formal and technological diversity in terms of local production practices rather than in terms of local task differentiation.

In short, I ask whether different communities made different types of pottery and whether potters working in different communities made similar ceramic forms in different ways.

Table 47 gives the proportions of eight pottery wares in the three post-1500 Heart region assemblages. All three are dominated by Le Beau ware, long recognized as the Heart region's signature pottery, but the frequencies of this ware differ among them in interesting ways. At Slant Village, Le Beau ware decreases steadily in popularity over time. This trend is coupled with a steady increase in the popularity of Knife River ware, the next most prevalent kind of pottery. Knife River Fine ware, a small, highly decorated companion to larger Knife River ware cooking vessels, also increases in popularity over time. Previous work on the Slant Village collection documented these same complementary trends (Breakey and Ahler 1985; Speakman, Ahler, and Breakey 1997). In fact, archaeologists have long considered this basic pattern—a gradual decrease in the popularity of S-rim wares accompanied by an increase in the popularity of braced, straight-rim wares—as a long-term, regional "megatrend" (Ahler and Swenson 1993:120).

Table 47. Frequencies of eight pottery wares in three post-1500 Heart region assemblages.

	Site							
	Slant			Scattered		Double Ditch		
Ware	post-1700	1600-1700	pre-1600	1600-1700	pre-1600	post-1700	1600-1700	pre-1600
Unclassified Straight Rim	4.4%	5.8%	3.2%	5.6%	6.0%	3.9%	6.3%	5.4%
Unclassified S-rim	4.4%	5.8%	4.8%	.9%		3.9%	7.3%	4.9%
Le Beau	66.2%	69.8%	82.5%	57.6%	64.3%	45.8%	56.5%	62.7%
Knife River	14.7%	9.3%	1.6%	24.4%	22.6%	18.5%	18.4%	19.1%
Knife River Fine	7.4%	3.5%	1.6%	5.4%	4.8%	1.2%	3.8%	3.9%
Transitional	2.9%	2.3%		3.8%	1.2%	4.2%	1.6%	1.0%
Sperry				.5%		20.2%	1.9%	
Le Beau Fine		3.5%	6.3%	1.8%	1.2%	2.4%	4.1%	2.9%
Total	68	86	63	443	84	336	315	204

However, a rather different pattern is evident at Scattered and Double Ditch villages, where Knife River ware is far more common overall and where its share of the total ceramic assemblage remained stable over time. The consistent popularity of Knife River ware at these

two sites demonstrates that it was an important early component of the regional ceramic inventory, not a recent introduction as was once believed (Ahler, Warner, and Smail 2002). This pattern characterizes the pre-1600 assemblage from Larson Village collection as well (Mitchell, Madden, and Ahler 2007). At all three post-1500 villages in the subsample, the proportions of Knife River Fine ware tracks the proportions of Knife River culinary ware.

Only one trend is common to all three collections. Though low overall, the popularity of Transitional ware steadily increases over time in each assemblage. Transitional ware, generally viewed as a hybrid incorporating the formal elements of both Knife River ware and Le Beau ware, is common in the Knife region, especially at Big Hidatsa Village (Ahler and Swenson 1993). However, lacking any apparently pre-1500 antecedents, its origin remains enigmatic. In the Heart region, Transitional ware exhibits a distinctive and reasonably consistent combination of rim form and decorative technique, suggesting that it could have been produced by a small number of people. Alternatively, it may have served a special culinary function, given its characteristically large size and thick walls.

The two unclassified ware groups in the sample are made up of a wide variety of unusual, often unique, vessels that occur in low numbers in most northern Middle Missouri assemblages. The meaning of the apparent dearth of unusual s-rim forms at Scattered Village is not clear. No particular trends are evident in the frequency of Le Beau Fine ware, a group that somewhat inconsistently includes both small, carefully executed vessels as well as small practice pieces. Finally, the frequency of Sperry ware pots, which make up nearly a third of the late assemblage from Double Ditch, but are entirely or virtually absent in the other two assemblages, is a unique and revealing case that I examine closely later.

Inter-site typological differences are even more dramatic within Le Beau ware, the region's most abundant post-1500 ceramic type. Table 48 presents variety data on 922 Le Beau ware vessels organized by site and time period. The most striking differences are in the frequencies of Le Beau Recurved vessels. This highly distinctive variety makes up nearly

Table 48. Frequencies of Le Beau ware varieties within each post-1500 assemblage. Four vessels classified as Le Beau T-lip variety are omitted.

	Site							
	Slant			Scattered		Double Ditch		
Le Beau Variety	post-1700	1600-1700	pre-1600	1600-1700	pre-1600	post-1700	1600-1700	pre-1600
Classic	33.3%	42.4%	48.0%	30.6%	31.5%	73.2%	77.5%	86.7%
Recurved	20.0%	37.3%	48.0%	20.8%	31.5%	14.4%	11.2%	2.3%
High Rim	17.8%		2.0%	28.2%	16.7%	9.8%	7.9%	8.6%
Paddled	8.9%	5.1%		2.4%		1.3%	.6%	
Plain	20.0%	15.3%	2.0%	18.0%	20.4%	1.3%	2.8%	2.3%
Total	45	59	50	255	54	153	178	128

half of the early assemblage from Slant Village, but only slightly more than 2 percent of the contemporaneous assemblage from Double Ditch Village. And while it increases in popularity over time at Double Ditch, the opposite trend characterizes the Scattered and Slant assemblages.

Site-specific patterns also are evident in other varieties of Le Beau ware. Before 1600, Le Beau Plain was uncommon at Slant and Double Ditch villages but relatively common at Scattered. Over time its popularity increased at Slant, but not at Double Ditch. Le Beau Paddled seems to have been introduced during the seventeenth century and became particularly prevalent at Slant Village. Le Beau High Rim was twice as popular at Scattered Village as it was at Double Ditch Village. In the two earliest samples from Slant Village it is uncommon or absent but is comparatively common in the late sample. Overall, these data indicate that, even though each of the defined types is present in every settlement, their proportions varied among contemporaneous assemblages.

Spatial Variation in Manufacturing Techniques

The inter-site typological differences documented in table 47 are matched by technological differences. Table 49 tallies data on the rim forms of vessels assigned to the single most abundant ceramic variety in the collections, Le Beau Classic. In each assemblage, most Le Beau Classic vessels were built with a simple S-rim form, but the frequencies of different types

Table 49. Frequencies of rim forms used on Le Beau Classic variety vessels in three post-1500 Heart region assemblages.

	Site			
Rim Form Class	Slant	Scattered	Double Ditch	Total
s-rim	54.7%	63.2%	67.0%	337
s-rim, exterior brace	35.9%	23.2%	2.2%	53
s-rim, interior brace	9.4%	13.7%	30.5%	129
s-rim, interior and exterior brace			.3%	1
Total	64	65	361	520

of brace vary among assemblages. Potters at Slant Village applied an exterior brace to more than one-third of the vessels they made, while only about 2 percent of the Le Beau Classic vessels at Double Ditch have an exterior brace. Conversely, about 30 percent of the Le Beau Classic pots at Double Ditch incorporate an interior brace, but compared to less than 10 percent at Slant. The Scattered Village assemblage exhibits intermediate values. These differences remained stable over time.

Even when the between-site comparison is restricted to unbraced vessels, it is still evident that potters in different communities used different manufacturing techniques. Table 50 presents data on the methods used to manufacture the upper rim of Le Beau Classic variety pots. Potters at Double Ditch mainly added lip coils and interior coils to build up the lip, while those at Slant and Scattered used a more diverse set of methods. Inter-community differences in upper rim and lip construction technique are even more marked in the manufacture of Le Beau Recurved

Table 50. Frequencies of upper rim construction techniques used to produce Le Beau Classic variety vessels in three post-1500 Heart region assemblages. Data limited to unbraced s-rim vessels for which the construction confidence determination was coded as “high” or “moderate.”

	Site			
Upper Rim Construction	Slant	Scattered	Double Ditch	Total
no addition	10.0%	16.7%	9.8%	32
exterior coil	23.3%	14.8%	7.8%	31
interior coil	30.0%	31.5%	41.0%	110
lip coil	30.0%	24.1%	39.0%	102
two exterior coils		3.7%		2
modified lip coil	3.3%	1.9%	.5%	3
interior and exterior coils	3.3%	5.6%	1.0%	6
two lip coils		1.9%	1.0%	3
Total	30	54	205	289

variety vessels (table 51). At Scattered and Slant villages, pots of this type were usually made by adding an exterior coil but at Double Ditch they incorporate an interior coil more that 40 percent of the time. Differences also exist in the methods used to construct the lower rim. The data in table 52 show that potters at Double Ditch made use of the distinctive triple strap technique more frequently than potters elsewhere to build Le Beau Classic vessels.

Table 51. Frequencies of upper rim construction techniques used on Le Beau Recurved variety vessels. Data limited to vessels in the 1600-1700 sample for which the construction confidence determination was coded as "high" or "moderate."

	Site			
Upper Rim Construction Technique	Slant	Scattered	Double Ditch	Total
no addition			5.3%	1
exterior coil	68.2%	84.6%	31.6%	65
interior coil	13.6%		42.1%	11
lip coil	9.1%	11.5%	15.8%	11
modified lip coil	4.5%			1
interior and exterior coils	4.5%	1.9%	5.3%	3
two lip coils		1.9%		1
Total	22	52	19	93

There also are between-site differences in the methods used to manufacture Knife River ware, the second most popular pottery type, though they are less marked than are the differences exhibited by Le Beau ware vessels. Table 53 compares upper rim construction techniques in Knife River ware vessels at Scattered and Double Ditch villages; the Slant Village sample is too small to permit comparison. At Double Ditch, potters used lip coils, or multiple lip coils, more commonly than potters at Scattered Village. These differences, though relatively slight, remained

Table 52. Frequencies of lower rim construction techniques used on Le Beau Classic vessels. Data limited to simple S-rim vessels for which construction technique confidence determination was coded as "high" or "moderate."

	Site			
Lower Rim Construction Technique	Slant	Scattered	Double Ditch	Total
single strap		6.7%	11.7%	21
double strap	100.0%	90.0%	72.2%	168
triple strap		3.3%	16.0%	27
Total	24	30	162	216

Pearson chi-square=12.684; *df*=4; p=0.013

Table 53. Frequencies of upper rim construction technique used on Knife River ware vessels at Scattered and Double Ditch villages.

	Site		
Upper Rim Construction Technique	Scattered	Double Ditch	Total
no addition	.8%		1
exterior coil	86.0%	68.4%	210
interior coil	1.7%	.6%	3
lip coil	5.0%	16.1%	31
two exterior coils	2.5%	3.2%	8
interior and exterior coils	1.7%	.6%	3
two lip coils	2.5%	10.3%	19
complex		.6%	1
Total	121	155	276

stable over time. No differences are evident in the methods used to manufacture the lower rim.

There is some evidence indicating that certain manufacturing techniques shifted over time. Table 54 presents data on changes in the methods potters at Double Ditch used to construct both the upper and lower rims of Le Beau Classic variety vessels. The temporal comparison is limited to vessels from Double Ditch Village because the sample from that site is larger than those from other settlements and effectively dominates regional temporal patterns in this ware.

Table 54. Temporal trends in upper and lower rim construction techniques at Double Ditch Village. Data limited to Le Beau Classic variety vessels built on a simple S-rim form and for which confidence in construction confidence determination is coded as “moderate” or “high.”

	Period			
Construction Technique	post-1700	1600-1700	pre-1600	Total
Upper Rim Construction				
no addition	15.2%	11.1%	3.0%	20
exterior coil	15.2%	6.9%	1.5%	16
interior coil	25.8%	58.3%	37.3%	84
lip coil	40.9%	23.6%	53.7%	80
modified lip coil			1.5%	1
interior and exterior coils			3.0%	2
two lip coils	3.0%			2
Total	66	72	67	205
Lower Rim Construction				
single strap	22.2%	5.5%	7.5%	19
double strap	68.5%	70.9%	77.4%	117
triple strap	9.3%	23.6%	15.1%	26
Total	54	55	53	162

For upper rim construction method: Kendall’s tau-b=0.185; Approx. T=2.839; Approx. p=0.005
For lower rim construction method: Kendall’s tau-b=0.143; Approx. T=2.029; Approx p=0.042

Potters at Double Ditch most often used interior coils or lip coils to construct the upper rim, although over time more vessels were built without an added coil of any kind. At the same time, single strap construction of the lower rim became more common. Though these changes are modest, they do point to an overall simplification of production methods in the 1700s.

These data on inter-site technological differences provide a context for data on vessel wall thickness other investigators have collected. Among Knife region assemblages, the mean maximum thickness of size grade 2 body sherds declined during Extended Middle Missouri times, reaching a minimum value about 1500, after which it increased steadily (Ahler and Swenson 1993). Parallel trends exist in neck (zone 2) and upper rim (zone 3) thickness. Speakman and others (1997) also document a slight post-1500 increase in mean maximum body sherd thickness at Slant village, though wall thickness there is significantly thinner than in the Knife region. More recently, though, it has become clear that Heart region assemblages do not exhibit the temporal trends observed in the Knife region (Ahler, Madden, and Mitchell 2006). Instead, between-site differences are more important. Mean maximum thickness values are especially uniform at Double Ditch and Scattered villages, with vessels at Scattered Village roughly 10 percent thinner than those at Double Ditch Village. This finding suggests that vessel wall thickness differences are mainly a function of site-specific production techniques, rather than broad-scale temporal differences in production skill.

Associations between Style and Technology

Several style-specific technological differences cross-cut these between-site differences in manufactuing techniques. Each of the post-1500 wares exhibits some distinctive technological characteristics regardless of where they were made. The comparisons examined here are limited to the two most abundant wares, Le Beau and Knife River. First, characteristic surface and interior colors suggest that different firing techniques were used to manufacture these two wares.

Figure 25 illustrates these differences. Knife River ware more often exhibits a black or gray exterior surface and a black or gray interior, while Le Beau ware more often exhibits a brown surface and a firing core or an interior color gradient. Knife River ware also more often exhibits firing clouds on the surface and a variable core. These differences suggest that the method used to fire Knife River ware more often produced a reducing atmosphere.

There also are between-ware differences in surface treatment (table 55). A smooth stone was used to burnish or polish the neck or lower rim (zone 2) on about three-quarters of the Le Beau ware vessels in the sample. By contrast, a polishing stone was used on just over half of the Knife River ware vessels, and nearly 10 percent exhibit a rough surface.

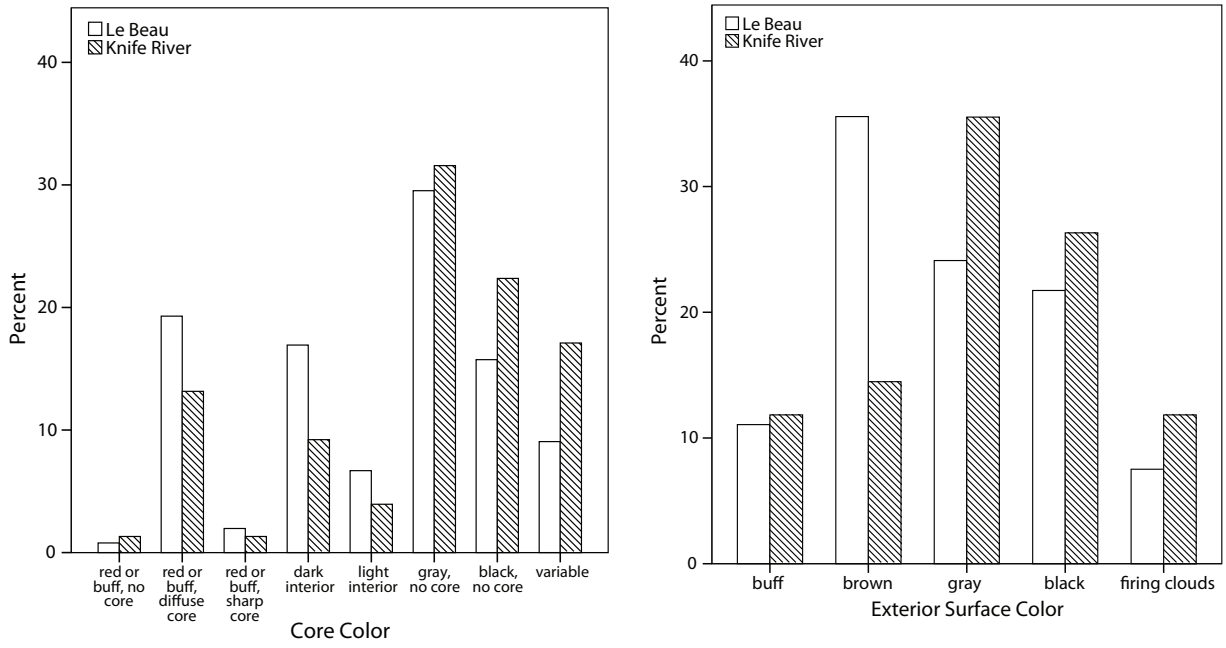

Figure 25. Comparison of surface and core colors in Knife River ware and Le Beau ware vessels in three post-1500 Heart region assemblages.

Table 55. Comparison of methods used to finish the lower rim (zone 2) on Le Beau and Knife River ware vessels.

	Collapsed Zone 2 Surface Treatment Class				
Ware	plain/rough	smoothed	burnished	polished	Total
Le Beau	1.8%	24.0%	61.1%	13.2%	167
Knife River	9.2%	34.6%	51.2%	5.1%	217
Total	23	115	213	33	384

Pearson chi-square=21.112; *df*=3; p=0.000

The Sperry Horizon

Some Heart region ware groups are just that—catch-all categories that include unique vessels not otherwise assignable to a specific type. The Unclassified S-rim and Unclassified Straight-rim ware groups are of this sort. Other wares are true classes because their member vessels exhibit a set of necessary and sufficient attributes. Transitional ware, Knife River ware, and Le Beau ware are classes; however, the requirements for class membership are minimal, and each ware encompasses significant formal and technological variability. Le Beau ware in particular is further subdivided into a number of subwares, based mostly on decorative technique and design motif, that are somewhat ad hoc in character. Sperry ware, alone among Heart region wares, exhibits a regular, though not strictly invariant, arrangement of formal and technological attributes and therefore fits Spaulding's (1953:305) classic definition of a ceramic type as "a group of artifacts exhibiting a consistent assemblage of attributes whose combined properties give a characteristic pattern." In addition, a number of the attributes defining Sperry ware are virtually unique, a circumstance that makes it both technologically and aesthetically unmistakable.

Sperry ware has a unique rim form. Though usually manufactured with a simple S-rim, Sperry vessels feature a distinctive, if subtle, uneven curve in the lower part of the upper rim (zone 3), just above the neck, giving them a slightly collared appearance (table 56; figures 22 and 23). This uneven curvature is usually only expressed on the vessel's exterior wall. Burnishing

Table 56. Condition and shape of the upper rim (zone 3) in Le Beau and Sperry ware vessels from Double Ditch Village. Data limited to vessels where zone 3 is complete.

	Zone 3 Shape Class				
Ware	curved	slightly uneven curve	uneven curve	faint S	Total
Le Beau	75.0%	2.4%	1.2%	21.4%	84
Sperry	43.5%	56.5%			23
Total	73	15	1	18	107

or polishing with a smooth stone is more common on Sperry ware vessels than on Le Beau ware vessels (table 57). A burnishing stone was used on about one-third of the Le Beau vessels at Double Ditch Village but three-quarters of the Sperry vessels. About one-sixth of the Sperry vessels exhibit a polished surface that must have taken considerable effort to achieve.

Table 57. Upper rim (zone 3) surface treatment on Le Beau and Sperry ware vessels from Double Ditch Village.

	Zone 3 Surface Treatment Class							
Ware	plain/rough	smoothed	burnished	polished	burnished over brushed	smoothed over simple stamped	burnished over simple stamped	Total
Le Beau	7.4%	58.7%	30.9%	2.0%		.2%	.7%	443
Sperry	2.7%	19.2%	60.3%	16.4%	1.4%			73
Total	35	274	181	21	1	1	3	516

Sperry ware vessels exhibit a distinctive combination of interior and exterior surface colors, suggesting that a particular firing method was routinely used in their manufacture. Table 58 presents surface color data for a sample of 359 Sperry, Le Beau, and Knife River ware vessels from Slant, Scattered, and Double Ditch villages. For each ware, there are twenty-five possible combinations of the five interior and exterior colors. Among Le Beau ware vessels, 88 percent of the possible combinations are represented. Eighty-four percent of the combinations are represented for Knife River ware. The single most common color combination for Le Beau ware, recorded on about one-sixth of the vessels, is a black exterior and a black interior. Separately, though, brown exteriors and gray interiors are more common. A somewhat similar pattern is evident in Knife River ware.

By contrast, for Sperry ware only 44 percent of the possible color combinations are represented and the most common combination—a black interior with a brown exterior—occurs on more than one-third of the vessels in the sample. Interior paste colors show a similar pattern of distinctiveness and uniformity (table 59). These color patterns suggest that fine fuel may have been added to the vessel interior during or immediately after firing, producing a strongly reducing atmosphere and a smudged surface.

Table 58. Matrix comparing interior and exterior surface colors on Sperry, Le Beau, and Knife River ware vessels. Data limited to vessels represented by size grade 1 sherds; one re-fired Le Beau ware vessel is omitted. Lighter shading in marginal columns and rows indicates dominant patterns; darker shading indicates most abundant single color combination for each ware.

		Interior Surface Color Class					
Ware	Exterior Surface Color Class	buff	brown	gray	black	firing clouds	Total
Le Beau	buff	5.9%	2.0%	2.8%	.4%		11.1%
	brown	5.9%	9.1%	11.9%	6.3%	2.4%	35.6%
	gray	4.0%	1.2%	11.9%	5.9%	1.2%	24.1%
	black		1.6%	4.0%	15.8%	.4%	21.7%
	firing clouds	1.6%		1.6%	1.2%	3.2%	7.5%
	Total	17.4%	13.8%	32.0%	29.6%	7.1%	253
Knife River	buff	3.9%		3.9%	1.3%	2.6%	11.8%
	brown	2.6%	3.9%	2.6%	5.3%		14.5%
	gray	6.6%	2.6%	19.7%	5.3%	1.3%	35.5%
	black		1.3%	2.6%	21.1%	1.3%	26.3%
	firing clouds	2.6%		2.6%	2.6%	3.9%	11.8%
	Total	15.8%	7.9%	31.6%	35.5%	9.2%	76
Sperry	buff				3.3%		3.3%
	brown		3.3%	13.3%	36.7%	3.3%	56.7%
	gray	3.3%	3.3%	13.3%			20.0%
	black				13.3%		13.3%
	firing clouds			3.3%	3.3%		6.7%
	Total	3.3%	6.7%	30.0%	56.7%	3.3%	30

Table 59. Interior paste colors in Sperry, Le Beau, and Knife River ware vessels. Data limited to vessels represented by size grade 1 rim sherds.

	Interior Color Class								
Ware	red or buff, no core	red or buff, diffuse core	red or buff, sharp core	dark interior	light interior	gray, no core	black, no core	variable	Total
Le Beau	.8%	19.3%	2.0%	16.9%	6.7%	29.5%	15.7%	9.1%	254
Knife River	1.3%	13.2%	1.3%	9.2%	3.9%	31.6%	22.4%	17.1%	76
Sperry		6.7%	3.3%	26.7%		46.7%	13.3%	3.3%	30
Total	3	61	7	58	20	113	61	37	360

Finally, there are differences in the techniques used to manufacture Sperry ware vessels. Tables 60 and 61 tally data on the frequencies of various upper and lower rim construction techniques, respectively. This comparison only includes Le Beau ware vessels built with a simple, unbraced S-rim form. Potters used a comparatively diverse array of upper rim or lip construction techniques to build Le Beau ware vessels. For the lower rim, just 10 percent of the Le Beau ware vessels exhibit a triple strap technique, while nearly 40 percent of the Sperry ware

Table 60. Frequencies of upper rim construction techniques in Le Beau and Sperry ware vessels from three post-1500 assemblages. Data limited to Le Beau ware vessels built with a simple S-rim for which construction technique confidence determination was coded as "high" or "moderate."

	Upper Rim Construction Technique									
Ware	no addition	exterior coil	interior coil	lip coil	two exterior coils	two interior coils	modified lip coil	interior and exterior coils	two lip coils	Total
Le Beau	12.6%	10.5%	37.4%	34.9%	.5%	.2%	1.2%	1.9%	.9%	430
Sperry	11.1%	1.6%	55.6%	30.2%					1.6%	63
Total	61	46	196	169	2	1	5	8	5	493

Table 61. Frequencies of lower rim construction techniques in Le Beau and Sperry ware vessels in three post-1500 assemblages. Data limited to Le Beau ware vessels built on a simple S-rim for which construction technique confidence determination was coded as "high" or "moderate."

	Lower Rim Construction Technique			
Ware	single strap	double strap	triple strap	Total
Le Beau	11.9%	78.0%	10.1%	327
Sperry		60.7%	39.3%	56
Total	39	289	55	383

vessels do.

Potters used just one simple motif to decorate Sperry ware vessels, usually consisting of four horizontal cord impressions (figures 22 and 23). Conspicuously absent are the nodes and nested chevrons or rainbow patterns long characteristic of S-rim wares in the Middle Missouri. Sperry vessels do, however, commonly exhibit a deformed or wavy orifice created by

Table 62. Frequencies of appendages on Le Beau and Sperry ware vessels from Double Ditch Village.

	Appendage Type						
Ware	not observed	node	tab	castellation	wavy or deformed rim	asymmetrical	Total
Le Beau	92.4%	4.1%	.2%	.7%	2.2%	.4%	460
Sperry	24.3%				75.7%		74
Total	443	19	1	3	66	2	534

pinching or bending the upper rim (table 62). This feature must have made the orifice of these vessels polygonal rather than circular, though it is difficult to estimate the number of vertices or inflection points because no whole Sperry ware pots are available for study. This effect is quite distinct from the finger-impressed lips seen on some other Heart region vessels. It should be noted that there are many more inflection points or vertices on each Sperry ware pot than there are nodes, tabs or castellations on each Le Beau ware pot and for this reason the "not observed" category in table 62 is not meaningful.

Sperry ware is unevenly distributed, both spatially and temporally. It appeared suddenly about 1700; 90 percent of the 76 Sperry vessels in the subsample occur in analytic units assigned to the post-1700 group. Its distribution is spatially restricted, too. Ninety-seven percent of the vessels come from Double Ditch Village. No Sperry ware pots occur in the Slant Village assemblage analyzed here, but an unsystematic examination of Strong's collection from the site suggests that a few may be present. Sperry ware is present on a number of other sites in the Heart region, though, most notably the Sperry site, from which the ware takes its name. Sperry Village is located on Burnt Creek about 5 km south of Double Ditch. Ahler (2001) briefly examined collections from there, but no systematic analysis has yet been carried out. Sperry ware also occurs at Larson Village, 3 km to the north of Double Ditch (Mitchell and Swenson 2008) and at Boley Village, a right-bank settlement located across the river from Sperry (Ahler, Madden, and Mitchell 2006). Even at Double Ditch, though, Sperry ware is unevenly distributed. Table 63 shows the frequencies of four wares in three post-1700 excavation loci there. Among them,

Table 63. Spatial distribution of major wares in three post-1700 analytic units at Double Ditch Village.

	Ware				
Analytic Unit	Le Beau	Knife River	Transitional	Sperry	Total
Md. B,X1213	31.1%	27.3%	4.5%	37.1%	132
Md. I2	67.0%	14.8%	6.1%	12.2%	115
Md. JJw	70.6%	17.6%	2.0%	9.8%	51
Total	154	62	14	68	298

Mound B (Unit 12-13) stands out for its high frequencies of both Sperry ware and Knife River ware. Several lines of evidence indicate that the major mounds at Double Ditch accumulated relatively rapidly and contain material derived mainly from one sector or neighborhood of the village (Ahler 2005b), suggesting that these frequency differences indicate that Sperry ware was produced or used more frequently in certain parts of the village.

In sum, the appearance of Sperry ware marks a "horizon" of sorts. Aesthetically, its exuberant style is an unprecedented departure from long-standing northern Middle Missouri patterns. While it shares certain decorative and technological characteristics with Le Beau High Rim variety pottery, it is nevertheless distinctive. Moreover, its distinctiveness is matched by its uniformity, both technologically and decoratively. The methods used to construct and fire it are notably uniform compared either to Le Beau or to Knife River ware. The techniques and patterns used to decorate it are simple and consistent. In the absence of regional antecedents it is difficult to interpret the cultural historical significance of Sperry ware, but its distribution and its technological and formal properties suggest that it was produced by a relatively small number of potters, likely living in a single village. It is tempting to attribute Sperry ware's provenance to Double Ditch, but the available evidence suggests that the Sperry site may be as good a candidate.

Cordage Manufacture

Most northern Middle Missouri pottery is decorated with cord impressions and this provides an opportunity to study aspects of cordage manufacture and to consider the relationship between potters and cordage makers. I collected data on two variables related to cordage manufacture: cord diameter and final twist direction. Two-ply cordage can be finished in one of two ways, known as z-twist and s-twist. Across North America, cultural traditions embodied in producer training seem to have been the most important factor determining final twist direction, though it also may be affected by a variety of other factors, including the kind of plant material used (Teague 1998).

In contrast with many of the technological characteristics of the pottery itself, no between-site differences are evident in final twist direction. Among post-1500 contexts, potters used s-twist cords to decorate between 4.5 and 6.5 percent of all cord-impressed vessels. With the exception of Sperry ware, which only exhibits impressions of z-twist cord, no ware-specific preferences are evident in final twist direction; the frequency of s-twist cordage varies from 5.1 to 8.9 percent among different wares. In fact, the only significant variation in the frequency of s-twist cordage is temporal (table 64). More than 11 percent of the vessels from early fifteenth-century contexts at Bypass Village are decorated with s-twist cordage. The lowest frequency of s-twist occurs in the sixteenth-century sample, after which it rises slowly in the 1600s and 1700s. Though this trend can only be described as modest, precisely the same trend has been documented in the Knife region (Ahler and Swenson 1993). There, s-twist cords are relatively

Table 64. Regional temporal trends in cordage final twist direction.

	Period				
Ply Direction	post-1700	1600-1700	pre-1600	1400-1450	Total
s-twist	7.7%	6.0%	3.2%	11.4%	79
z-twist	92.3%	94.0%	96.8%	88.6%	1231
Total	350	633	283	44	1310

Pearson chi-square=8.017; *df*=3;p=0.046

common during Extended Middle Missouri times, fall to a minimum frequency in the 1500s and 1600s, and then steadily become more common in the 1700s and 1800s, even though, overall, they are more common there than in the Heart region. The existence of this type of large-scale, long-term trend, coupled with the absence of local variation in the Heart region suggests that the factors controlling this aspect of cordage manufacture are not related to learning frameworks or to local communities of practice. Whether they reflect long-term shifts in the material used to manufacture cordage or some other factor is not known.

The second variable is cord diameter. Variation in cord diameter is precisely opposite to that of final twist direction: there is no temporal trend, but there are strong spatial and pottery style patterns. Contrary to widely held expectations, no change in cord diameter is evident among post-1500 Heart region contexts. Previous research has shown that, regionally, there is a gradual decline in cord diameter over time, but apparently nearly all of that decline occurred before 1500 (Ahler 2001; Ahler and Swenson 1993). Table 65 presents data on differences in mean cord diameter among sites. Scattered Village potters used the thinnest cords, while the widest were used at Slant Village. The Scattered Village cordage is also the most uniform. Unfortunately, it is possible that some of this variation could be a product of systematic measurement bias, because different analysts measured cord diameters for each site collection. At present there is no way to

Table 65. Inter-site comparison of mean cord diameter. Data limited to vessels made between 1600 and 1700.

					95% Confidence Interval			
Site	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Slant	59	2.314	.5114	.0666	2.180	2.447	1.5	3.7
Double Ditch	247	2.067	.5774	.0367	1.995	2.140	.9	4.7
Scattered	272	1.643	.3425	.0208	1.602	1.684	.7	2.7
Total	578	1.893	.5329	.0222	1.849	1.936	.7	4.7

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	34.884	2	17.442	77.772	.000
Within Groups	128.957	575	.224		
Total	163.841	577			

test this possibility.

However, equally striking differences are evident in the sizes of the cords used to decorate different pottery wares and measurement bias cannot be responsible for this pattern because, for each site, all of the measurements were made by a single analyst. Table 66 presents data on mean cord diameters used to decorate four different wares at Double Ditch Village and three different wares at Scattered Village; cord diameter data are available for just one Sperry ware vessel from Scattered Village. The same relationships can be seen at both sites: the thickest cords were applied to Le Beau Classic vessels, while the thinnest were applied to Knife River

Table 66. Inter-ware comparison of mean cord diameters. Upper panels present data from Double Ditch Village while lower panels present data from Scattered Village.

					95% Confidence Interval			
Ware	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Le Beau	377	2.166	.4872	.0251	2.117	2.215	.9	3.7
Knife River	123	1.873	.4237	.0382	1.798	1.949	1.0	3.1
Knife River Fine	18	1.522	.2922	.0689	1.377	1.668	1.1	2.2
Sperry	55	1.882	.2982	.0402	1.801	1.962	1.3	2.5
Total	573	2.056	.4820	.0201	2.016	2.095	.9	3.7

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15.474	3	5.158	25.000	.000
Within Groups	117.400	569	.206		
Total	132.874	572			

					95% Confidence Interval			
Ware	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Le Beau	178	1.699	.3556	.0267	1.646	1.751	.7	2.6
Knife River	94	1.623	.3241	.0334	1.556	1.689	.7	2.6
Knife River Fine	26	1.450	.3592	.0704	1.305	1.595	.7	2.2
Total	298	1.653	.3525	.0204	1.613	1.693	.7	2.6

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.533	2	.767	6.393	.002
Within Groups	35.374	295	.120		
Total	36.907	297			

Fine vessels.

Between-site differences in cord diameter may signal that cordage makers in different communities used slightly different techniques. They could also mean that cordage makers in some communities were more skilled than those living in other communities or that different communities used different materials. The association between specific pottery forms and particular cord sizes could simply be related to the aesthetics of various decorative patterns. It seems more likely to me, though, that it indicates that different potters, each manufactuing specific ceramic forms, obtained their cordage from producers who used different methods or had different abilities.

The data at hand do not resolve these alternative interpretations, but a comparison between cord diameter and cord spacing suggests one possibility. Cord spacing is defined as the center-to-center distance between parallel, horizontal cords and is determined by the potter, within the limits imposed by the diameter of the cords used. Figure 26 plots cord spacing against cord diameter for 300 Le Beau ware vessels from Scattered, Slant, and Double Ditch villages. Three overlapping, though partly distinct, clusters are evident. As I mentioned, there is a possibility that these inter-site comparisons are confounded by measurement bias, but the fact that pottery style, as expressed by cord spacing and determined by the potter, is correlated with technological variation in cordage manufacture, as expressed by cord diameter and determined by the cordage maker, could signal that cordage was in fact produced by potters themselves. Clearly, additional data on cordage manufacturing will be necessary to sort out these possibilities.

Skill in Pottery Production

To measure variation in the proficiency of Heart region potters I used an ordinal scale that, like the scale I applied to stone tool manufacture, incorporates both “efficiency” and

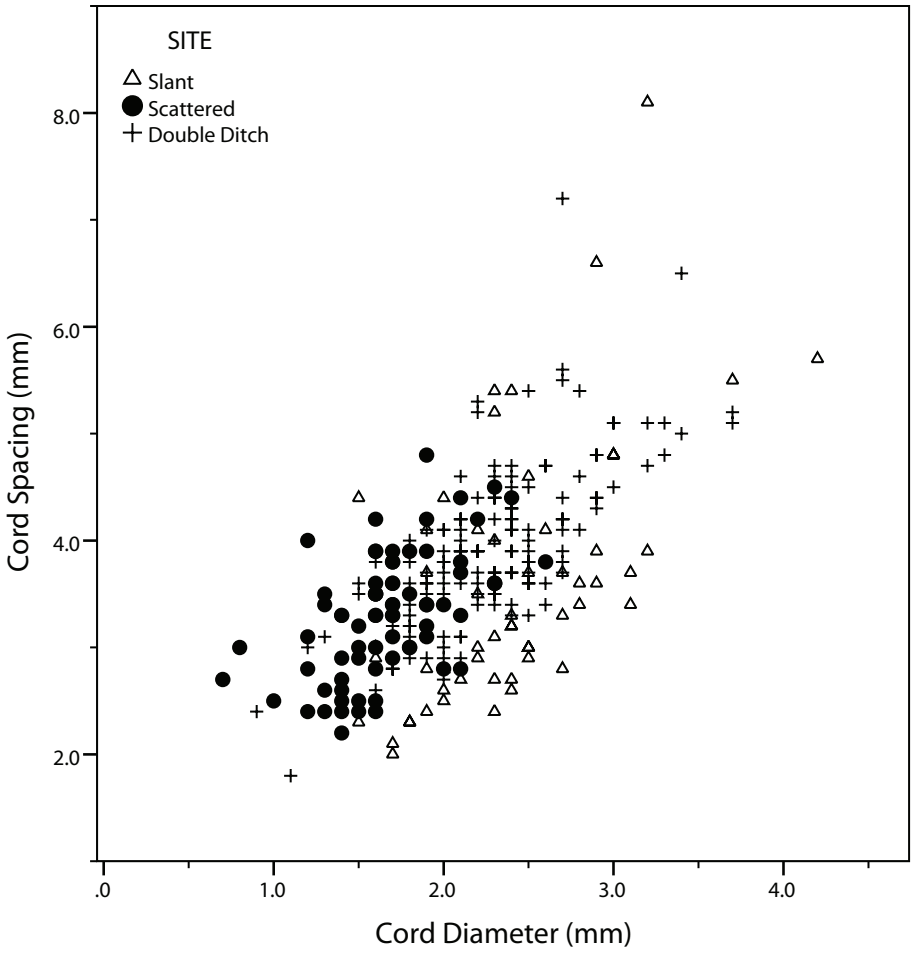

Figure 26. Scatterplot showing the relationship between cord spacing and cord diameter on Le Beau ware vessels from three post-1500 Heart region assemblages.

"artisanal" criteria. Some are related to the technical quality of the vessel. These include the thoroughness of paste preparation, the uniformity of the vessel's walls, the care taken in surface finishing, and the control of firing. The rationale for measuring errors in pottery production is the same as the rationale for doing so in stone tool production: the more one produces, the better one becomes. Potters who spend a greater share of their productive life making pots (which, of course, could be measured at several scales, ranging from daily to seasonally to annually) will, other things being equal, produce better pots more efficiently than those who spend a lesser share.

I explicitly do not consider the complexity or aesthetic qualities of the design motifs applied to the vessels, but I do evaluate the precision with which they are applied. Thus, the skill groups combine an estimate of error rates (embodied in poor control of raw materials or manufacturing defects) with an assessment of symmetry and uniformity of vessel form and decorative pattern. Vessels represented only by small rim sherds, especially those exhibiting what seem to be conflicting technical properties, are omitted. It should be noted that pots in the "non-functional" group are underrepresented in this sample relative to their actual occurrence in assemblages from the four study sites because "miniature" vessels, which consist mainly of poorly made practice pieces, are systematically excluded from the group of regular, full-size vessels subjected to detailed study. I present a more complete description of the attributes of each of the defined skill groups in appendix 3.

Table 67 shows that changes in production skill were integral to the fifteenth-century technological transition discussed previously. Twice as many pots in the Bypass Village assemblage fall into the "serviceable" group and none fall into the "exceptional" group. The reason for the absence of poorly made vessels in the Bypass Village assemblage is not clear. Still, owing to these differences, I exclude vessels from Bypass Village from the data presented in the remainder of this section. It is worth pointing out, though, that large, well-made pots are present in many Extended Middle Missouri assemblages, so the absence of exceptional vessels in the Bypass Village sample may be due in part to sample size.

Turning to the three post-1500 assemblages, it is clear that skill varies primarily among

Table 67. Between-site comparison of skill in pottery production.

	Skill Group					
Site	non-functional	poorly made	serviceable	well made	exceptional	Total
Slant		1.8%	34.8%	48.2%	15.2%	164
Scattered	.3%	2.5%	37.7%	51.8%	7.8%	398
Double Ditch		3.3%	31.2%	55.0%	10.6%	613
Bypass			67.6%	32.4%		71
Total	1	33	446	645	121	1246

ware groups, rather than among sites (tables 68). Three main patterns can be identified. Overall, the best-made vessels are assigned to Le Beau ware and Knife River Fine ware. Le Beau ware is, of course, the type most closely associated with the Heart region. Knife River Fine ware mainly includes small, highly decorated pots used for a variety of purposes other than food preparation. A second set of wares, including Knife River ware, Transitional ware and Sperry ware are generally well made, with Sperry ware vessels exhibiting the highest overall quality. Finally, a third group of wares exhibits variable technical quality. These include vessels assigned to the two unclassified, catchall groups and to Le Beau Fine ware. Again, vessels in the unclassified groups include a wide variety of unusual, often one-of-a-kind, forms. Le Beau Fine ware includes a variety of small S-rim vessels, some of which could as easily be assigned to Unclassified S-rim ware. Some Le Beau Fine ware vessels are well-made but others are pots made by novices or children.

Table 68. Inter-ware comparison of skill in pottery production. Data limited to vessels from Double Ditch, Scattered, and Slant villages for which skill could be determined; one Stanton ware vessel from Slant Village is omitted.

	Skill Group					
Ware	non-functional	poorly made	serviceable	well made	exceptional	Total
Unclassified Straight Rim		24.6%	41.5%	27.7%	6.2%	65
Unclassified S-rim		6.7%	51.1%	37.8%	4.4%	45
Le Beau		.6%	30.4%	55.0%	14.0%	658
Knife River	.4%	1.3%	38.6%	57.4%	2.2%	223
Knife River Fine		2.2%	28.9%	51.1%	17.8%	45
Transitional			32.4%	58.8%	8.8%	34
Sperry		4.5%	18.2%	68.2%	9.1%	66
Le Beau Fine		7.9%	65.8%	23.7%	2.6%	38
Total	1	33	397	622	121	1174

These ware-specific expressions of skill are consistent across site assemblages. In table 69 I present data on three wares, this time organized by site, which show that, in each assemblage, Le Beau ware is better made than Knife River ware. The difference is most striking at Slant, though this may be due partly to the small number of Knife River ware vessels from

Table 69. Inter-site comparison of skill in pottery production, organized by ware.

Site	Ware	Skill Group					Total
		non-functional	poorly made	serviceable	well made	exceptional	
Slant	Le Beau			26.8%	54.5%	18.8%	112
	Knife River		6.3%	50.0%	43.8%		16
Scattered	Le Beau		.9%	36.3%	52.2%	10.6%	226
	Knife River	1.0%	1.0%	39.6%	57.4%	1.0%	101
	Sperry		50.0%		50.0%		2
Double Ditch	Le Beau		.6%	27.5%	57.2%	14.7%	320
	Knife River		.9%	35.8%	59.4%	3.8%	106
	Sperry		3.1%	18.8%	68.8%	9.4%	64

that site. Again, a larger combined proportion of Sperry ware pots fall into the "well made" and "exceptional" categories than any other ware. Closer inspection, though, reveals that a large fraction of the difference in the skill of Le Beau ware production is attributable to just two varieties, Le Beau Recurved and Le Beau High Rim (table 70). At each site, Le Beau Recurved variety vessels are the best made. Le Beau High Rim vessels also exhibit skillful production, as do many Le Beau Classic vessels. By contrast, Le Beau Plain pots exhibit much lower skill levels at all three sites. It bears repeating that, while Le Beau Recurved vessels commonly

Table 70. Inter-site comparison of pottery production skill expressed in five varieties of Le Beau ware. Four vessels assigned to Le Beau T-lip variety are omitted.

Site	Le Beau Variety	Skill Group				Total
		poorly made	serviceable	well made	exceptional	
Slant	Classic		27.3%	56.8%	15.9%	44
	Recurved		17.5%	50.0%	32.5%	40
	High Rim		16.7%	66.7%	16.7%	6
	Paddled		14.3%	85.7%		7
	Plain		64.3%	35.7%		14
Scattered	Classic		39.1%	59.4%	1.6%	64
	Recurved		26.3%	54.4%	19.3%	57
	High Rim	1.6%	28.6%	52.4%	17.5%	63
	Paddled		50.0%	50.0%		6
	Plain	2.8%	58.3%	36.1%	2.8%	36
Double Ditch	Classic	.4%	29.1%	57.4%	13.1%	244
	Recurved		8.6%	60.0%	31.4%	35
	High Rim		31.0%	58.6%	10.3%	29
	Paddled		50.0%		50.0%	2
	Plain	11.1%	44.4%	44.4%		9

exhibit complex decorative patterns and so contrast in that regard with Le Beau Plain vessels, the measure of skill I used only takes into account the execution of the decorative pattern, not its complexity.

Production skill changed little over time. Table 71 presents data on two wares organized by regional time period. No change is evident for Le Beau ware, even when individual varieties are considered. There is a modest decline in quality for Knife River ware, but whether this decline is tied to longer-term trends in the skill of pottery production identified during the KNRI project is not known (Ahler and Swenson 1993).

Table 71. Temporal trends in the skill of Heart region potters.

		Skill Group					
Ware	Period	non-functional	poorly made	serviceable	well made	exceptional	Total
Le Beau	post-1700			27.1%	57.9%	15.0%	133
	1600-1700		.6%	33.6%	52.2%	13.6%	360
	pre-1600		1.2%	26.1%	58.8%	13.9%	165
Knife River	post-1700		2.1%	43.8%	54.2%		48
	1600-1700	.8%	1.5%	39.8%	55.6%	2.3%	133
	pre-1600			28.6%	66.7%	4.8%	42

For Knife River ware: Kendall's tau-b=0.117; Approx. T=1.928; Approx. p=0.054

Discussion

The most striking patterns in the ceramic technology data relate to the scope of the fifteenth-century transformation in the organization of production. Hints of this transformation are evident in the stone tool data presented in the previous chapter, but it is more dramatically expressed in the ceramic data. In short, pots made in the sixteenth century and later differ markedly in style, rim form, manufacturing technique, firing technology, and production skill from pots made in the mid-1400s. Overall, vessels produced after 1500 are better made and the techniques potters used to make them are significantly more complex and varied. This transformation was probably rapid, given the magnitude of the differences between the mid-

1400s Bypass Village assemblage and sixteenth-century assemblages from Slant, Double Ditch, and Scattered villages. More data are needed on fourteenth- and fifteenth-century assemblages, but there is no question that Bypass Village assemblage has far more in common with earlier Extended Middle Missouri assemblages than it does with later assemblages.

These trends point to a significant increase in the localization of ceramic production sometime in the late 1400s. However, judging by the extent of post-1500 stylistic and technological diversity, the process of localization likely was tied to the formation of communities of ceramic practice. Potters in different settlements appear to have focused their efforts on the production of different wares, even though, with the exception of Sperry ware, the complete regional inventory of pottery wares can be found at each site. For instance, during the seventeenth century, Knife River ware was twice as common at Double Ditch and Scattered villages as it was at Slant Village. At the same time, Le Beau Recurved was more than three time as popular at Slant Village as it was at Double Ditch Village and nearly twice as popular as it was at Scattered Village. If one assumes a constant number of potters per capita after 1500, then it must have been the case that practitioners in different communities specialized in producing different kinds of pots.

However, the situation is more complex than this picture of settlement-specific specialization suggests. On the one hand, different site assemblages exhibit different vessel forming techniques. The clearest expressions of this aspect of production are the differing frequencies of bracing in Le Beau Classic vessels (table 49) and upper rim construction techniques in Le Beau Recurved vessels (table 51). On the other hand, some of the specific technological properties of the major wares cross-cuts this pattern of local production. That is, vessels express the technological properties characteristic of their type—especially those governing their appearance, such as surface treatment, firing technique, and overall quality—regardless of provenance. This suggests that some of the technical knowledge necessary to produce particular forms was shared among potters in different communities or that individual

potters moved among settlements. Intriquingly, though, it could also mean that the production of certain types, notably Le Beau Recurved variety and Knife River Fine ware, was restricted to certain communities but that they were manufactured by several different groups of people—communities of practice—using somewhat different vessel forming techniques. If so, then inter-community ceramic exchange may have been relatively common, at least of some wares.

The technology and distribution of Sperry ware provides a less ambiguous case of specialized production and inter-community exchange. Certainly, the sudden appearance of what might be called the "Sperry aesthetic," along with its attendant technological distinctiveness, could signal the arrival of a new group of people in the region. But regardless, that distinctiveness and uniformity indicates not only that Sperry ware was produced by a relatively small number of people, but also that its production likely was concentrated in one village from which it was distributed to some, but not all of the settlements in the region. Its prevalence at Double Ditch suggests that it may have been manufactured there, but Sperry Village, despite its comparatively small size, cannot be ruled out.

It is not clear whether potters obtained the cordage they needed for ceramic decoration from dedicated producers or whether they made it themselves. The persistent but infrequent use of cordage plied with an s-twist suggests that local cultural factors were not important determinants of production method. However, marked inter-site and especially inter-ware differences in cord diameter imply that cordage producers learned and practiced their craft in local communities of practice. The fact that the relationship between cord diameter and cord spacing is site specific could indicate that potters made their own cordage.

These data provide evidence for three basic modes in the organization of ceramic production. The first is characteristic of Le Beau and Knife River ware. The differing abundance of these types, coupled with the complex and varied methods used to produce them and their generally good quality, suggest that production took place in some but not all of the households making up each community. The amount of time each producer devoted to their craft was greater

than that of their fifteenth-century predecessors, but nevertheless potting probably was just one of the productive tasks in which they participated. These wares can be considered the region's standard cooking vessels.

The second mode is characteristic of Le Beau Recurved variety and Knife River Fine ware. The potters who made these vessels were highly skilled, suggesting that they devoted a significant amount of time to their craft. It seems possible, too, that production of these types of vessels was more concentrated than production of Knife River ware or Le Beau Classic variety vessels, and therefore that at least some degree of inter-village exchange may have been taking place. The fact that Le Beau Recurved vessels make up 37.5 percent of the entire pre-1600 assemblage from Slant Village, but only 1.5 percent of the pre-1600 Double Ditch assemblage, lends some support to this idea. Knife River Fine ware vessels probably were used for special, often non-culinary, purposes. Charred food residue is present on many Le Beau Recurved vessels, but given their consistently very high quality it is possible that they were used mostly for special meals or on special occasions.

The third mode characterizes the production of Sperry ware. Sperry ware pots were made by a relatively small number of producers and production was concentrated in one or perhaps a few villages. In contrast to Le Beau Recurved variety and Knife River Fine ware, which exhibit marked artisanal skill, the qualities of Sperry ware can best be described as an example of efficiency skill. Sperry ware pots are boldly and consistently executed by potters who had a particular aesthetic in mind and who knew how to achieve it. The evident localization of Sperry ware production, coupled with its unique discontinuous distribution indicates that it was distributed through a local market. This market seems mainly to have linked east-bank villages, judging by its presence at Sperry, Double Ditch, and Larson villages; however, Sperry ware also occurs at Boley, so at least one west-bank community was involved. It is possible that Scattered Village, where Sperry ware occurs in very limited quantities, may have been abandoned about the time Sperry ware appeared. It is certain, however, that Slant Village was occupied until the

1780s, long after Sperry ware was introduced.

In sum, there appears to have been a dramatic per-capita reduction in the number of potters during the late 1400s. After 1500, pots were produced by several individuals or households in each community and distributed by various means, both within and between settlements. Each producer seems to have focused on making a limited number of forms. Local production techniques varied to some extent, though particular styles seem to have been produced in particular ways. Certain wares were produced by only a few people, and in some instances these wares may have been exchanged between villages. In the late 1600s, ceramic production, at least of Sperry ware, became even more concentrated. At the same time distribution through inter-village markets became more important.

Chapter 8:

An Archaeological History of the Heart River Region

How were changes in Heart region demography and subsistence linked to changes in the organization of craft production? This chapter weaves together the disparate strands of archaeological data presented previously into a first-generation narrative history of the Heart region during the centuries prior to the arrival of European visitors. This history necessarily relies on models derived from ethnographic analogies. Alfred Bowers and Gilbert Wilson collected much of the ethnographic data used here between 1908 and 1933 from Mandan and Hidatsa informants. The memories of their oldest informants reached into the 1840s, long after the period this history covers. Bowers in particular made a concerted effort to compare the data he collected with data Lewis and Clark, Catlin, Maximilian, and other European journalists reported, but all of these historic sources describe a situation much effected by disease and displacement.

With these limitations in mind, I use direct historical data in two ways. In keeping with the principles outlined in chapter 2, the most important use is supplementary. For instance, I incorporate data on the social context of Mandan and Hidatsa craft production in the nineteenth century to bolster the archaeological interpretations offered in chapters 6 and 7, interpretations which do not themselves rely on direct historical data. Such vetting of ethnographic data against the archaeological record demonstrates both continuity and change in northern Middle Missouri economic practices and political institutions. The second use reverses the interpretive relationship between the archaeological and ethnographic data. In this case, the ethnographic data are used as a source for hypotheses against which archaeological data can be tested.

I also make use of cross-cultural analogies based on ethnographic data collected in other times and places. In some cases, these analogies enter the discussion indirectly, in the guise of interpretations of archaeological data from the Southwest or the Northeast or elsewhere. Until

archaeologists draw from a bigger stock of comparative analogies their histories will fail to fully document patterns and processes of change not evident in the ethnographic and historic records. Lekson (2008:249) makes the same case for the Southwest, arguing that archaeological research there is "freighted with a century of ethnographically saturated interpretation," and that comparative analogies are needed to expose the dynamics of historical change.

Creating Tradition

While anticipated by the economic and social practices of Late Woodland communities such as Menoken Village, the establishment of Extended Middle Missouri tradition settlements in the Heart region in the 1200s clearly was a watershed, one that established many of the traditions farming communities in the Northern Plains would reiterate for six centuries. Central to this new configuration was aggregated village life itself (Wood 1974). In other parts of North America, the earliest villages often were unstable, coming together and breaking apart at intervals (e.g. Wilshusen and Ortman 1999). In the northern Middle Missouri, by contrast, farmers lived exclusively in aggregated settlements housing at least 100 people from the early 1200s to the late 1880s, when the Dawes Act forced Indian households onto individual allotments. The fact that settled village life began in the northern Middle Missouri at Menoken even before the adoption of intensive maize agriculture underscores the elemental character—and fundamental resilience—of the social and economic arrangements within and among households that made aggregated communities possible there. This is not to say that specific settlements remained static. Some went through complex spatial and structural transformations (Ahler 2005a). Others were abandoned and reoccupied repeatedly, by the same cultural group or by different groups (Ahler 1993a; Ahler et al. 2006). But throughout this long period, aggregated villages remained the durable hubs of social life.

Another key ingredient was a multifocal subsistence economy. Like village life, it

remained a basic feature of northern Middle Missouri communities into the nineteenth century. The successful long-term realization of the multifocal economy required a set of social adjustments. One was asymmetrical changes in the economic roles, and perhaps status, of different community members. In the northern Middle Missouri, the establishment of aggregated villages mainly involved adding maize agriculture to the resource repertoire, rather than shifting from one resource to another. Thus, individuals tasked primarily with bison hunting may have seen relatively little change in their economic roles during the Late Woodland-Plains Village transition. By contrast, individuals tasked primarily with intensive farming—an untried and demanding activity—experienced a dramatic shift, as planting, cultivating, and harvesting pushed aside other activities during much of the year. In the nineteenth century, men assumed a larger role in bison hunting while women assumed a larger role in farming, though neither activity was gender-exclusive: women provided much of the labor expended during communal hunts and men helped clear fields for planting. But from what currently is known about economic task differentiation in the Plains (Spector 1983), the social changes inspired by the emergence of the dual economy likely disproportionately affected women.

Another adjustment involved changes in the relations of production. Because both communal bison hunting and intensive maize agriculture require periods of focused activity during certain seasons, the dual economy depends on careful task scheduling. Joan Richtsmeier (1980) and Darcy Morey (1982) each develop idealized seasonal work schedules for what might be called the "economic year," based on historic and ethnographic data and on the growth cycle of maize (Hurt 1969; Will 1987 [1917]). Whether their models accurately reflect past subsistence practices is not known. In fact, there are reasons to suspect that they do not, given uncertainties about the mix of resources exploited during earlier periods, as well as the possibility that Middle Missouri hunter-farmers used farming technologies—such as various forms of water management—not in evidence in the historic record. But the models do call attention to several key issues. One is the determining role of agriculture. Regardless of the relative dietary

emphasis Middle Missouri communities placed on different resources, it was the physiological requirements of maize that controlled the allocation of labor during much of the year (Morey 1982). The second is the unremitting flow of the annual cycle. Though the timing of communal bison hunting need not interfere with agricultural tasks, successful coordination of the two activities is contingent on rainfall and temperature patterns and those varied from year to year. Accommodating such variation surely mandated flexibility in the economic roles of different members of the household, as well as in systems for economic decision-making at both the household and community levels.

New subsistence data from Chief Looking's Village, a mid-sixteenth-century Heart region settlement, add another level of complexity to the picture. While there is no question that bison and maize were always the foundations of the northern Middle Missouri economy, evidence from Chief Looking's Village indicates that during certain seasons—or perhaps for certain communities—lower-ranked resources, including fish, birds, and small mammals, were crucial components of the subsistence economy (Picha and Falk 2010).

For these reasons the comestible economy of the region is best seen as an adaptive system. Though underwritten by large- and small-scale ecological diversity, and by the tremendous abundance of certain key resources (Toom 1992b), the persistence of the multifocal subsistence regime indicates that it featured mechanisms enabling individual households and communities to adjust their subsistence activities to both short- and long-term fluctuations in the returns afforded by different resources and in the availability of labor.

Aspects of village social relations are evident in the layout and features of Extended Middle Missouri communities. The presence of substantial, permanent plazas is perhaps the clearest indicator of some form of supra-household community organization. As detailed in chapter 4, three of the 12 Extended Middle Missouri sites for which data are available definitely contain an interior public plaza and just two show no evidence of a plaza. Data from Larson Village, a Middle Missouri tradition settlement founded in the late 1400s or early 1500s, calls

attention to the signal importance of this space in the life of the community. The plaza at Larson was established when the community was founded and remained in place, free of household refuse, storage pits, or hearths until the settlement was abandoned some 250 years later (Mitchell 2008). The integrity of the plaza was maintained despite a whole series of changes in the size and layout of the town, even after the residents withdrew inside a fortified perimeter that excluded the plaza. While the specific uses of Larson's plaza are not known with certainty, nineteenth-century pictures, photographs, and descriptions indicate that similar spaces were used for conducting important religious events and as a setting for socializing and cooperative work. Interestingly, the plaza at Larson features a low earthen mound that Bower's interprets as the original location of the Lone Man shrine, a small wooden structure that stood in nineteenth-century Mandan plazas to commemorate the wall the culture hero Lone Man built to protect them from a world-spanning flood (Bowers 1940; Mitchell 2008). Wood (1967) suggests that plazas became a more-regular feature of northern Middle Missouri villages after the end of the Extended variant, but their prominence at later sites may simply reflect the fact that those settlements are larger, more compact, and more ordered. On balance, the data suggest that integrative ceremonies involving the entire community originated well before 1400.

Other aspects of village layout provide evidence for centralized community leadership, during Extended variant times as well as later. Data from two Extended variant sites in the southern half of the Middle Missouri, Hickey Brothers and Pitlick, demonstrate that their size and overall layout were established when they were founded (Lehmer 1971). At both cases the fortification was put up first, defining the orientation, shape, and extent of the community, but for unknown reasons the settlements were abandoned before substantial houses could be constructed. Moreover, at later sites for which full-coverage magnetic gradiometry data are available—including Huff, Double Ditch, Larson, and Chief Looking's villages—hearths and pits are all but absent outside their fortified perimeters, again suggesting that their extent and layout were established when the fortifications were built. The fact that many, perhaps most,

northern Middle Missouri settlements were built on a definite plan, rather than allowed to grow organically, argues for the existence of institutionalized supra-household leadership. That such leadership was a regular feature of these communities is further bolstered by the fact that many post-1500 communities periodically rebuilt and redesigned their defensive features, tasks no doubt requiring village-wide coordination.

Finally, the sizes of Extended variant lodges indicate long-term continuity in household size. On average, the 46 excavated Extended Middle Missouri lodges enclose 114.5 sq. m. The smallest is 68.1 sq. m, while the largest is 158.0 sq. m. Though little is known about earthlodges built between 1400 and 1750 (Ahler 1993b), there is no indication of a radical departure from earlier periods. Ten excavated houses at the mid-fifteenth century Huff site average 122.8 sq. m. The few known examples dating to the sixteenth or seventeenth centuries are similar in size. More data are available for a handful of eighteenth and nineteenth-century settlements. The single excavated lodge at Boley Village, which likely dates to the mid-1700s, encloses 84.4 sq. m. The mean size of 13 excavated lodges at the late-eighteenth-century Rock Village is 85.2 sq. m. An early nineteenth-century lodge at Sakakawea Village covers 147.3 sq. m. Five excavated lodges at Star Village, occupied briefly in 1862, average 137.2 sq. m, including one very large ceremonial lodge. Only at Like-A-Fishhook Village, abandoned in the mid-1880s, are earthlodges appreciably larger. Fourteen excavated structures there average 198.8 sq. m, though this figure includes a ceremonial lodge, which at 421.4 sq. m is far and away the largest earthlodge ever documented in the region. Though these data are scanty at best, they do suggest that the household size reported for the early nineteenth-century originated in Extended variant times. Whether the composition of Extended Middle Missouri households was also similar remains an unanswered question.

An interesting aspect of these house size data is the magnitude and persistence of contemporaneous variation. The mean sizes of Middle Missouri tradition lodges remained remarkably stable from the 1200s into the 1400s, but so did large standard deviations in lodge

size. At the Extended variant Thomas Riggs site, for instance, the largest of six excavated houses is about 4 times the size of the smallest. At Huff, built a century later, the largest of 10 houses is about 3.5 times larger than the smallest. Such variations could reflect differences in household size or composition, but that conclusion does not seem to be supported by other data, such as the ratio between house size and hearth frequency. Rather, it is more likely that lodge size relates in some way to household status. In the nineteenth century, high-status households, especially those possessing important ceremonial bundles, occupied larger lodges (Bowers 1950). If lodge size is in fact related to status, then inter-household status distinctions must have existed during Extended variant times.

Little empirical archaeological data bearing on Extended variant social organization are currently available. Drawing on ethnographic and historic sources, Edward Bruner (1961), who calls it the "Small Village Culture," believes that their settlements were socially isolated and economically and politically autonomous. He infers that there were significant linguistic and cultural differences among them and that they lacked the clans, sodalities, and complex ceremonialism for which the Mandans and Hidatsas were so well known in the nineteenth century. Wood (1967) takes essentially the same position, arguing that clans and sodalities probably formed during the Huff focus around the middle of the fifteenth century (based on the current chronology) from groups that once were separate and independent. Bowers's (1950:29) informants told him that different clans were established at different times in the past, some of them by Lone Man and some by Clay on the Face.

However, the view that corporate descent groups formed after Extended variant times seems incompatible with cross-cultural patterns of social organization. Across western North America, and indeed around the world, most groups occupying stable, long-lasting communities and exploiting an abundant resource base are organized into corporate descent groups, whether they recognize unlineal or bilateral kinship (Jorgensen 1980:186; Keesing 1975). This is because sedentary food-producing communities require systems for allocating land and other resources,

both among community members and across generations.

If, on the one hand, Extended variant communities recognized matrilineal descent, as was true of the Mandans and Hidatsas in the nineteenth century, then their settlements almost certainly incorporated multiple descent groups. In his study of 172 western North American groups, Joseph Jorgensen (1980:181) shows that matrilineages never formed independent, single descent-group communities. The reason for this lies in the role of women's sons, brothers, and uncles in managing clan affairs (Keesing 1975). These men, known as the avunculate, commonly hold leadership positions in their clans. Descent group exogamy and matrilocal post-marital residence can force them to abandon their corporate responsibilities unless marriage partners from other clans live in the same community. This problem, sometimes called the "matrilineal puzzle," was certainly a fact of life for the Mandans and Hidatsas of the nineteenth century, made even more complex by systems for transferring possession of sacred clan property between men (Bowers 1950, 1992).

If, on the other hand, Extended variant kinship was patrilineal, as may have been true of their Late Woodland bison-hunting predecessors (Vehik 1982), or bilateral, then their communities might have housed just one corporate group. In that case, descent group exogamy would have led to affinal connections among communities, even distant ones.

Inferences about earlier Initial variant communities do little to clarify the situation. David Benn and William Green (2000) draw on archaeological data to argue that Late Woodland horticultural communities in the Prairie Peninsula may have been organized into matrilineal corporations, but that eastern Initial Middle Missouri communities, under the influence of complex Mississippian chiefdoms, recognized patrilineal descent. However, Anderson (1981), Henning (1996), and Tiffany (1982) conjecture that Initial variant communities were composed of matrilineal descent groups. It is relevant to note here that George Murdock (1949:190) categorically denies the possibility of a "direct transition" from a patrilineal to a matrilineal kinship system, as would had to have taken place if Extended variant communities recognized

patrilineal descent. In any case, a more interesting and informative story may lie in changes in post-marital residence patterns, particularly from matrilocal to avunculocal, consequent on the changing economic roles—and power—of men and women (Keesing 1975). As Stephen Lensink (2005) argues, a desire to maintain close connections among male clan members, for the purposes of alliance building and long-distance exchange, may have led to a shift away from matrilocal residence to avunculocal residence in aggregated Initial variant communities. Avunculocality, he notes, is associated in the ethnographic record with matrilineal societies engaged in intercommunity warfare and long-distance exchange (Lensink 2005:155). Clearly, detailed studies of formal and technological variation in Extended variant pottery, architecture, and stone tools, will be needed to better understand these issues.

One distinctive and widely recognized feature of Extended Middle Missouri archaeology further complicates the picture. Archaeologists consistently describe Extended variant material culture as homogeneous, an observation that seems to argue against extreme social isolation. One might expect that social autonomy, especially among widely scattered communities, would lead over time to the development of local styles in pottery, architecture, and other material forms, but that does not seem to have happened. Certainly, there is some spatial variation in Extended variant pottery, corresponding roughly to the variant's two currently recognized taxonomic subdivisions, the Thomas Riggs phase in the south and the Fort Yates phase in the north (Johnson 2007a:113-118). While a systematic study of Extended variant ceramic technology might reveal certain local differences, as it currently stands the differences between these two phases lie mainly in the proportions of the two principal pottery types, not in the form, design, or technology of the types themselves (Johnson 1999). No one has yet undertaken a large-scale study of Extended variant lodge design or construction, but Ann Johnson's (1979a) assessment of Lehmer's "Modified" Initial Middle Missouri variant indicates overall continuity in Middle Missouri tradition architecture. She does make the point that lodge size increases as one ascends the Missouri, but the differences she documents mainly exist between Initial and Extended

variant houses and in this study I detect no spatial or temporal differences in mean lodge size within the Extended variant itself. Lehmer (1966:58-59) states that north-south differences exist in house pit depth and in the occurrence of an earthen entrance ramp, but he judges these distinctions minor. The culture-historical differences he considered to be more important are based on a chronology (and a climate reconstruction) that is no longer considered valid (Johnson 2007a).

A possible explanation for the Extended variant's material homogeneity is that its overall span was even shorter than the two centuries archaeologists now estimate. It seems more likely to me, though, that some type of social mechanism existed that maintained connections between communities and worked against the development of clear local traditions. A number of different mechanisms could have facilitated the movement of people among communities, alone or in combination. Given women's central roles in both pottery manufacture and lodge construction in the nineteenth century, it is certainly tempting to think that women were moving, carrying their technical knowledge with them. However, this interpretation seems at odds with documented aspects of nineteenth-century social organization, such as community endogamy, and other factors such as wife-capture or alliance building could have produced similar material outcomes (DeBoer 2008; Habicht-Mauche 2008). Another intriguing possibility is that sodalities were present in Extended Middle Missouri communities and were the vehicle for intercommunity transfers of technological knowledge. A third possibility is that clans were distributed among communities, facilitating the movement of lodge groups or factions between villages, as was the case in the nineteenth century (Bowers 1950:28).

These arguments imply that clans, and perhaps sodalities, existed during Extended variant times, though one can only speculate on the specific forms they may have taken. That such supra-household institutions arose in the thirteen and fourteenth centuries would help to explain how the large post-1400 towns came together without massive social disruption, a topic I touch on later. However, none of this sheds any light on the origins of the clear linguistic and cultural

differences among the Mandan divisions of the eighteenth and nineteenth centuries, differences that by their magnitude must have been in place for a lengthy period. It is worth observing, though, that there are a number of examples from the Plains of long-term linguistic continuity in the context of intimate political and economic connections; the Plains Apaches are perhaps the most well-known case (Foster and McCollough 2001).

Transformation

Despite the evident durability of these organizing traditions, it is clear that an array of social, cultural, and economic changes swept the northern Middle Missouri in the fifteenth century. The effects were profound: in ways both large and small, the experiences of a child born in the late 1300s would scarcely have been recognizable to their grandchildren or great-grandchildren living in the late 1400s.

Population Aggregation and Settlement Clustering

The most conspicuous aspect of the fifteenth-century transformation is a dramatic, and seemingly sudden, increase in population density. Two processes were at work: aggregation and clustering. During the fifteenth century mean village population increased three-fold. Extended Middle Missouri communities in this study's sample ranged in size from about 120 to 670 people; the estimated mean population of 13 settlements is 309. Mean lodge density was stable during Extended variant times, but because settlements in the north are larger on average than those in the south, estimated mean population in the north is twice as large as mean population in the south (362 people compared to 179 people). Sites occupied in the 1300s are slightly larger on average than those occupied in the 1200s, but this too is due to a modest increase in mean settlement size, not an increase in lodge density.

In the 1400s and 1500s, mean site area remained stable, at about 4 ha, but lodge density tripled, resulting in significantly larger communities. Mean estimated population for three fifteenth-century communities is about 1090; for six communities occupied between 1400 and 1600 it is 886 people. The early sixteenth century population at Double Ditch Village could have topped 2200, assuming the mean lodge density for this two-century period. Another 1400 people lived at Larson Village, just 3.5 km to the north. Mean site area decreased sometime after 1600, perhaps owing to the effects of epidemic diseases, but residential density remained essentially unchanged. Settlements dating to the eighteenth and early nineteenth centuries still averaged 594 residents.

Settlement clustering accompanied these increases in individual settlement size. In the thirteenth and fourteenth centuries, Extended variant sites were distributed widely throughout much of the Middle Missouri subarea. Some small settlement clusters may have existed, especially in the north, but given their short occupation durations it is almost certain that significant distances separated contemporaneous settlements. This basic situation changed in the fifteenth century. No Middle Missouri tradition settlements were built south of the Cannonball or north of the Knife after about 1400. By 1500, the mouth of the Little Heart River marked the southern limit of settlement. The northern boundary remained the Knife River, and a 40-km gap likely opened up between the southernmost Knife region towns and the northernmost Heart region towns, leading to a further restriction of settlement. Thus, the distances between villages diminished dramatically between the late 1300s and the late 1500s. After 1600, the positions of the region's major towns seem to have changed little, leading to a significant increase in settlement duration.

Together, aggregation and settlement clustering led to much higher local population densities. On the face of it, one could argue, as Wood (1967) and Bruner (1961) do, that this change must have sparked a variety of social organizational changes. It is telling, though, that population aggregation in the Heart region does not seem to have led to radical changes in

community plan. Elsewhere in North America, for instance in central New Mexico in the 1300s, aggregation prompted changes in the ways communities were organized, changes marked by evidence for community planning and by the enlargement and formalization of public space (Rautman 2000). In the northern Middle Missouri, by contrast, key elements of settlement layout indicative of community and household social organization, including plazas, community layout, and lodge size and layout, remained essentially unchanged during the population consolidation of the 1400s.

Nevertheless it does seem likely that the power and reach of community leaders increased during this period. Building on ideas Gregory Johnson (1982) first developed, Krisztina Kosse (1990) points out that communities sheltering 150 or more people, a threshold easily met during Extended variant times, require various integrative mechanisms to maintain stability. In settlements with 500 to 2500 members, the management of community affairs may be vested in a relatively smaller number of decision makers. At around 1000 residents, mid-fifteenth-century settlements in the northern Middle Missouri, such as Huff, fall squarely within these limits. Moreover, the proximity of other similarly sized settlements suggests that, at a regional scale, social mechanisms regulating interactions among communities increasingly became necessary. This was especially true in the sixteenth century, when peak population density, coupled with longer settlement occupation durations, inevitably increased the ecological footprints of the Heart River towns relative to that of earlier settlements. The resulting increased likelihood of both within- and between-community disputes over agricultural fields, timber, fish, and other key resources suggests that mechanisms for adjudicating conflicts among households and communities arose at this time. Conversely, though, the shorter distances between communities engendered modes of economic and social cooperation and interaction unavailable before 1400. I return to this topic later in the chapter.

In sum, then, there are two principal inflection points in the social history of northern Middle Missouri communities. The first is marked by the founding of Extended variant farming

settlements in the 1200s. Without question, Extended variant communities established the fundamental subsistence and settlement practices that their descendants would continue to follow into the late 1800s. The evidence further suggests that a number of fundamental social institutions arose during Extended variant times, including corporate descent groups, limited community-level leadership, community-wide ceremonialism, household status differentiation, and perhaps sodalities. Whether the establishment of descent corporations also entailed a shift in kinship reckoning is not known; in any case it is probable, largely on theoretical grounds, that Extended Middle Missouri groups recognized matrilineal descent. It is worth point out, though, that these social practices do not necessarily constitute a coherent package; they may well have begun at different times and developed at different rates in different communities or regions.

The second inflection point is marked by population aggregation and settlement clustering in the 1400s. Higher local population densities, and, somewhat later, increases in settlement occupation duration, likely strengthened and elaborated the institutions founded in the 1200s and 1300s. Aggregation and clustering also encouraged an expansion of community- and regional-level leadership crosscutting these basic institutions, to coordinate within- and between-community cooperation and to adjudicate disputes. Importantly, this second historical juncture occurred during a time of explosive growth in long-distance exchange.

Expansion of Trade and Interaction

Long-distance trade was so important to the economic and social lives of Middle Missouri tradition people that it is not really possible to fully appreciate local patterns without an understanding of regional trade relations. For instance, trade with emergent elites at Cahokia seems to have been a crucial catalyst for the formation of eastern Initial Middle Missouri villages in the eleventh and twelfth centuries (Tiffany 2003). Exchange with mobile bison hunters likely played a comparable role for western Initial variant communities (Ahler 2007). In both cases,

trade drew households into aggregated settlements. Aggregation in turn produced a cascade of social changes that reinforced and sustained village life (Lensink 2005; Tiffany 2007a).

Trade also played a role in the economies of Extended variant communities, though they interacted with different groups. Extended variant assemblages contain fewer artifacts made from Gulf Coast shell than Initial variant assemblages, but dentalium and olivella shells, arriving overland from the Pacific, are likely more common. In addition, artifacts originating in the Great Lakes region and upper Mississippi River valley, including copper and red pipestone, are present in Extended variant assemblages. Thus, the Extended variant trade network seems to have had a more multilateral character, integrating socially and culturally diverse groups living east, north, and west of the Middle Missouri.

Especially after 1400, though, the Northern Plains witnessed a major increase in the geographical scope of the trade network as well as in the volume of goods moving through it. Two aspects of this system are important for the history of the Heart region: trade with hunter-gathers living across a broad region and trade with other villagers on the river itself.

Forager-Farmer Interaction

Though certainly evocative of the interactions between Late Woodland bison hunters and Initial Middle Missouri hunter-farmers, the forager-farmer exchange of the 1400s and 1500s involved many more groups scattered across a wider region. Evidence for the scope of this network can be seen in the distribution of stone tools made from Knife River flint (KRF). Mobile bands trading with hunter-farmers on the Missouri carried KRF northward into the Saskatchewan River basin in Alberta and Saskatchewan and the Assiniboine River basin in Manitoba. While it is true that KRF had long been a favored trade item, especially during Middle Woodland times (Gregg 1994), the establishment of permanent settlements of hunter-farmers near the quarries surely altered the content and structure of the exchange system (Walde 2006).

The complexity of the system is attested by the appearance of hybrid or acculturated ceramic assemblages in a broad arc west, north, and east of the Middle Missouri in the 1300s and 1400s. Though quite different from one another, their stylistic and technological properties provide direct evidence of sustained, intimate contacts among and between hunter-farmers and hunter-gatherers across a wide swath of the Northern Plains. Perishable goods circulated as well. Recently obtained evidence from sites in southwest Manitoba and elsewhere indicates that maize was regularly consumed but for the most part not grown there (Boyd and Surette 2010; Boyd, Surette, and Nicholson 2006; Boyd et al. 2008). Interestingly, the northern maize trade seems to have been quite ancient, long pre-dating the Plains Village period. Direct evidence for exchange of bison meat and hides during Extended variant times is currently lacking, though it is certainly fair to say that overproduction of animal products for exchange was a long-standing tradition on the Northern Plains (Brink 2008). Finally, dentalium and other marine shells, copper, obsidian, and red pipestone, all from distant regions and brought to the Missouri by mobile groups, are present in sixteenth and seventeenth century Heart region assemblages (Mitchell, Picha, and Madden 2007; Wood 1974). The fact that the Mandans were known in the eighteenth and nineteenth centuries as skilled linguists, able to communicate fluently in many languages, underscores their long-standing promotion of trade and interaction with many different groups (Smith 1980; Wood 1967:164).

Evidence for the prevalence and structure of forager-farmer interaction also can be found in the towns on the Missouri. As I reported in chapter 6, stone tool raw material data show that different Heart River towns maintained connections to different mobile groups. At Boley Village, the abundance of toolstone from distant western and southwestern sources likely reflects historical connections to groups living in those regions (Ahler, Burns, and Madden 2006). A contrasting situation is evident at Double Ditch Village. There, the virtual absence of exotic raw materials suggests that their preferred trading partners lived in toolstone-poor regions to the east or the north, and therefore offered other trade items instead.

Together, these data suggest that several different modes of forager-farmer exchange were taking place simultaneously across the Northern Plains, beginning in the 1300s and accelerating in the 1400s and 1500s. Interaction likely occurred in numerous venues: near the towns on the Missouri, at horticultural hamlets on lesser streams, as well as at distant rendezvous. Regardless of the setting, it is clear that—in addition to toolstone, pottery, shell, maize, and hides—people, both men and women, were moving among participating groups. This movement very likely was multilateral, with villagers establishing both short- and long-term encampments away from the Missouri and hunters visiting the towns on the river. In a few cases, large factions, or even whole communities, may have been involved in these movements (Brooks 1995; Mulloy 1942). In fact, given the scope and evident importance of forager-farmer interaction, it is probably no coincidence that two Hidatsa divisions, the Hidatsas proper and the Awaxawis, moved to the Missouri River valley from eastern North Dakota about 1600 (Wood 1993a), or perhaps earlier (Toom 2004). It would not be safe to assume, though, that these interactions were uniformly cooperative; rivalries surely existed among the parties involved, motivated by efforts to control the wealth that flowed from successful trade and fueled by power differences among the participants (Boyd 1998).

Inter-village Interaction

Summarizing more than two decades of River Basin Surveys research, Lehmer (1971:124-128) proposes a complex model describing interactions between the two village-dwelling cultural traditions on the Missouri. In brief, he thought that, in the fifteenth century, Extended Middle Missouri groups attempted to re-colonize the southern part of the Middle Missouri subarea, a stretch of the valley they had left some 200 years earlier. This time, though, they found it occupied by Initial Coalescent communities, as well as by "Modified Initial Middle Missouri" communities. After a period of conflict they abandoned the effort and were

driven northward, back to their ancestral homeland, by Extended Coalescent communities expanding out of the Big Bend. Returning to the Heart region, formerly dispersed Extended Middle Missouri groups consolidated into a few large villages. Though Lehmer recognized that Coalescent tradition people adopted a variety of "Middle Missouri traits," including bastioned fortifications and simple-stamped pottery, his model emphasizes conflict rather than cooperation between the two traditions.

Data obtained since the 1970s now show that key elements of this model are wrong. Recent dating efforts demonstrate that the chronology underpinning the model is in error (Johnson 2007a). The span of the Extended variant of the Middle Missouri tradition is shorter than Lehmer thought, and the apparent Extended variant abandonment and re-occupation of the southern Middle Missouri was simply an artifact of the few radiocarbon dates available to him at the time, as well as mistaken views about the distinctiveness of the "Modified Initial Middle Missouri" variant (Johnson 1979a). Initial Coalescent colonization of the Big Bend region began a century or more earlier than he thought (Johnson 2007a; Toom 1992a). A crucial implication of these corrections is that Extended Coalescent groups expanding northward in the 1400s were colonizing a vacant landscape, one Extended Middle Missouri communities had left decades earlier (Johnson 2007a:180). In fact, the major pulse of Extended Coalescent expansion likely took place in the late 1400s, as much as a century after Extended Middle Missouri communities stopped building south of the Cannonball.

In addition, several lines of evidence indicate that interactions between Middle Missouri tradition and Coalescent tradition communities were largely cooperative rather than confrontational, at least until sometime in the 1600s. This interpretation is suggested by the marked design disparities in the defensive works surrounding Middle Missouri and Coalescent tradition settlements dating to the 1400s and 1500s. Though far larger, and therefore better able to field an effective military force, Middle Missouri tradition communities of the time were stoutly defended whereas contemporaneous Coalescent tradition communities were largely or

wholly undefended (Mitchell 2007). If the two groups came into conflict regularly, the demands of what David Jones (2004) calls the "offensive/defensive spiral" would naturally have lead them to construct functionally equivalent defenses. That is, if Extended Coalescent groups had pushed Middle Missouri tradition groups northward out of the Grand-Moreau region, why were they able to enjoy the benefits of what has been called "Pax La Roche," a period of relative peace coincident with the expansion of Extended Coalescent settlement (Caldwell 1964), while their more numerous neighbors to the north lived behind palisades? This is not to say that conflict never arose between them, but the disparities in settlement size and fortification argue against large-scale bilateral confrontation.

Furthermore, beyond this circumstantial evidence, there are abundant data confirming exchange of goods, likely accompanied by the movement of people, between the Middle Missouri tradition communities of the Heart region and the Coalescent tradition communities of the Grand-Moreau. Ceramic data provide the clearest indication. Heart region and northern Extended Coalescent assemblages dating to the 1400s share a number of formal and decorative attributes. Braced, excurvate straight-rim vessels with tool impressions, common in earlier Extended Coalescent assemblages, appear in the Heart region at this time. At the same time, Heart-region-inspired S-rim pottery bearing cord-impressed decoration is more common in Extended Coalescent assemblages in the Grand-Moreau region than in Extended Coalescent assemblages farther south. Trade vessels may also have moved between the Heart and Grand-Moreau regions, though elemental composition data confirming that are not currently available. It is also possible that some or all of these apparent trade vessels were produced by nonlocal women, who came to reside in a foreign community through political marriages or as refugees or captive wives (DeBoer 2008; Habicht-Mauche 2008). However, the rarity of such vessels, relative to other indicators of the movement of people, does suggest that they were acquired through long-distance exchange.

Bilateral ceramic trade and emulation continued in the 1500s. Cord-impressed S-rim

vessels, long the signature ware of Heart region potters, are an important component of sixteenth-century Akaska focus assemblages in the Grand-Moreau region (Johnson 2007a:125). The emulation of Coalescent styles in the Heart region can be seen in the increasing popularity of the distinctive alternating triangle motif previously unknown there. Technological analyses of unusual ceramic vessels dating to the 1500s from Slant, Larson, and Chief Looking's Village in the Heart region suggest that they represent imports from the Grand-Moreau region (Mitchell, ed. 2011; Mitchell and Swenson 2008; Speakman et al. 1997). Again, though, elemental composition data are lacking and other factors may be partly responsible. My brief examination of the pottery assemblage from the Lower Grand site, an Extended Coalescent settlement in the Grand-Moreau region dated to the sixteenth century, suggests that it includes Heart region imports.

The most intriguing evidence for interaction lies in the remarkable transformation of Middle Missouri tradition residential architecture that began in the 1400s. For more than four centuries, Initial and Extended Middle Missouri people built long-rectangular lodges with gable or gambrel roofs. Then, in the 1400s, sub-rectangular to circular, four-post lodges—a distinctive Coalescent-tradition design—began to appear in Middle Missouri tradition settlements. At Huff, dated to the middle decades of the fifteenth century, up to 10 percent of the lodges, clustered into sectors or neighborhoods, may have been built on the new four-post plan (Kvamme, McKinnon, and Weiwel 2009). Data from Chief Looking's Village, an east-bank settlement some 35 km upstream, indicate that the Mandans continued building long-rectangular lodges during the century after Huff was abandoned (Mitchell, ed. 2011). However, by the time Europeans arived in the eighteenth century, the transition to circular, four-post lodges was complete.

Almost nothing is known about the specific social context in which this transition took place, but the conclusion that it was a consequence of regular, intimate contacts between Coalescent tradition groups, especially Extended Coalescent communities in the Grand-Moreau region, and Middle Missouri tradition groups seems inescapable. The leading explanation centers on the movement of women among these communities. If women built and owned lodges in

the fifteenth century, as was the case in the nineteenth century, then the presence of four-post structures in the Heart region indicates the presence of Extended Coalescent women there. However, one can only speculate on the specific circumstances of their relocation. Individual women may have moved to cement alliances between leading households or they might have been taken as captives and incorporated into their abductor's extended household. Or, following a pattern known from the nineteenth century, translocated women could have arrived in the Heart along with their extended household or lodge group, comprised of men, women, and children (Bowers 1950).

In addition to evidence for the movement of individuals or households, there also is some evidence for larger-scale migrations. The sixteenth-century residents of Elbee Village in the Knife region may have arrived en masse in the northern Middle Missouri from elsewhere. Indeed, Scattered Village phase ceramic assemblages from the Knife region, which date to the early fifteenth century, are notably heterogeneous, possibly signaling the amalgamation of several formerly disparate groups.

Overall, then, the weight of the evidence points to trade and cooperation as the dominant modes of interaction between northern Coalescent and Middle Missouri tradition groups, probably into the seventeenth century. As was true of the interactions between farmers and foragers, though, it is unlikely that these relationships were never marred by violence. The desires the participants shared to control the terms of trade virtually guaranteed that conflict was never very far away.

Patterns of Economic Change

A variety of economic changes accompanied population aggregation, settlement clustering, and the expansion of trade in the 1400s and 1500s. The data and interpretations presented here point to two principal domains of economic change: intensified subsistence

production and the rise of specialized craft production.

Subsistence Intensification

Hunting practices began to change in the 1400s. While there is absolutely no question that bison remained the dominant source of animal protein (and supplied hides and a host of other products as well), lower-ranked species steadily became more important. Several processes likely contributed to this change. The increased use of smaller game may have been a byproduct of agricultural intensification (discussed later in this section). As people spent more time in their fields, and more time travelling to increasingly distant fields, they were afforded more opportunities to capture birds, small artiodactyls, canids, and other small mammals. Attempts to increase agricultural productivity also likely brought more household members to the fields, especially children or young adults charged with protecting crops from animal pests, again increasing opportunities to capture lower-ranked species. The success of opportunistic garden hunting could have been improved by more-frequent use of near-field game pits, which in the nineteenth century were owned by individual lodge groups and were used to capture a wide variety of animals (Bowers 1948:164, 1950:97).

At the same time, the increasingly anthropogenic landscape resulting from more intensive maize production may actually have attracted small animals to the fields, further increasing encounter rates. In fact, an increase in opportunistic hunting is a logical and foreseeable result of population aggregation. As the distance between settlements decreased, and as their populations and occupation durations increased, the proportion of the landscape under cultivation would necessarily have increased and animals attracted to both active and fallow fields would have become a more productive resource.

The increasing importance of certain lower-ranked resources may also reflect altered labor relations within the household. The increased consumption of fish, for instance, may

signal the expanding efforts of household members not previously called upon to contribute subsistence products. Older adults or adults with injuries or disabilities may have begun exploiting previously untapped resources, increasing the overall productivity of the household. In this connection, Bowers (1950:97) reports that in the nineteenth century older men managed fish traps. The exploitation of upland game birds could well have followed a similar pattern. A detailed examination of the contexts in which the requisite harvesting technologies were produced or discarded likely would shed light on this issue (Picha and Falk 2010).

Heart River hunters also attempted to increase the productivity of bison hunting. Across the region, the proportion of arrowpoints in each community's stone tool assemblage increased over time. This increase continued even as metal arrowpoints began to appear in the region, suggesting that the stone tool data in fact underrepresent the overall increase in the manufacture of hunting equipment in the seventeenth century. That is, the increased demand for hunting equipment may have entirely absorbed the influx of metal arrowpoints, effectively delaying the demise of stone-tipped arrows. Judging by the slight fall off in the frequency of small patterned bifaces in post-1700 Heart region assemblages, the replacement of stone by metal may only have begun at the beginning of the eighteenth century and then only weakly. Of course, arrows also were used in war and a part of the increased demand for them could have been prompted by the evident increase, beginning in the mid-1400s, in the incidence of collective violence, a topic I return to later. Hidatsa informants told Gilbert Wilson (Weitzner 1979:240) that arrows meant for war differed from those meant for hunting. However, no one has yet identified morphological differences reflecting those different functions among flaked stone arrowpoints from the northern Middle Missouri.

Accompanying this increase in the demand for arrows was an increase in the skill of arrowpoint production. Arrow production became more concentrated over time, freeing some men (presumably those more physically able) to devote more effort to hunting, while others focused on producing hunting gear. Both changes increased overall household and community

productivity. But the increased concentration of arrow production also had more direct effects. Skilled arrow makers produced better, more uniform arrows less liable to failure. Because they performed better, arrows (along with other hunting gear) made by skilled producers could have increased the reliability of kills and therefore the productivity of hunting parties.

Not a lot is known about the demographic context in which these changes in hunting practices took place. There is evidence for regional population decline during the 1600s and early 1700s (Ahler 2005a; Ramenofsky 1987), though the timing, magnitude, and causes of this decline are not entirely clear (Ahler 1993b). Certainly, the introduction of European epidemic disease is a likely leading cause for the progressive contraction of Double Ditch and Larson villages in particular, though community fissioning cannot be ruled out entirely. Given the changes in village size I reported in chapter 4, it seems clear that the aggregate population of the Heart region was either stable or declining in the 1500s and 1600s. If so, efforts to increase the productivity of hunting at that time must have been motivated primarily by a desire to produce surplus meat (or hides) for exchange, rather than for local consumption.

Direct data on changes in agricultural productivity are more difficult to come by. Macrobotanical data show that Heart region farmers harvested a variety of domesticated, naturalized, and wild plants, but no quantitative data on changes in the relative emphasis placed on different resources are available and in any case there are reasons to believe that such data may not be very meaningful (Toom 1992b). No one has yet gathered archaeological data on northern Middle Missouri cultivation methods, but given the data covered in chapter 4 showing that the region's sixteenth- and seventeenth-century subsistence economy was more complex than historic or ethnographic accounts attest it is certainly possible that farmers of the period also used a range of productivity-boosting techniques not documented in the nineteenth century. Specifically, one could speculate that the sudden and dramatic increase in population density during the fifteenth century prompted the introduction of new cultivation practices (Gallagher and Sasso 1987; Netting 1990), perhaps including some type of irrigation or floodwater

management. If preserved fields could be located, using a variety of geophysical techniques, a study of their morphology would add greatly to the larger understanding of Heart region history.

Nevertheless, some proxy data bearing on the question of changes in agricultural productivity are available. Trends in the sizes and numbers of subterranean storage features imply that the kinds of changes seen in hunting were matched by similar changes in agricultural production. While no one has yet attempted to rigorously quantify diachronic change in per-capita storage capacity, the data now available suggest that it increased over time. Many excavated Extended variant houses are associated with two or three undercut storage pits ranging in volume from about two-thirds to one and two-thirds cu. m (Calabrese 1972; Sperry 1995). Later, at the mid-1400s Huff site, excavated houses are associated with three to six such pits, with capacities up to about two and one-half cu. m (Wood 1967). In the seventeenth and eighteenth centuries, secondary storage pits sometimes were excavated into the floors of existing pits, perhaps to increase their size without sacrificing too much floor space. One such feature at Double Ditch Village boasts a capacity of at least three cu. m (Ahler 2005b). Storage pits in these communities are located both within and between houses, but there is no reason to think that subsistence production was carried out by social units larger than the household. Thus, given the apparent long-term stability in mean household size, at least as measured by house floor area, increases in the numbers and sizes of pit features likely reflects productivity increases, rather than simply increases in overall production.

Certainly, there is no question that the fields of the northern Middle Missouri produced substantial surpluses in the nineteenth century. In 1797, John McDonnell, a North West Company trader, observed that the Mandans, then living near the Knife River, grew enough maize, beans, and squash to satisfy local needs and to "sell and give away to all strangers that enter their villages" (Bushnell 1922:127). Later, Francis Chardon, the agent for Pierre Chouteau's Upper Missouri Outfit at Fort Clark, noted that the Mandans produced surpluses sufficient to meet their own needs as well as those of the trading post (Anfinson 1987). These observations are

supported by data on bone tools assemblages from settlements near the Knife River. Weston and Ahler (1993:282) argue that a notable increase in the frequency of bison scapula hoes there during the nineteenth century, a time when metal hoes increasingly were available, likely reflects agricultural intensification.

Admittedly, in the absence of comprehensive population estimates it can be difficult to distinguish between increases in per capita productivity—that is, intensification—and increases in total production. In fact, it seems entirely likely that these two processes often co-occur. In this case, though, the changes in the organization of craft production identified in chapters 6 and 7 bolster the view that the subsistence changes reflected in faunal assemblages and storage capacity do in fact indicate economic intensification.

Changes in the Organization of Craft Production

Among historically documented small-scale societies around the world, subsistence intensification commonly occurs in tandem with intensified craft production, embodied in producer or community specialization (M. Stark 1995). Frequently, specialized production, at least of pottery, arises where the best agricultural land is in short supply (Arnold 1985; M. Stark 1991). However, empirical data show that relationship between farm land availability and ceramic specialization is more complex than this simple formula admits. For instance, Karen Harry (2005) makes the case that the correlation does not hold in the prehispanic Southwest. Scott Cook (1984:20) argues that, for rural households in modern Oaxaca, Mexico, access to "agricultural means of production" is directly correlated with participation in craft production. Thus, both subsistence intensification and intensified craft production are best seen as strategies for creating surpluses, which are deployed in various ways depending on ecological and social organizational factors (Cobb 1993:69; Netting 1990; M. Stark 1995:218).

Before summarizing data on Heart region craft production, I want to digress briefly

to consider the meaning and significance archaeologists commonly assign to evidence for specialized craft production. Archaeologists have spilt a great deal of ink on the subject (Flad and Hruby 2007). Specialized production figures prominently in studies of cultural evolution, especially those focusing on the origins of the state and the rise of hereditary social inequality. The linkage between specialization and social complexity can be traced directly to V. Gordon Childe (and indirectly to Adam Smith and Karl Marx), who saw specialized production as a key indicator of a basic division of labor that ultimately made asymmetrical accumulations of wealth possible (Clark 1995; Wailes 1996). Though Childe acknowledged that several forms of specialization could be identified in the archaeological and ethnographic records, he chose to emphasize the sociopolitical significance of full-time specialization, especially in metalworking, while downplaying the significance of part-time or household specialization.

Specialization remains an important theme for scholars interested in the evolution of complex societies (Brumfiel and Earle 1987; Schortman and Urban 2004), but many archaeologists have sought recently to untangle the web of theoretical connections linking it exclusively to political complexity (Clark 1995; Clark and Parry 1990; Cobb 1993; Flad and Hruby 2007; Hendon 2007; M. Stark 1995). That a complex relationship exists between specialization and complexity is amply attested by archaeological, historical, and ethnographic data demonstrating that, among nonstratified or minimally stratified societies, specialization is common and that it takes on a wide range of complex forms. Craft specialization has, for instance, been identified as a feature of some complex hunter-gatherer economies (Arnold 1987); of the earliest farming communities in northern Europe (Keeley and Cahen 1989; Sliva and Keeley 1994); of prehispanic communities in the Southwest (Abbott 2009; Harry 2005) and the Plains (Creel 1991; Vehik 1990); of nineteenth-century communities in New Guinea (Allen 1984); and of rural farming communities in the modern Philippines (Stark 1991). In view of this diversity, many archaeologists now advocate an approach to the study of craft production that de-emphasizes specialization *per se* and instead focuses on understanding broader relationships

among people, the things they produce, and the values they assign to them (Clark 2007; Hendon 2007; Spielmann 2002). While I agree with the thrust of this argument, I nevertheless think that the term "specialization" remains both apt and useful in some contexts. In hopes of retaining its utility, while reducing the weight of its evolutionary baggage, I opt here for a minimalist definition of specialized production: specialization, in my view, is present whenever the number of people producing a particular item (or service) is substantially smaller than the number of people consuming it (Clark 1995; Costin 2001:276; Cross 1993:65).

The changes in the organization of stone tool and pottery production laid out in chapters 6 and 7 point to the appearance of specialized producers in the Heart region in the 1400s and 1500s. Pottery data show quite clearly that in the 1500s production was limited to a relatively small, though unquantified, fraction of households. Three main modes of production are evident. Many pottery-producing households made cooking pots, particularly Le Beau Classic variety and Knife River ware vessels. A smaller number of households produced Knife River Fine ware and Le Beau Recurved variety vessels. Knife River Fine ware pots are highly-decorated, special-function vessels. Le Beau Recurved pots were used for cooking, judging by the occurrence of carbonized food residues on them, but their consistently high quality suggests that they may have served a distinctive culinary function. Finally, beginning in the late 1600s, only a few producers, living in one or two villages, made Sperry ware pots. Sperry ware vessels were used for cooking, but their unique design and marked uniformity are indicative of a distinct organizational mode. Interestingly, these results are reminiscent of those Miriam Stark (1995) obtained in her study of the Kalinga pottery producers in the northern Philippines. Stark's data show that productivity among part-time specialists there varies, and, moreover, that different producers emphasize the production of different types of vessels.

Stone tool production data indicate that specialists were producing arrows in the Heart region during the sixteenth century and later. Inter-community differences in the skill and uniformity of arrowpoints indicate that specialist arrowmakers were unevenly distributed

across the region. It seems clear, though, that arrows were made both by specialists and by non-specialists. Given the frequencies of arrowpoints assigned to different skill classes it appears that, overall, non-specialists produced more arrows than specialists, but that the share of specialist production increased over time. To put these observations in context, it is worth recalling that chipped stone knives (large patterned bifaces) evidently were not produced by specialists. In fact, the skill of knife production seems to have declined even as the skill of arrowpoint production increased. This suggests that part- or full-time specialists only produced certain types of crafts.

Data on burial accompaniments, though limited, bolster these findings. In his excavation at Slant Village, Duncan Strong documented the interment of an older man accompanied by "arrow-making tools," including projectile points, antler and copper flakers, shaft wrenches, and other items (Seeman 1984:Appendix 1.1; Strong 1940:362). A cache of KRF cores and tools recovered from the Larson site may also represent a specialist's raw material inventory (Bowers 1940; Mitchell and Swenson 2008).

An interesting feature of the arrowpoint production data may inform on the social context of specialized arrow production. There is a marked difference in the production skill exhibited by ordinary arrowpoints intended for hunting (or war) and the skill exhibited by outsized arrowpoints that almost certainly were fixed to bow lances, a ceremonial weapon form. Bow lance tips are comparatively rare, making up just 2.9 percent of the arrowpoints I studied. However, more than three-quarters of them exhibit a high degree of production skill, compared to just over one-quarter of ordinary arrowpoints.

Specialist potters and arrowmakers learned their crafts in local communities of practice or technological traditions. Heart region arrowmakers, for instance, used four different haft preparation methods. All four methods are well represented in the Double Ditch Village assemblage, but only three are present in the Slant Village assemblage, and, with the exception of a small number of specimens, only two are present in the Scattered Village assemblage. A range of skill levels is exhibited by points exhibiting each preparation method, indicating that

accomplished as well as less accomplished flintknappers produced each type. The pottery data also suggest that producers learned and practiced their craft in cooperative communities of practice, though the data are more difficult to interpret. On the one hand, production methods and production skill are tied to ceramic style: different types of pots exhibit different technical properties. This finding is not particularly surprising, because Heart River pottery styles are defined in part on technological criteria. On the other hand, though, there are certain inter-community differences in vessel forming methods, suggesting that the relationship between style and technology was complex. It may be that multiple communities of practice were responsible for producing particular types of pots. An unresolved, potentially confounding factor is the extent of inter-community exchange. It is possible that several different communities produced certain common forms using somewhat different forming methods, but that exchange blurs the regional pattern. Alternatively, it is possible that some communities of practice spanned several settlements, through marriage or relocation. Additional data on the details of ceramic production likely will help distinguish among these possibilities.

Specialists likely produced other types of crafts as well. Excavation at Boley Village yielded evidence for concentrated bone fishhook manufacturing (Ahler and Falk 2006). Nine percent of the modified bone and antler assemblage from Boley is made up of fishhook manufacturing residue or fishhook fragments broken during manufacture. By contrast, just four percent of the modified bone and antler assemblage from Scattered Village consists of fishhooks, fishhook fragments, or manufacturing debris (Ahler and Falk 2002). Moreover, nearly one third of the Scattered Village fishhook assemblage consists of finished, discarded specimens, rather than production failures. Interestingly, 25 of the 26 Boley Village specimens come from a single large pit. This circumstance certainly raises questions about sampling bias, but, given the fact that this pit filled rapidly (as evidenced by an analysis of its contents and stratigraphy), the concentration of fishhook manufacturing debris in it seems to indicate that one or more artisans specializing in that task may have been working nearby.

Stone beads and stone bead manufacturing debris are common at Slant Village (Ahler, Minor, and Smail 1997). Though rare overall, stone beads are three times as common at Slant as they are at Scattered Village, and two-thirds of the Scattered beads in fact consist of unmodified concretions (Ahler et al. 2002). The Slant Village assemblage also includes bead fragments exhibiting several different phases of production.

Manufacturing debris from antler bracelet production is three times as common in the Scattered Village assemblage as it is in the 2004 collection from Double Ditch Village (Ahler 2005a; Ahler and Falk 2002). Antler shavings, possibly produced while tillering composite bows (Hamilton 1982), appear to be absent, or nearly so, from every Heart region collection except that from Chief Looking's Village where they are relatively abundant (Mitchell, ed. 2011). Diorite celts are notably common at Larson Village, as is manufacturing debris from celt production (Crawford and Mitchell 2007; Mitchell and Swenson 2008). While these data are certainly more limited than the those on stone tool and pottery production described in chapters 6 and 7, either because the materials in question are comparatively rare or because the site samples are small, they do suggest that production of some items was concentrated in certain communities or in certain households.

Ethnographic data supplement these archaeological findings, showing that key aspects of sixteenth-century production practices continued well into the nineteenth century. There is no question that, among both the Mandans and Hidatsas, specialists produced some crafts in the 1800s. For the Mandans, Bowers (1950) reports that specialists made pottery and arrows. His list for the Hidatsas also includes bull boats (circular, hide-covered wooden frames used to transport people and goods on the Missouri) and baskets (Bowers 1992). Specialists also performed a range of activities other than craft production, including certain medical practices, singing, painting, tattooing, storytelling, and designing and supervising the construction of earthlodges (Bowers 1950, 1992; Gilman and Schneider 1987; Pauls 2005; Will 1930). In addition, specialists operated certain facilities, including fish traps and game pits. Finally, specialists

filled some community offices. Howard Harrod (1995) notes that Corn Priests, charged with performing rituals necessary for a successful harvest, were specialists whose position was hereditary and whose appointment was life-long. Similarly, Bowers's (1950) informants told him that certain men with recognized abilities specialized in leading summer bison hunts and war parties.

The number of people producing particular crafts or employed in particular activities varied. Gilbert Wilson (1934:356) notes that in each village only a few women were authorized to cut and position the four main posts of an earthlodge (Pauls 2005; Will 1930). Bowers (1950:92) reports that "there were usually at least two skilled painters in each village." Bowers's (1992:166, 373) Hidatsa informants did not know precisely how many households produced pottery, but believed the number to be limited. Arrowmaking, by contrast, followed a different pattern. Describing Mandan practice, Bowers (1950:92) says that while "all males usually made arrows, some were employed specially for arrowmaking," a pattern also evident in the archaeological data. Nineteenth-century arrowmaking specialists were men who were older, or who had been injured, and therefore could spend much of their time producing arrows to be sold to others.

Unfortunately, little is known about the amount of time specialists spent practicing their crafts. Harrod (1995:53) believes that a Corn Priest's responsibilities kept him continuously busy from the spring until the early fall. Specialist arrowmakers likely spent "much of their time" producing arrows (Bowers 1950:93) and possibly other hunting gear. Other specialist's time commitments seem to have been more limited. Though no empirical data are available, it seems likely that painters, for instance, could have performed their tasks mainly during the winter, when other demands on their time were comparatively limited. Potting could have been pursued during the spring and fall, when the fuel needed for firing was not also needed for home heating but when the burden of agricultural tasks was lower. In any case, the degree to which specialists earned a living by their craft seems to have varied.

Marked skill was a recognized component of specialized production. In some cases, a specialist's competence was grounded in prior aptitude: if, for example, a boy had a good voice he was encouraged to purchase rights to sing in public ceremonies (Bowers 1950:92). Skill was also rewarded by appointment to specialized offices or tasks. Men who led successful hunts or combat missions later were chosen as community leaders.

Some types of production conferred prestige. Painters and storytellers, for instance, were "highly regarded" in their communities and therefore able to command high prices for their services (Bowers 1950:92-93). The marked skill exhibited by oversize arrowpoints meant for bow lances, a ceremonial weapon, in the archaeological assemblage suggest that specialized arrowmakers enjoyed a certain amount of prestige. Other activities, such as mat making, were less well regarded, though not necessary less technically demanding; accordingly, producers earned less for their efforts.

Men and women tended to specialize in different tasks, according to their larger roles in society. Arrowmakers, Corn Priests, and hunt leaders were men. Women specialized in basket making, potting, and lodge construction. However, these divisions were not absolute. Hidatsa informants told Bowers (1992:374) that older couples sometimes made pots, with the man doing many of the physically demanding tasks such as digging and transporting clay. Among the Mandans, both men and women were storytellers (Bowers 1950:93).

Finally, ethnographic data provide insights into the specific ways specialized activities were organized and specialized skills were transmitted. A defining feature of Mandan and Hidatsa specialization was a system of production privileges linked to ownership of sacred bundles. Individuals only were authorized to practice particular vocations if they purchased rights to do so from an established practitioner. In addition to providing authorization, the purchase process channeled the communication of technical knowledge from experienced producers to novices. It also legitimated the reproduction of certain motifs or forms (Bowers 1992:104). The linkage between the transmission of technical knowledge and the authorization

to reproduce particular styles is evident in the archaeological data demonstrating the connections between ceramic types and production methods.

The purchase price and procedure varied according to the nature of the bundle with which the craft or activity was associated. The right to narrate certain sacred stories, for instance, could be quite expensive, requiring the buyer to enlist family assistance in gathering the property necessary to make the purchase. Pottery production, by contrast, was often purchased by young girls from their mothers for a nominal gift, usually consisting of a small feast. In both cases, though, the principle of payment for training was enforced. Because transfers of different bundle rights were managed variously by clans, sodalities, and lineages, and the method of transfer varied to some extent between the Mandans and Hidatsas, the training process played out differently depending on the community and the craft or activity in question. In each instance, though, the acquisition of technical knowledge was inseparably tied to the creation of social relationships, though the nature of those relationships varied somewhat from place to place. It is worth noting, though, that this pattern was not universal. Relatively few people practiced mat weaving, but apprentices were not required to pay for instruction and their production did not require sacred sanction (Gilman and Schneider 1987:116).

Taken together, the archaeological and ethnographic data indicate that specialized craft production was a long-standing tradition in the northern Middle Missouri. But the archaeological evidence also points to aspects of the organization of craft production not attested in ethnographic and historic sources. One is the extent and economic significance of specialized production. Though admittedly a subjective assessment, the abundant evidence for specialization in a wide range of crafts suggests that it may have been more important in the 1500s and 1600s than it was in the 1800s. This is particularly evident in pottery production. Such a change is to be expected, given the fact that the functions—though probably not the social significance—of pottery vessels began to shift in the early nineteenth century. It is worth remembering, though, that many crafts incorporated perishable components and so the archaeological data reveal only

a part of the picture. For instance, even though the use of flaked stone began to wane in the late eighteenth century, arrows themselves—fitted with metal tips—remained crucial, a fact attested by the many finely crafted examples preserved in nineteenth-century ethnographic collections.

The most conspicuous pattern not reflected in the documentary record is the evidence for community specialization at Scattered Village. While the specific item (or items) they were making is not entirely clear, the resident's widespread and frequent use of bipolar technology demonstrates unequivocally that they were engaged in an activity only infrequently carried out at other settlements in the region. Bone tools and antler ornaments are the leading candidates and important implications follow from either. On the one hand, the fact that antler ornaments may have appealed to both hunter-farmers on the river and to their mobile trade partners links specialized production in the Heart region with larger-scale patterns of interaction. On the other, if they were making bone tools, including scapula hoes and split-rib flakers, then the concentration of production there indicates that some of the most important tools in the hunter-farmer tool kit were distributed through local trade.

Scattered Village may not have been the only community specializing in a particular craft. Data from Boley Village hints at the possibility that its residents produced hides (Ahler, Burns, and Madden 2006); however, the current sample is too small to fully evaluate that possibility. It is relevant, though, that at least in theoretical terms one type of community specialization is likely to have engendered others (Abbot, Smith, and Gallaga 2007).

Producer and community specialization likely contributed to economic intensification in at least three ways. First, specialization enabled some degree of economic efficiency; the value of such efficiencies may have increased when the extent of cultivated land increased, requiring farmers to travel farther to increasingly distant fields. Second, economic benefits may have been afforded by the increased availability of well-made goods. High-quality hunting kits likely improved the reliability, and therefore marginal returns, of hunting trips. Larger and better-made pots may have eased some aspects of food preparation. Third, the greatest economic benefits

probably derived from the increase, whether measured at the household or community level, in overall economic output that specialization made possible. As was likely the case for fishing and small-mammal hunting, specialization (in craft production as well as services) provided older or disabled members of the community an opportunity to make substantive economic contributions to their households. If the patterns Bowers and Wilson document obtained during earlier periods, and the evidence certainly suggests that they did, then many specialists received payments, not only for their production, but also for the training they offered apprentices. Judging by the ethnographic record, these payments could be substantial.

It should be said, though, that the consequences and significance of specialization are not simply economic, but simultaneously social (Clark 2007). As Cobb (2000; see also Wolf 1982) points out, craft production (or subsistence production, for that matter) should be analyzed not only as work, in terms of the effort and materials needed to accomplish tasks, but also as labor, in terms of the social relationships among producers and between producers and consumers. Specialization entails a reconfiguration of the connections among people, with ramifying consequences for household and community social structure. Future study of Heart region specialization therefore should focus on how, and by whom, the surpluses economic intensification created were mobilized.

Intra-regional Interaction

Apart from the fact that specialization likely diversified a household's sources of income and increased its overall productivity by involving more members in gainful activity and by freeing some members from certain tasks, it also created a web of new connections between producers and consumers (Cobb 1993:66). Household-level specialization minimally requires systems for within-community exchange. In the Heart region local exchange may have been channeled by kinship or sodality membership, perhaps in the context of small-scale markets.

By contrast, community specialization—in bone tools or antler ornaments, Sperry ware vessels, and possibly hides and other items—almost certainly required regional marketplaces. Such intra-regional bazaars need not require a hierarchical administrative apparatus to function (Stark 1991). But they do need to be regular enough and large enough to offset certain costs incurred by participants (Abbot, Smith, and Gallaga 2007). Producers need to be assured that the number of prospective buyers will be adequate to justify the time spent in preparation (perhaps to the exclusion of other activities) and the effort of transporting their goods to market. Consumers need to be assured that the items on offer will be sufficiently varied to justify their participation. Both need to be assured of fair dealing, which requires a mechanism for fixing prices.

In the Heart region, these requirements could have been satisfied by combining marketplace exchange with events in the ceremonial calendar. David Abbott and others (2007) make a similar claim for middle Sedentary period Hohokam groups in the Phoenix basin. There, ritual ballgames played on specially built courts located adjacent to public plazas in most settlements were simultaneously settings for trade. Abbott and others (2007:478) argue that, "the hindrances to regional exchange and other forms of intercommunity interaction were met by extending the moral economy of kinship with a shared consciousness of religious identity."

For the Heart River Mandans, a similar function could have been served by the premier event in the religious calendar, the Okipa, a dramatization of the earth's creation during which the Mandan's history was recounted. According to Bowers's (1950:122) informants, the four-day event was celebrated in each village at least once during the summer. Men, known as Okipa Makers, volunteered to sponsor the ceremony after receiving visions of bison singing the Okipa songs (Bowers 1950:121). Sponsorship imposed great demands on the Okipa Maker, his household, and even his clan, to produce the goods necessary to pay the many singers, dancers, and officials involved; generally a year of advance preparation was required (Bowers 1950:123). Significantly, the ritual mandated the use of four turtle-shaped drums, of which only one set existed, curated by the most prestigious clan, the Waxikena (Bowers 1950; Taylor 1996). Thus,

even though each community held its own Okipa ceremony, they could not all occur at the same time.

Periodic inter-ethnic trade fairs, carried out under the banner of fictive kinship forged in the calumet ceremony (Blakeslee 1981), could have served a similar function, albeit without the sense of shared religious identity the Okipa or other events in the ceremonial cycle engendered. Historic sources imply that the trade visits made by mobile groups to the Heart River towns may have been sufficiently well-attended, regular, and prolonged to accomplish the functional prerequisites noted previously. If so, this is another reminder that long-distance exchange was closely intertwined with local exchange.

It is relevant to note that a reasonably formal barter system built up around specialized production in the nineteenth century. As Bowers (1950:91) observes, the principle of payment for specialist production was "highly developed" among the Mandans and Hidatsas. Payment occurred in two contexts. One was payment for training: novices paid experienced practitioners to teach them how to carry out particular activities. In some cases, training costs were quite high, and amounted to an important source of income for established producers. The other was payment for services rendered or crafts produced. Having received training, producers were now authorized to charge for their work (Bowers 1950:92).

In both cases, the method of payment varied. Bowers (1950:93) describes what amounts to straightforward barter: ten arrows, for instance, might be worth one unpainted bison robe. Such exchanges involved subsistence products, finished goods, and immaterial property, such as sacred songs or stories. Frequently, a portion of the debt was paid through feasting. Wilson (1916:182) describes a somewhat more complex type of transaction in which a buyer's praise for an item obliged the producer to present it as a gift, for which payment later would be made, with the price paid presumably dictated by accepted conventions governing the relative values of different items. Note that in this case no clear distinction was made between gifts and commodities and in fact purchases commonly involved the establishment of a defined social

relationship between producers and consumers. For instance, when a man purchased rights to an age-grade society—paid for in robes, clothing, or other material goods—he simultaneously established a father-son relationship with the men from whom the purchase was made.

Warfare

In the Heart region, settlement reorganization and economic intensification were bound up with warfare. Wood (1967) recognized the seeming paradox of this linkage more than 40 years ago: just as the residents of the towns clustered around the Heart began escalating their interactions with downriver village groups, with bands of mobile bison hunters, and with each other, the specter of war appeared. Before assessing the place of war in northern Middle Missouri society, it is useful first to reflect on the nature of the evidence for collective violence. Archaeological data on the frequency and intensity of warfare come in a number of forms. Evidence of traumatic injuries preserved in human remains and of preparations for war embodied in community fortification are certainly the most vivid (Milner 1990; Mitchell 2007; Willey 1990). Other forms of evidence include the details of settlement design and location (Lippincott 2007); incidents of catastrophic structure fires (Wood, ed. 1976); images pecked, painted, or carved on stone or drawn in ledgers (Keyser et al. 2006); the occurrence of trophies made from human body parts (Owsley et al. 2007); and unequal sex ratios (Bowers 1950; Owsley, Berryman, and Bass 1977). Each of these datasets yields a particular point of view on warfare. Osteological data on traumatic injuries, for instance, document the intensity of particular conflicts as well as details of battle tactics. Depictions of battles and individual combatants in rock art illustrate particular conflicts and indicate something about the cultural context of warfare.

Here, the focus is on the frequency and design of defensive works. From a purely practical standpoint, tallies of village fortifications provide the most comprehensive view of

Middle Missouri warfare. While there certainly are instances in which the presence or form of such features cannot be discerned without excavation or geophysical surveys (Ahler, ed. 2005), data on fortifications are less subject to recovery bias than other classes of data. Most Middle Missouri subarea village defenses incorporate a ditch feature, the presence of which commonly is indicated by a clear, if sometimes partially obliterated, swale that investigators seldom fail to document.

More important, though, is the fact that the frequency of fortifications effectively measures social perceptions of war (Mitchell 2007). That is, they are an unambiguous proxy for a community's expectation or anticipation of collective violence. Defensive works are sensitive barometers of community sentiment because they are costly: building them required the coordinated labor of every able-bodied member of the community and they consumed large amounts of timber, which in the Middle Missouri is a resource in short supply that is also needed for lodge construction. Fortifications create a need for community-level leadership to settle on an appropriate and cost-effective design and to manage construction. Moreover, because defensive works are only as effective as their weakest section, they need sustained and coordinated maintenance. They are, in effect, a form of monumental architecture that consumed significant resources and that required both supra-household authority and significant engineering and organizational know-how to build and maintain. As I mentioned at the beginning of this chapter, several lines of evidence indicate that Middle Missouri tradition communities were planned, beginning when deemed necessary with the fortification ditch and palisade. That is, they were not an afterthought, built in response to an imminent threat, but rather integral to the overall layout and structure of the community. Because they took time to build and had to be designed and put up prior to the onset of active hostilities, they indicate trends in community sentiment over a period of time. From these considerations, I infer that warfare was itself an integral feature of the social life of these communities.

In addition, data on the properties of particular fortification systems can be used to draw

inferences about the strategies and tactics of war characteristic of a particular time or place. While there is no question that warfare was a long-standing "cultural institution" in the Middle Missouri subarea, differences in the design of specific fortifications indicate that the frequency and form of collective violence varied both spatially and temporally (Mitchell 2007; Robarchek 1994:312). For instance, about half of the known Initial Middle Missouri settlements are fortified (Bamforth 2006; Tiffany 1982), but in many cases only limited labor and resources were required to build their defenses. A smaller proportion of Extended variant sites are fortified, but those that were typically featured a longer ditch and palisade and some included specialized features such as bastions. Massive bastioned defenses surround virtually every Initial Coalescent community (Johnson 2007a). By contrast, few Extended Coalescent settlements are fortified. However, those that are exhibit a wide variety of configurations; in many cases, only a portion of the community was surrounded by a ditch and palisade with just one or two bastions (Hoffman 1967).

What was different, though, about fifteenth- and sixteenth-century warfare in the Heart region was the fact that it was almost universally anticipated. (Initial Coalescent communities located some 450 km downriver likely shared the same sentiment, though there are a variety of reasons to think that the social context of war differed there [Bamforth 1994; Zimmerman and Bradley 1993]). Substantial defenses protected nearly every Heart region settlement occupied between 1450 and 1750 (Swenson 2007). Not only were they larger and more costly, they also were more elaborately engineered. The best-documented defensive system in the northern Middle Missouri surrounds the Huff site (Ahler and Kvamme 2000; Kvamme, McKinnon, and Weiwel 2009; Wood 1967). There, the community built a massive, carefully planned ditch-and-palisade system featuring ten prominent, regularly spaced bastions. The fortification also featured a series of angled, presumably sharpened, poles projecting outward from the base of the palisade (chevaux de frise). Later, in the 1600s, massive earthen mounds, which clearly required enormous effort to build, were incorporated into the fortifications surrounding other Heart region communities (Ahler 2005a).

In sum, the frequency and design of Heart region fortifications indicate that warfare intensified there in the 1400s: it was waged on a larger scale and, most importantly, was more predictable than during any previous period. Every community expected war and that expectation was consistently maintained. If there were times between the late 1400s and the late 1700s when village defenses fell into disrepair they likely were brief, given the well-documented efforts by the residents of Double Ditch and Larson villages to reconstruct, repair, and realign them. It is worth noting that the presence of village defenses, however complete or well-maintained they may have been at any particular moment, likely reminded the community's residents that conflict was never very far away. Moreover, from the outside, ditches and walls reminded visitors of the villager's ability to project military power (Pauketat 2009:255). Whether intended or not, fortifications—nominally a defensive feature—helped perpetuate the social conditions for war.

An Emerging Heart River Confederacy

All of these changes—the increased predictability of warfare, the dramatic expansion of the trade network, the increase in local population density, the reorganization of craft production, the intensification of subsistence production—began in the Heart region sometime in the 1400s. It is precisely under these conditions, especially an increase in population density, an increase in long-distance trade, and an increase in warfare, that Native communities elsewhere in North America established complex intercommunity coalitions commonly described as confederacies (Wallace 1957). Such confederacies took a number of forms and functioned in a variety of ways but all of them featured political alliances among clustered groups of communities.

It is interesting to note that there are parallels between the pattern of historical development in the Heart region and that of contemporaneous societies in other parts of North America. In southern Ontario, for instance, the Hurons established large, fortified towns beginning in the fourteenth century (Trigger 1976). In the 1400s, those towns coalesced into a

series of tightly packed clusters. Among the Haudenosaunee, to the east in modern New York State, similar changes were taking place at about the same time (Bradley 2005; Englebrecht 2003). There, development of a large-scale exchange network seems to have been particularly important. Across the continent, in the Rio Grande valley, population aggregation and settlement clustering began earlier, in the late 1200s, but by the fifteenth century the smallest communities and clusters of communities were gone, absorbed into larger settlements and settlement clusters (Adams and Duff 2004). Community specialization in ceramic production has long been recognized as a feature of some of these Rio Grande settlements, but other forms of economic complementarity—accompanied by marketplace exchange—likely existed as well (Kohler, Herr, and Root 2004). Many archaeologists see collective violence, and the development of social mechanisms for managing conflict, as important contributing factors in each of these cases (Spielmann 1994). However, it is clear that the specific historical processes at work varied and, moreover, that significant differences existed in the internal structures and external relationships of different confederacies.

What was the nature of the political relations within and among the Heart River confederacy's constituent communities? At the moment, no full answer to this question can be given. Research on similar clusters in the Rio Grande valley suggests that a number of organizational modes are possible (Spielmann 2004); for the Heart region, insufficient data are available to select among various alternatives. However, in keeping with the principles of historical processualism laid out in chapter 2, it is possible to use anthropological models of emerging social and political complexity to offer some tentative answers (Cobb 2000:20).

The changing demographics of the Heart region may hold one clue. Archaeologists have long held the view that a relationship should exist between population and sociopolitical organization. However, cross-cultural research carried out over the last 30 years or so has generally failed to establish an unambiguous empirical link between them, at least for non-state societies. Of course, each of these variables can be measured in a number of different ways.

For instance, sociopolitical organization might be reflected in degrees of status differentiation, in the number of tiers in the administrative hierarchy, in the duties and functions of community leaders, or in the differentiation of labor (Arnold 1996; Feinman and Neitzel 1984). Population can be tallied as the total head-count of a region, as the size of the largest settlement, as the proportion of people living in the region's largest settlement, or as population density (Drennan 1987). Among these factors, Gary Feinman and Jill Neitzel (1984:69) find a correlation in their ethnographic data between total population and the number of tiers in the decision-making hierarchy. As I mentioned in chapter 4, it is likely that 8,000 or 9,000 people lived in the Heart region in the middle of the eighteenth century. No reliable estimate is available for the sixteenth century, the likely period of peak population, but a figure one-third larger seems like a reasonable starting point given the available data on mean settlement size. That would put the population of the Heart region at 12,000, which translates into roughly 25 to 30 people per sq. km living within the immediate vicinity of the river valley. At 2,200 people, Double Ditch may have been the largest single settlement. Working from Feinman and Neitzel's analysis, these figures suggest that the Heart region administrative hierarchy consisted of two, or possibly three, levels.

There is some archaeological evidence for such a hierarchy. Much of the discussion here emphasizes the area's largest settlements, such as Double Ditch Village. But other, much smaller sites—about which very little is known—seem to have been occupied at the same time. Perhaps the best example is 32MO42, a fortified settlement with about 10 lodges, located on the west bank directly opposite Double Ditch Village. Moreover, size differences exist even within the roster of larger sites mentioned here. For instance, Sperry Village, with a maximum of about 40 lodges, is considerably smaller than many of its contemporaries (Swenson 2007). Though all of these settlements are fortified, it seems likely that the smallest among them possessed only limited military capabilities. In addition, smaller settlements' participation in regional marketplaces likely differed from their larger neighbors.

There are other hints of supra-community leadership in both the archaeological and

ethnographic records. The long-term stability of the distant resource zones different Heart region towns exploited, documented in the lithic raw material data discussed in chapter 6, suggests that a social mechanism existed for setting boundaries and adjudicating disputes. A clearer indication of between-community political connections lies in the evidence for community specialization in antler ornaments, bone tools, or hides. Even crafts manufactured by households or groups of households may have been distributed through regional or sub-regional markets. This is particularly true of Sperry ware vessels.

Bowers's (1950:23) informants told him that, prior to the epidemic of 1782, "all the available corn grounds were planted and that it was necessary for the villages to meet in council to define the garden limits of each village." He goes on to say that the Mandan system "was a theocracy in which the Okipa Makers [the sponsors of the annual Okipa ceremony] of the respective villages met to define policies relative to inter-village action while matters related to the assignment of corn grounds was [sic] in the hands of the leader of the Corn Ceremonies" (Bowers 1948:148). Bowers (1948:214) further asserts that the villages "acted in unison in social and economic affairs or for mutual defense." The intercommunity leadership necessary for such unified action was "vested in the hierarchy of bundle-owners or priests" (Bowers 1950:30). However, Bowers's (1948:177) informants believed that tribal-level leadership positions were not permanently filled. Instead, tribal posts may have been filled when needed, with leaders called upon to adjudicate disputes, distribute subsistence products, or coordinate cooperative military operations.

Sodalities could conceivably have played a role in inter-village cooperation. All of the age-grade societies were present in each village but no specific data are available on the nature of the interactions between cohorts living in different communities. Finally, while marketplace exchange in itself may not have required administrative oversight, an intercommunity council of some sort may have been needed to schedule Okipa performances, owing to the fact that there was only one set of the turtle drums necessary for the ceremony.

Political organization within the Heart River towns is better documented, both archaeologically and ethnographically. The archaeological evidence for strong, community-level leadership is particularly clear for the communities founded in the mid-fifteenth century and later, though there are hints that structurally similar administrative positions existed during Extended variant times as well. Many Middle Missouri tradition settlements exhibit evidence of coordinated advance planning. The construction of village defenses—a form of monumental architecture and therefore the purview of local leaders—involved significant planning and oversight, to engineer the ditch and palisade, to harvest and transport the massive amount of timber required, and to coordinate the construction efforts of individuals and households. Data from Double Ditch Village also indicate that large-scale sediment transport, featuring both extensive planar borrowing and the construction of massive earthen mounds, began there in the fifteenth century and continued throughout the history of the settlement (Ahler, ed. 2004, 2005). Though questions remain about the purpose of these borrow areas and mounds, there is no question that they represent an enormous labor investment. All of these activities—village planning, fortification, and mound construction—must have necessitated administrative levels above the household.

Bowers documents the existence of several tiers of community leadership in the nineteenth century. Each clan elected a leader, usually an older man known for his personal accomplishments and his compassion for clan members (Bowers 1950:30). Leaders were also elected for time-limited responsibilities, such as the summer communal bison hunt, or were appointed for specific ceremonies, such as the Okipa. For this reason, Bowers (1950:36) observes that "the responsibilities for leadership in various Mandan social and ceremonial activities were profusely scattered through the entire population," and that a man's status was partly context-dependent.

Each community had a local council, drawn from the ranks of men owning tribal bundles. The councils were hierarchical, with member's status determined by the importance

of the bundles they owned (Bowers 1950:33). Out of this group two especially prominent men, ideally with complementary abilities, were chosen as chiefs. The one with the greatest record in combat was chosen to be war chief. The other chief was selected for his interpersonal skills: "he should be the one who was thoughtful of others, gave frequent feasts, was popular with the tribes coming to the village to trade, and was able to settle little quarrels within the village or with visiting tribes" (Bowers 1950:34). Note that a man's popularity among the community's members figured in his election to village-wide office. In fact, individual lodge groups, or even lineages, retained the prerogative of, as the saying goes, voting with their feet by moving to another community when they found themselves at odds with local authorities (Bowers 1950:28).

Another key aspect of sociopolitical organization in middle-range societies is persistent status differentiation. If differences in house size can be taken as an indicator of household status, then some degree of social ranking must have existed beginning in Extended variant times. In a number of cases, the largest excavated houses face onto the public plaza, a position which in the nineteenth century was reserved for the highest-status households. However, it is possible that the fact that the largest excavated structures consistently adjoin plazas reflects in part excavation strategies predicated on this ethnographic observation. In any case, there is no question that household status varied in the nineteenth century; that it depended on wealth and, especially, on the ownership of sacred bundles; and that the highest-status households occupied lodges that doubled as ceremonial structures (Bowers 1950). It is also true that these differences largely were hereditary. Men born to families owning tribal bundles had advantages over those who were not; as Bowers (1950:85) puts it, "children of eminent parents were presumed to be better informed" than those from lesser families, and therefore better able to lead. Bundle ownership conferred economic advantages as well. Not only were bundle owners considered authorities on matters sacred, but they also were paid well for officiating at ceremonies tied to the bundles they owned (Bowers 1950:75). Prominent families attempted to preserve their advantages by arranging marriages with other families owning important bundles. Moreover, Bowers's (1950:34)

informants believed that "the sons of chiefs were usually selected [as leaders], since they were better trained and were exposed to sacred bundles which had proved their potency."

Still, like many other similarly organized societies, a man's "personal qualifications" affected his status and his ability to achieve high office (Feinman and Neitzel 1984:61). Demonstrable success in war, or in organizing and executing communal hunts, helped advance a man's career (Bowers 1950:33, 86-87). Bowers (1950:34) also notes that a chief's authority rested on his rhetorical abilities to persuade his peers to adopt his views; this basis for leadership was in fact common throughout much of Native North America (Clements 2002).

Exotic trade goods, which archaeologists often take as markers of status, are certainly present in all the Heart River towns, but no data currently are available on their associations with other indicators of status, such as house size. (Data on artifacts associated with human interments are quite meager, owing at least in part to the fact that recent archaeological field investigations have sought to steer clear of burials.) Nevertheless, control of trade has long been considered, at least on theoretical grounds, to be bound up with the accumulation of wealth and exercise of political control. Specifically, trade provides an arena for transforming surplus production into various kinds of social valuables, including status. Local dissemination of trade goods creates a web of obligations to be satisfied by surplus production, which in turn enables trade. Lensink (2005) makes a case that this was one of the factors responsible for the establishment of the first aggregated farming communities on the Northern Plains. Ahler (2007) makes a similar case for the origin of the Extended variant. Interestingly, Feinman and Neitzel (1984:56) find that control of external trade is more common among "strong" leaders than it is among "weak" ones.

Finally, as the data presented here clearly show, labor differentiation accompanied the emergence of the Heart River confederacy. It is difficult to imagine that specialization failed to reconfigure the economic and political relationships among individuals, households, and communities in one way or another. However, despite abundant evidence for surplus production, almost nothing is definitely known about how or by whom it was appropriated, or

about the political or social ends it served. These questions cannot be addressed effectively until household-level data become available, the generation of which will require a fundamental shift in the research strategies applied to sites in the Heart region.

Sociohistorical Processes in the Heart Region

Identifying the factors leading to intensification and alliance formation in the Heart region is challenging. The trouble is two-fold. First, too little is known about the late fourteenth- and early fifteenth-century archaeology of the region. Most published studies on the Extended variant are organized around culture-historical research questions and in any case report on sites located outside the Heart region. Detailed data are available for the Huff site, but there are other large, fortified communities likely dating to the fifteenth century about which almost nothing is known (Wood 2001).

The second—and more vexing—problem is the imprecision of the chronological tools now available. While the data at hand suggest that elements of the new social and economic configuration of the sixteenth century can be traced to the late 1300s or early 1400s—notably the increase in interregional trade and, perhaps, the intensification of the subsistence economy—radiocarbon dating cannot pull apart the temporal relationships among other core elements, such as the increase in settlement density, the increase in the intensity of warfare, and the re-organization of craft production. New data from previously unstudied sites, especially those dating to the 1400s, will certainly improve the situation, but it seems likely that a better understanding of the relationships among various factors and processes will require new chronometric methods.

Nevertheless, with the data at hand, and by drawing on a range of general concepts and models, it is possible to generate a set of hypotheses or scenarios about how the trends in Heart region history identified here fit together. To set the stage for those scenarios I first turn briefly to

a consideration of the part played by climatic change.

The Role of Climate Change

A number of archaeologists make a case that climatic change, including sustained droughts, played a role in the history of the Middle Missouri subarea generally and of the Heart region specifically (Bamforth 1994, 2006; Lehmer 1970; Toom 1992b; Wood 1967). However, before considering the relationships between patterns of precipitation and temperature and the suite of changes I document here, a couple of general points need to be made about the uses of climate data. As Bamforth (1990, 2006) points out, the large-scale atmospheric circulation models archaeologists most often cite to assess the effects of climate change on culture are really too coarse for the purpose. For one thing, local and regional empirical studies document significant temporal variation within the broad periods these models define. For another, local proxy data reveal contemporaneous spatial variation at several different scales.

What are needed instead are climatic reconstructions based on local, high-resolution records. Several such records, based on studies of lake sediments or tree-rings, are available for the Northern Plains (Fritz et al. 2000; Laird, Fritz, and Cumming 1998; Laird et al. 1996; Stahle et al. 2007). Here, I draw primarily on a recent reconstruction of decadal to multidecadal moisture regimes over western North America based on summer Palmer Drought Severity Indices (PDSI) derived from numerous tree-ring studies (Stahle et al. 2007). It should be said, though, that while the reconstruction does incorporate proxy data from several sites on the Northern Plains data from the region are sparse. Diatom-inferred salinity and other data from closed-basin lakes in North Dakota largely confirm the tree-ring reconstructed summer PSDI time series, though there are some differences. The tree-ring data, though, have the virtue of integrating local, high-resolution records with larger patterns of climatic variation.

Three megadroughts, defined as periods of low precipitation more severe and sustained

than those documented in recent instrumental records (Stahle et al. 2007:142), occurred over western North America from the late 1300s to the late 1600s. Each of these events was spatially complex. The fourteenth-century drought was most intense in the northern Middle Missouri from 1387 to 1398. In the fifteenth century, drought conditions were most intense from 1456 to 1461 and again from 1474 to 1481. The sixteenth century megadrought, the most intense and widespread drought event in North America during the last 500 years (Stahle et al. 2000), was felt most acutely in the northern Middle Missouri from 1577 to 1582. Of these periods, 1456-1461 and 1577-1582 likely were the most intense.

Lacustrine data from closed-basin lakes in central and eastern North Dakota suggest a slightly different climate history for the Middle Missouri subarea (Fritz et al. 2000). Like the tree-ring derived PDSI data, they indicate drought in the mid-1400s and again during the second half of the 1500s. However, they also suggest a period of drought running from the late 1200s to the early 1300s, the latter portion of which is recorded as a period of average to wet conditions in the PDSI data (Cook et al. 2004; Stahle et al. 2007). Cook and others (2007) present evidence for a widespread drought between 1267 and 1297 centered on the American Southwest that could also have affected the Middle Missouri, though not with the intensity of the droughts Stahle and others (2007) classify as megadroughts. The reasons for these differences in the fourteenth-century record are not entirely clear, but as Fritz and others (2000) point out, local, and imperfectly understood, hydrologic factors may be at work.

The first of the three megadroughts documented in the PDSI record (1387-1398) occurred during, or just before, a period of cultural change in the northern Middle Missouri. Recall that around the turn of the fifteenth century or a little later the relatively small, widely dispersed communities of the Extended variant began to coalesce into large, densely settled communities. Drought conditions could have led to changes in bison migration patterns (Bamforth 1988), to reductions in the frequency or magnitude of Missouri River floods, or to declining water tables under fields planted on small alluvial fans issuing from intermittent drainages. Each of these

shifts could have led to subsistence shortfalls, which had to be made up in other ways. It is not at all clear, though, that aggregation is the best strategy for coping with subsistence stress. Studies carried out in the Southwest, for instance, have come to conflicting conclusions on the question (Hill et al. 1996; Kohler and Van West 1996). It should be said, though, that the multifocal economic strategy of Middle Missouri communities bears little resemblance to that of ancestral Puebloan groups.

Trade is another strategy for coping with the potential for subsistence shortfalls. Blakeslee (1975) argues that the origins of what he calls the Plains Interband Trade System, a network that remained robust into the nineteenth century, lie in attempts by both hunter-farmers and hunter-gatherers across the region to reduce subsistence risk. In Blakeslee's view, trade buffered local shortfalls by connecting widely separated groups pursuing different subsistence strategies in different regions. The success of this buffering strategy only could be assured, though, if trade connections were maintained during times of abundance. It is perhaps no coincidence, then, that the scope of the Northern Plains trade network began expanding in the fourteen century, albeit probably before the onset of the tree-ring documented megadrought. However, the specific relationship between the drought of the late 1300s and the other historical processes documented here—aggregation, settlement clustering, warfare, and economic intensification—is not clear.

When the next megadrought hit, in the 1450s, the major settlement and economic changes documented here already were underway. The transition to higher residential density likely was complete. Population density had not yet reached its peak, but the process of settlement clustering was well along. Heart River communities already routinely expected warfare. The re-organization and intensification of craft production likely began about this time, though precisely when is not known. Thus, while the drought of the mid- to late-1400s cannot be considered a primary cause of these changes, it could have added fuel to the economic fire. Still, the linkage between drought and culture change seems to have been indirect at best. The emphasis on lower-

ranked animal resources, for instance, was a comparatively long-term change that began before the middle of the fifteenth century and likely continued at least until the Mandans left the Heart. Similarly, the fact that complex bastioned fortifications similar to those at Huff also surround Heart region communities founded a generation later, during a period of relatively favorable conditions, suggests that factors other than climate-change-induced subsistence stress were at work.

The effects of the sixteenth-century megadrought, the largest on record, seem to have been only dimly felt in the Heart region. When the drought hit sometime after 1550, most of the region's major communities already were established and they continued to be occupied long after the drought abated. Of course, some communities, perhaps those with limited access to prime field locations, may have relocated during this period. But there is no question that the major, long-term economic and settlement trends begun in the mid-1400s continued.

A number of archaeologists note the apparent insensitivity of Plains Village societies in the Middle Missouri subarea to climatic change (Griffin 1976; Tiffany 2007b; Wood 1974). One reason for this may be the fundamental flexibility of their subsistence practices. The social arrangements that held communities together seem also to have enabled them to calibrate their subsistence activities to the vagaries of climate, by allowing them to efficiently shift their efforts to resources promising the greatest return. Poor choices or unforeseen outcomes would have been buffered by the tremendous storage capacity available to them as well as by the complex network of connections they maintained with other groups, both locally and regionally. While specific data on cropping practices are not available, it is also possible that maize production was more intensive in the 1500s and 1600s, perhaps involving the use of water management features. Such a system would have minimized the impact of variations in local precipitation.

All this is not to say that the farming towns around the Heart were unaffected by climatic changes, but as Pauketat (2004:151) points out, "environmental factors are insufficient to explain sociopolitical change unless they are integrated with models that account for how people

accommodated" them. Moreover, as research in the Southwest and elsewhere shows, historical developments can fundamentally alter the relationships among the factors driving change (Kohler, Powers, and Orcutt 2004). As Sewell (2005:101) argues, "events must be assumed to be capable of changing not only the balance of causal forces operating but the very logic by which consequences follow from occurrences or circumstances." For these reasons, a detailed understanding of the demographics and cultural dynamics underlying observed patterns of historical change may be more important than identifying overarching causes (Cordell 1994).

A First-Generation Narrative of Historical Change in the Heart Region

Trade was always an integral component of Middle Missouri tradition economies. In the latter part of the fourteenth century, though, the reach and scale of the system began to increase, signaling the beginning of the transformation that would sweep the Heart region in the coming century. For the comparatively small settlements of the mid- to late-1300s, trade may have been one way to bridge periodic subsistence shortfalls. But it may also mark the efforts of leading families to enhance their social standing. Exotic items acquired through trade could have symbolized prestige rather overtly, but it seems more likely to me that they simply denoted the extent and strength of the network of social and economic relationships to which high-status households had access. In fact, these twin motivations—subsistence buffering and status enhancement—need not be seen as mutually exclusive. Important households could demonstrate their status by establishing relationships that would help ensure the flow of resources to the entire community. One venue for their largess might have been community-wide religious rituals performed in public plazas. It is relevant to note that nineteenth-century Mandan peace chiefs were selected in part for their generosity and compassion as well as for their success in resolving disputes among community members and with visiting traders. In any case, it seems likely that disparities in wealth, claims to exclusive ownership, or unequal access to material or immaterial

resources only would have been tolerated under "normal subsistence conditions in which surpluses can be reliably generated" (Hayden 1996:55). The drought of the late 1300s (or the late 1200s and early 1300s recorded in lacustrine data) notwithstanding, there is every indication that favorable conditions marked the two centuries of Extended variant occupation of the Middle Missouri. In fact, the frequency and intensity of droughts likely declined in the northern Plains after 1200 (Laird, Fritz, and Cumming 1998) and this may have been one factor facilitating the large-scale expansion of Extended variant settlement in the 1200s and 1300s.

Whatever the specific motivations, this expansion of trade also marks the initial stages of the regionalization of the northern Middle Missouri economy. Extended variant communities' attempts to enhance trade made their villages more attractive destinations for mobile groups. The result was an increasingly dense web of social connections, both real and fictive, joining culturally disparate groups across the Northern Plains (Albers 1993; Habicht-Mauche 2000).

To finance their participation in this developing regional economy, hunter-farmers on the Missouri began to intensify subsistence production, albeit only tentatively at first. Importantly, there is no reason to think that intensification was limited to maize production: rather, all the evidence points to a broad-gauge effort to increase the productivity of a wide range of activities. The proportion of household members engaged in subsistence pursuits of one sort or another likely increased, as a wider range of resources was targeted. Later, additional emphasis was put on the production of bison meat (and, very likely, hides) for exchange.

Several factors promoted community aggregation beginning in the fifteenth century. One was the villager's efforts of control surplus production. There is no evidence for a change in household size, so attempts to mobilize surpluses likely focused instead on establishing economic and social connections among households. Clans could have channeled these relationships. Another factor promoting aggregation was the relative appeal of larger communities to mobile groups. Bigger population centers are able to provide bigger, more diverse inventory of trade goods more reliably. In fact, competition among settlements on the

Missouri to attract larger trade delegations more frequently seems entirely likely. It is interesting to note that the most recent documented Extended variant settlement, the Helb site, is also the most densely settled, foreshadowing the much higher residential densities of later communities like Huff. In any case, after the turn of the fifteenth century, the communities on the Missouri increasingly became ports of trade, a function they would continue to perform for centuries.

The increasing value of trade, and Mandan's consequent wealth, led to conflict. Certainly, exchanges gone awry can initiate conflict, either to express moral outrage at having been cheated or to obtain by force what could not be had by negotiation. But collective violence also has wider social uses (Pauketat 2009). As the number of participating groups and the complexity of the network increased, incentives to control the flow of goods, or to prevent rivals from obtaining such control, also increased. In turn, warfare likely promoted further aggregation, because larger communities were better able to defend themselves. At the same time, though, the largest settlements would have had the most to lose from collective violence.

Warfare also spurred the formation of political alliances for the purpose of common defense. The goal of such defensive alliances would have been best achieved when the distance between settlements was not too great, and this prompted the initial stage of settlement clustering. One important and well documented mechanism for cementing such alliances is community specialization (Chagnon 1968; Whiteley 2004). Specialization creates mutual dependencies that are a "social catalyst" for political affiliation (Chagnon 1968:100). In the Yanomamo case Napoleon Chagnon describes such complementarity does not derive from an uneven distribution of (or unequal access to) critical resources, but rather is contrived expressly for the purpose of creating fictive dependencies that serve as entry points for alliance formation.

The apparently accelerated pace of change in the late 1400s was an outcome of the emerging synergy between settlement clustering and craft specialization. Alliance-inspired clustering made specialization and marketplace exchange increasingly feasible by reducing the travel time between neighboring communities. In turn, specialization promoted further clustering

by increasing the extent of intercommunity dependency and hence the importance of marketplace exchange. Clustering also increased the Heart region's overall appeal as a trade destination, reinforcing the initial incentives for confederation. As more groups came to trade, the hunter-farmers of the Heart region stepped up efforts to produce surpluses, further increasing the economic incentives for specialization. The outcomes of these intertwined processes were higher population density—among the highest ever documented on the Northern Plains—and greater sociopolitical complexity.

In the 1500s, a kind of political equilibrium was achieved. Community size reached a maximum, perhaps reflecting the practical limits of the sociopolitical system. The Heart River settlement cluster reached maximum density, balanced between the centripetal pull of political alliance and the benefits of local and regional exchange on the one hand, and the centrifugal pull of resource exhaustion and local conflicts over access to farmland and other resources on the other. While disease-induced population decline may have begun in the seventeenth century, the basic features of the system remained essentially intact for nearly two centuries, until the pan-continental smallpox outbreak of the late 1770s and early 1780s.

I present this scenario in narrative form, but it is not necessary to think about Heart River history in such linear terms. Rather, it is important to recognize that iterative or recursive relationships exist among the factors considered here. That is, historical developments established new conditions for action, which in turn affected the range of choices made later, foreclosing some options while enabling others. Moreover, the unintended consequences of action—for instance, the seemingly perverse relationship between trade and war—were as important to Heart region history as were the Mandan's decisions and dispositions.

Problem History in the Heart Region

Finally, I return to the specific historical questions posed in chapter 3. The first asked whether the availability of European goods was responsible for transforming the economies of the Heart River towns. The answer is clear: the colonial economy cannot be held liable for economic intensification or for social and political reorganization in the Heart region. On the contrary, the major elements of the situation Europeans encountered in the eighteenth century clearly were in place in the late 1400s. That is not to say that the trade in European goods, especially the fur trade that began in earnest in the late 1600s, had no effect. The economic (and, no doubt, political) significance of specialized craft production increased from the late 1600s into the 1700s, given the sudden appearance of Sperry ware and the evidence for increasingly specialized arrow production. These changes could reflect additional efforts to generate surpluses needed for colonial trade, spurred perhaps by the novelty of certain kinds of trade goods such as glass beads. But even if colonial trade can be implicated to some extent, the changes accompanying the introduction of European goods nevertheless represent a logical continuation of the historical processes begun during the great transformation of the fifteenth century.

In fact, there is even some reason to think that the effects of colonial trade were precisely the opposite of those the ethnohistorical model predicts. Several communities, notably Double Ditch and Larson villages, declined in size beginning in the 1600s, possibly due to the effects of diseases Europeans brought to the Americas. That loss of population may have lessened, rather than heightened, the impetus for intercommunity political alliances and for emerging social and economic differentiation. Nevertheless, there is no doubt that European trade goods played an increasingly important role in regional exchange networks after 1700, and those networks adjusted over time to better accommodate the transfer of sought-after items. But the basic structure of the Heart region economy continued to follow the trajectory set in motion centuries earlier.

The idea that the early fur trade flowed along ancient paths is by no means novel (Wood 1980; Swagerty 1988). But in my view simply acknowledging the fact of a preexisting cultural landscape fails to fully credit the historical importance of economic and political development in the Heart. Rather, to the extent that the economy of the Heart River confederacy was a regional economy, incorporating diverse groups living in a broad region, one can conclude that the geography and structure of the economic system fur traders confronted in the eighteenth century can be traced directly to the great transformation of the 1400s. Thus, the roots of the multi-ethnic trade alliances that became a hallmark of the fur trade also can be traced to the 1400s. The vast commercial network that built up around the Mandan's ports of trade, and the social and political relationships on which that network was built, afforded the colonists access to the resources of an enormous region, access they might not otherwise have had. Thus, the opportunities for commerce presented to Europeans depended directly on the Native history of the region, which set the fundamental conditions under which colonial trade operated, at least until the nineteenth century. Were it not for the Heart River confederacy the fur trade might have developed along rather different lines. In short, Native history mattered for the course of colonial development in the Northern Plains.

The answer to the second question posed in chapter 3—which asked whether the Heart River towns were economically self-sufficient and politically autonomous—is equally plain. While only the barest outline of the region's political system can be sketched at the moment, it seems clear enough that the towns on the Heart were substantially dependent on one another. The linkages among them were manifold. The evidence for economic interdependency is particularly robust. Different communities, as well as different households within those communities, produced various kinds of value-added goods and subsistence products that circulated locally as well as regionally. And while archaeologists have long surmised that there were non-hierarchical social connections among the Heart River towns, there also is good evidence for various forms of political connection.

Little more than echoes of this political and economic complexity can be found in the historic and ethnographic record. In part, this may say something about the preoccupations of European visitors. But in truth the system was in decline even before Lewis and Clark and other European diarists arrived on the scene. By the early twentieth century the political complexity of the 1500s and 1600s was, for Bowers's and Wilson's informants, an increasingly distant social memory. Thus, while many scholars argue that the zenith of Mandan power and prosperity occurred in the eighteenth century (Lehmer 2001), this study suggests that it occurred earlier, in the sixteenth and seventeenth centuries.

Comparisons with Prior Models of Heart Region History

Wood's (1967) analysis of Mandan history in the Heart region can only be seen as prescient, particularly in view of the limited data at his disposal. All of his major descriptive findings are amply borne out in this study. If anything, many of the patterns and processes he identified are now better attested. This is particularly true of the evidence for interaction between Extended Coalescent communities in the Grand-Moreau region and Middle Missouri tradition communities in the Heart and of evidence for the place of warfare in Middle Missouri tradition society. Moreover, the data now available on the founding communities as Larson and Double Ditch villages demonstrate that the processes at work at Huff continued and accelerated long after Huff was abandoned.

Wood does not address directly the question of economic intensification, lacking as he did systematically obtained faunal data or data on changes in the organization of craft production. However, he does recognize the existence of differences in production techniques at Huff (Wood 1967:160), and, later in his career, he encouraged a generation of students to pursue the kinds of fine-grained data necessary for economic analyses (Ahler 1975; Falk and Ahler 1988). In any event, the data presented here only bolster his overall view of historical change in the Heart

region.

The most significant difference between Wood's interpretation and that offered here concerns the extent of community interdependency. Tellingly, his assessment is based largely on ethnographic data, as well as on general cultural ecological principles, rather than on empirical archaeological data. The fact that archaeological data paint a rather different picture of regional political complexity highlights the value of archaeological history for an understanding of the Native past. Another difference between Wood's interpretation and the interpretation offered here is the causal priority he affords drought-induced warfare. The evidence now available shows that the widespread warfare that developed in tandem with the Heart River confederacy accompanied, rather than preceded, the major economic changes of the mid-1400s. Droughts may have contributed to intergroup conflict, but the major droughts of the 1400s and 1500s cannot themselves be seen as primary causes.

The ethnohistorical model does not fare nearly as well. John Ewers and other ethnohistorians correctly identify the paramount importance of trade as a force for culture change. But the data presented here do not support their claim that precolonial trade primarily involved mutualistic exchange of foodstuffs between hunter-gatherers and hunter-farmers, or that colonial trade induced the economic and political relationships European diarists cataloged. Craft items, raw materials, foodstuffs, and people were moving throughout the region in the 1300s and 1400s, just as they were in the 1700s and 1800s. In fact, there is no particular evidence to suggest that the things moving through the network varied much until the second half of the eighteenth century, when horses and guns arrived on the scene. Though metal tools and glass beads became available in the seventeenth century (likely accompanied by cloth, tobacco, and other items), there is no evidence that their presence fundamentally altered the structure of the trading network.

Matthew Boyd and Clarence Surette (2010) point out that it is a mistake to draw the distinction between durable prestige goods and perishable commodities too sharply: in some

contexts, the role of maize or hides in the trade system may very well have been analogous to the role played by copper or marine shell beads in other contexts, in that all of these items helped establish connections among individuals and groups, connections that ultimately would serve a wide variety of ends related to subsistence as well as status. Put more generally, value is not an intrinsic property of an item, but rather is mutable, varying by the social situation in which that item is offered for exchange (Appadurai 1986; Clark 2007; Thomas 1991). Moreover, the value assigned any particular item can vary throughout its use-life.

The ethnohistorical model recognizes that the political economy of what Ewers calls the "primary trade centers" on the Missouri only can be understood in a broader regional context. This project shows that the opposite also is true: the effects of historical developments occurring within Ewers's Mandan-Hidatsa trade center rippled outward, restructuring the economies of both hunter-gatherers and hunter-farmers living throughout the Northern Plains. Because local changes both stimulated and responded to regional changes, comprehensive historical analysis requires a multi-scalar approach.

Critical Junctures in Heart Region History

The chief goal of this dissertation is to write a narrative history of the Heart River region covering the period before, during, and immediately after the advent of Europeans in the Americas. But this history has a number of direct implications for later colonial history of the Northern Plains written from documentary sources. By the time Europeans began visiting and writing about the Missouri River valley, the Native peoples living there already were well-experienced actors on the colonial stage. This was true in part because the multiscalar, multilateral trade network that became the hallmark of the fur trade already had been developing there for centuries. It is easy to imagine that the Mandans and their contemporaries valued the same entrepreneurial spirit, the same commercial drive, that the fur traders themselves valued. In

fact, one could hypothesize that the economic practices and political structures that made the fur trade possible are the very same practices and structures that made the Heart River confederacy possible.

Nevertheless, a great deal changed in the 50 years before Lewis and Clark and the Corps of Discovery arrived on the scene. Most calamitously, the Mandans had made the wrenching decision to leave the Heart region, an area they had called home for more than 500 years. In the wake of the demographic bottleneck caused by the continent-wide smallpox epidemic of the late 1770s and early 1780s, the political alliances among Mandan communities collapsed, and with them the confederacy. That collapse created a political vacuum in the Northern Plains, a vacuum, one might conjecture, that was filled in the succeeding decades by the fur trade posts Europeans established on the river. But even before the epidemic, the introduction of horses and guns already had begun to tip the balance of economic and political power in the Northern Plains toward mobile bison hunting groups.

Thus, the late eighteenth century should be seen as a third inflection point in Mandan history. Recall that the first inflection point occurred in the 1200s, with the establishment of Extended Middle Missouri communities. Those communities put in place many of the traditions that would come to characterize later Heart River communities. The second inflection point, in the 1400s, set in motion the processes that produced the Heart River confederacy and shaped the political economy Europeans encountered when the fur trade began pushing onto the Northern Plains. New archaeological data on the third inflection point will be crucial to a better understanding of the forces shaping the Northern Plains in the nineteenth century. But that is a subject for another dissertation.

Into the Unknown

This study answers the specific questions about the precolonial history of the Heart

River region posed at the outset. In the process, though, it has raised a host of new questions. The most pressing concern the development and structure of the Heart River confederacy. How did the specific factors at work—aggregation, warfare, and economic intensification—interact to promote its rise? How were its constituent communities organized and how there they connected? What was the nature of their relationships with contemporaneous mobile groups? Archaeological historical research in the Heart region is still in its infancy, but there is no doubt that future projects will marshal the evidence needed to confirm, modify, or overturn key elements of the first-generation narrative I present here. Investigations designed to generate household-level data will be particularly important, as will those focused on sites dating the 1400s and on small sites post-dating 1500. The development of new chronometric tools will enhance these efforts.

Nevertheless, I take the emergence of new questions as a hopeful sign pointing to the effectiveness of the approach I develop here. Of course, the form archaeological history eventually will take, either methodologically or theoretically, remains, in Meriwether Lewis's (2002a) apt phrase, "for experiment yet to determine." It is a safe enough bet, though, that it will stretch the bounds of what usually has been taken as "history." That is all to the good, in as much as it credits the experiences and actions of everyone involved, both Native and newcomer.

In pursuing this line of research, archaeologists should not lose sight of their discipline's colonial patrimony. But I believe they can—and should—enter the historical fray and make "the pastness of the past," as Chance (1996:380) puts it, a principal object of their efforts. This study, and others like it, shows that archaeological research can contribute to a better, more balanced understanding of the Native past and, in the process, of their colonial experiences.

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Appendix 1:

Time, Space, and Taxonomy in the Northern Middle Missouri

A Brief History of Research

The Middle Missouri subarea, especially the stretch of the river valley between the Knife and Heart rivers, has been fertile ground for archaeological research for nearly 150 years. In June 1862, Louis Henry Morgan visited the ruins of the Arikara village at Fort Clark, abandoned less than a year earlier, and described the layout and construction of its "dirt houses" (Morgan 1959:161; 2003:125-130). Some twenty years later, Theodore H. Lewis, working under the auspices of the Northwest Archaeological Survey, mapped a series of settlements below the mouth of the Knife River (Ahler 1993c; Johnson 2007a:9; Wood 1986b). Double Ditch Village was the focus of the first professional excavation in the area, carried out in 1905 by George F. Will and Herbert J. Spinden, at the time Harvard University undergraduates (Will and Spinden 1906). Guided by their advisor, Roland B. Dixon, an early proponent of what later came to be called the direct historical approach, the account of their work was and remains today an exemplar of that method and a touchstone for research on colonial-period indigenous societies in the Northern Plains (Strong 1940:353-354).

Will, who eventually became the secretary of the State Historical Society of North Dakota, continued to investigate village sites in the northern Middle Missouri throughout his career, producing a series of influential summaries of the region's complex archaeology (Will 1924; Will and Hecker 1944). His classic ethnohistoric and experimental work on Hidatsa agriculture remains among the most important contributions to scholarly understanding of Native farming in North America (Will and Hyde 1964). Will also dabbled in dendrochronology (Will 1946).

Throughout the early decades of the twentieth century a cadre of surveyors and

archaeologists working for the State Historical Society of North Dakota mapped many of the region's most prominent villages (Ahler 1993c; Swenson 2007; Will 1924; Will and Hecker 1944; Wood 1986b). In 1929, Alfred W. Bowers, who was raised in western North Dakota near the Fort Berthold Indian Reservation, carried out extensive excavations at several well-known sites in the Heart and Knife regions, including Larson Village (Bowers 1940, 1948). Unfortunately, his archaeological work remains largely unpublished.

Apart from Will and Spinden's path breaking work at Double Ditch Village, perhaps the most influential early field investigation was carried out at On-A-Slant Village by W. Duncan Strong. Strong, a student of Alfred Kroeber at Berkeley and for many years an influential figure in Plains archaeology and anthropology, made data from his 1938 excavation there a centerpiece of his arguments about Plains Indian history (Strong 1940). Like Will and Spinden's Double Ditch monograph, Stong's work remains a model of direct historical research.

In the 1940s and 1950s, work in the northern Middle Missouri ebbed, as archaeologists turned their attention to more pressing projects spurred by the push to build massive reservoirs in South Dakota after World War II. River Basin Surveys crews visited a number of sites in the region, but carried out no substantial work there. Systematic research began again in the mid-1960s, directed by W. Raymond Wood and Donald J. Lehmer. They sampled a large number of sites, laying the necessary groundwork for future processual research in the area (Lehmer, Wood, and Dill 1978; Wood 1986). Apart from the specific results they achieved, Wood and Lehmer's various projects (and those of their students) had a number of other far-reaching consequences. First, they introduced a new set of research topics and research methods, including systematic faunal and macrobotanical analyses and multivariate statistical analyses (Calabrese 1972). Second, along with other projects taking place in the Middle Missouri at about the same time, they served as a training ground for a generation of students who later would make important contributions to northern Middle Missouri archaeology.

The results of Wood and Lehmer's projects were greatly amplified in 1970s, when the

National Park Service established the Knife River Indian Villages National Historic Site (KNRI), encompassing a series of Hidatsa sites at the mouth of the Knife River. Systematic archaeological research in the park, begun in 1978 under Stan Ahler's direction, adopted a regional approach, incorporating collections originally obtained by Wood and Lehmer and their students. Much of the effort focused on chronological and culture historical issues, though it also undertook processual research very much in the spirit of the times (Ahler 1978; Calabrese 1987; Mitchell 2006). KNRI research also introduced new research topics, including historical cartography (Wood 1986b), and greatly expanded the use of new research methods, including remote sensing, fine-mesh waterscreen recovery, and comprehensive attribute-based artifact analyses.

Research in the 1970s and 1980s focused mainly on the Knife region. One important exception to this was a project carried out by the University of North Dakota at On-A-Slant Village in 1980. This work, also under Ahler's direction, was the first large scale project in the Heart region since Strong's 1938 investigation. It also was the first to use the intensive field recovery and analytic methods pioneered in the KNRI work. However, a report on this project did not appear until 1997.

Intensive research in the Heart region began fortuitously in 1998 with the inadvertent discovery of Scattered Village beneath the City of Mandan (Ahler, ed. 2002). The Scattered Village project demonstrated for the first time that significant differences existed among contemporaneous communities in the Heart region. As the Scattered Village project was drawing to a close, the State Historical Society of North Dakota, working with a number of partner organizations, initiated research at Double Ditch Village. Over the course of four field seasons from 2001 to 2004, the research team explored the site using state-of-the-art geophysical techniques combined with targeted, problem-oriented test excavations (Ahler, ed. 2003a, 2004, 2005; Kvamme and Ahler 2007). This work documented the complex occupational history of the settlement, revealed previously unsuspected features, and offered a glimpse of the dynamic processes that shaped it during its 300-year period of occupation.

In 2005, the team moved to Boley Village, a little-known west bank settlement (Ahler, ed. 2006). Unlike Double Ditch Village, Boley has been severely impacted by modern development. However, by again combining extensive geophysical surveys with targeted test excavations, significant new discoveries were made about the age and history of the site. This same productive approach was taken in 2006 and 2007 at Larson Village (Mitchell, ed. 2007, 2008), and in 2008 at Chief Looking's Village (Mitchell, ed. 2011).

If passages in Lewis and Clark's journals can be taken as ethnography, and there certainly are reasons to view them that way, then anthropological research has been going on in the Knife and Heart regions for more than 200 years. In the early 1830's, George Catlin (1989) and Prince Alexander Philipp Maximilian (Thwaites, ed. 1905) penned lengthy descriptions of Mandan and Hidatsa history, village life, social organization, and religious practice. As the frontier of American settlement pushed past the remaining earthlodge villages on the Missouri in the 1860s, Ferdinand V. Hayden (1862, 1863), exploring with the Army Corps of Engineers, carried out brief ethnographic and linguistic studies among the Mandans and Hidatsas. Washington Matthews, an Army surgeon later noted for his work among the Navajos, published an account of Hidatsa culture and language in 1877.

After the turn of the twentieth century, Clark Wissler (1908), Robert Lowie (1917), and other professional anthropologists began work in the northern Middle Missouri, inspired by the emerging ethic of "salvage ethnology," and motivated by the desire to obtain artifact collections for their museums. They were joined on the scene by Edward S. Curtis (1909a, 1909b), a professional photographer and self-styled ethnographer, who's knowing and iconic photographs capture the on-going vibrancy of Native life. An unusual product of early twentieth-century anthropology in the Knife and Heart regions is a set of indigenous maps commissioned in 1906 and 1907 by Orin G. Libby, then Secretary of the State Historical Society of North Dakota. The maps, drawn by a Mandan named Sitting Rabbit, show the locations and names of earthlodge villages, as well as the locations of culturally significant natural features (Thiessen, Wood, and

Jones 1979).

Two men, whose backgrounds could hardly have been more different, are responsible for the most comprehensive and influential ethnographic work among the Mandans and Hidatsas. One was Gilbert L. Wilson, a Presbyterian minister born in Springfield, Ohio in 1868, who became interested in the Native farmers of the Missouri River valley after he was called to serve a congregation in Mandan, North Dakota in 1902. Sponsored by Wissler, the long-time Curator of North American Ethnology at the American Museum of Natural History, Wilson spent 12 summers, beginning in 1908, on the Fort Berthold Reservation. He was especially interested in traditional agricultural techniques, domestic architecture, craft production, and the roles of domestic animals in Hidatsa culture. The meticulous detail of Wilson's notes, along with the photographs he took and the artifacts he collected, remain a unique record of Middle Missouri life.

The other man was Alfred W. Bowers. Bowers saw his ethnographic work, carried out among the Mandans from 1929 to 1931 and among the Hidatsas from 1932 to 1934, as one piece of an integrated approach to Native history that he described as the "creatively historical method," which combined data gleaned from archaeological and anthropological research with indigenous oral traditions embodied in stories and myths (Parks 1992:xxxii). Though incongruously less focused on material culture studies than Gilbert Wilson, Bowers's work must be judged the more sophisticated. Certainly, Wilson's work, despite some early missteps, matured under Wissler's tutelage; eventually, Wilson earned a doctorate in anthropology from University of Minnesota. But Bowers brought a holistic vision to the task. He aimed to "produce a study of the personal and intimate relationships of individuals and organized groups living together within a complexly integrated social-ceremonial system" (Bowers 1992:4). To this end he recorded and published numerous Native accounts verbatim, allowing his informants to speak for themselves. He recorded genealogies, gathered census information, and charted kinship terminology. He learned Hidatsa to communicate better with his informants and to further his

understanding of their world view. The resulting ethnographies "combine the insights of British social anthropology with the Boasian culture-historical approach, extended to explore the intersection of myth and society" (DeMallie and Ewers 2001:38). Douglas Parks (1992:x) deems Bowers's Hidatsa study "a classic in American anthropology."

In the 1940s, with the completion of the Garrison Dam on the Missouri impending and the flooding of sections of the Fort Berthold Reservation imminent, the University of Chicago established the Fort Berthold Action Anthropology Project, under the direction of Sol Tax, to study the problem of forced resettlement. Among the students participating in the project were two doctoral students, Edward Bruner, who focused his dissertation research on Mandan, Hidatsa, and Arikara acculturation (Bruner 1954, 1961), and Robert S. Merrill. Perhaps not coincidentally, Bowers received his doctorate from the University of Chicago at about the same time, enabling Tax's project to make use of Bowers's voluminous field notes.

Additional discussion of the history of archaeological research in the Knife region can be found in Ahler (1993c), Calabrese (1987), and Wood (1986a). Swenson (2007) summarizes early mapping and excavation efforts in the Heart region. Krause (1998), Johnson (2007a), Johnson and Wood (1980), Mitchell (2006), and Wedel and Krause (2001) review aspects of the history of Northern Plains archaeology. Ethnological work among the Mandans and Hidatsas is summarized by Parks (1992) and Woolworth (1987). DeMallie and Ewers (2001) present an overview of ethnological research on the Plains.

Unsurprisingly, the many projects carried out in the Knife and Heart regions produced a welter of disparate, sometimes-contradictory classificatory systems. The balance of this appendix defines the spatial, temporal, and taxonomic units used in this study.

Spatial Units

In the 1960s, Lehmer and others, drawing on the "unit concepts" defined by Gordon

Willey and Philip Phillips (1962), codified the spatial divisions archaeologists working in the Northern Plains now use (Krause 1998; Lehmer 1971; Lehmer and Caldwell 1966). Within the Plains area Lehmer (1971) designates five subareas, including the Southern, Central, and Northwestern Plains; the Northeastern Periphery; and the Middle Missouri. Previously, he had split the Plains into just two subareas, the Southern Plains and the Northern Plains, and then partitioned the latter into three regions (Lehmer and Caldwell 1966). This shift was not simply semantic. His original formulation was meant to reflect ecological variations across the Plains, while the latter explicitly referenced spatial variation in the archaeological record itself (Lehmer 1971:28-29).

Lehmer's Middle Missouri subarea encompasses the valley of the Missouri River from the mouth of the Yellowstone River in present western North Dakota downstream to the mouth of the White River in southern South Dakota. He partitions the Middle Missouri into six local regions bounded mainly by the major western tributaries of the Missouri. Despite their nominal hydrologic boundaries, Lehmer (1971:29) anticipates that each region would encompass "a unique archaeological sequence."

Ahler's work in the KNRI in the 1980s led him to split Lehmer's Knife-Heart region into two parts and to define two new regions outside the Middle Missouri subarea proper (Ahler 1993a:58-59). Following earlier, informal usage (Wood 1986), Ahler's Knife region encompasses the upper half of Lehmer's Knife-Heart region, from just above the Knife River downstream to Square Buttes. Ahler's Heart region runs from Square Buttes to just below the mouth of the Heart. Taking up Lehmer's view that regions should be defined on the basis of their cultural content, Ahler argues that these two redefined regions reflect the "traditional homelands and territories" of the Hidatsas and Mandans, respectively, as reflected in both archaeological and oral historical data (Ahler 1993a:58).

More recently, Johnson (2007a:3) defined the Fort Randall region to encompass Plains Village sites from just below the mouth of the White River nearly to the South Dakota—

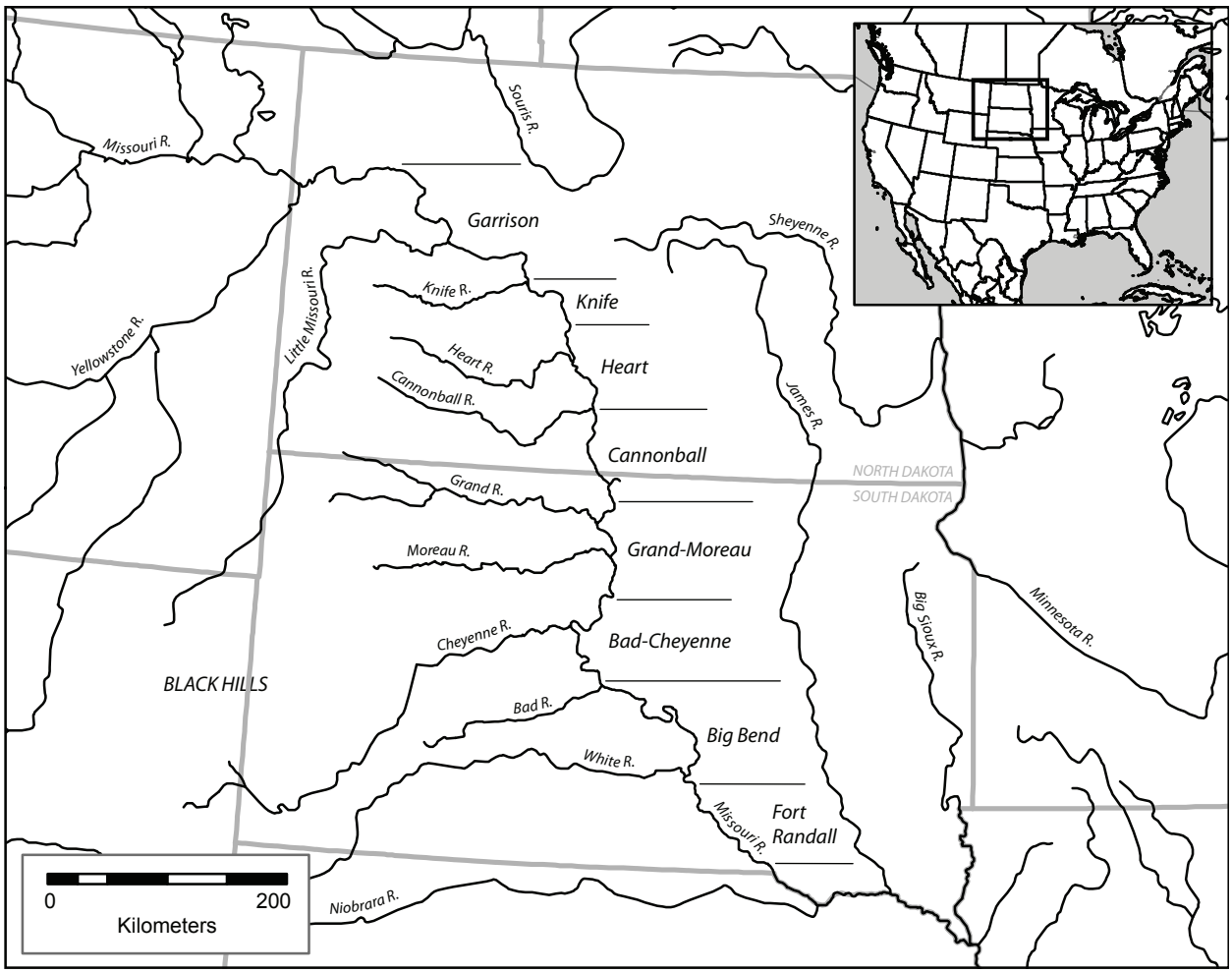

Figure A1. Archaeological regions of the Middle Missouri subarea.

Nebraska border.

Here, drawing on Lehmer's and Ahler's definitional principles, I shift the southern boundary of Ahler's Heart region southward to the mouth of the Cannonball River (figure A1). This change reflects the emerging understanding of the occupation history of this section of the river valley. The Cannonball River marks the southern limit of Middle Missouri tradition settlement after 1400 and fifteenth-century settlements located between the Cannonball and the Heart unquestionably are the archaeological precursors of the cluster of Mandan settlements that Europeans visited in the eighteenth century.

Throughout this dissertation, I use the term "northern Middle Missouri" to refer inclusively to the four northern regions: the Cannonball, Heart, Knife, and Garrison. I use the term "southern Middle Missouri" to refer to the four southern regions: the Grand-Moreau, Bad-Cheyenne, Big Bend, and Fort Randall.

Temporal Units

Johnson's (2007a) exhaustive study is the most comprehensive account of Plains Village chronology in the Middle Missouri subarea. His investigation features a meticulous compliation and detailed re-assessment of existing radiocarbon dates. He also reports dozens of new dates, many of them from previously undated sites. Johnson combines these radiocarbon data with an ambitious ceramic ordination study to place the majority of excavated Plains Village sites into a regional temporal framework. With the exception of the Terminal variant of the Middle Missouri Tradtion, which is discussed in more detail in the next section, the broad cultural-temporal periods he defines are adopted here without modification (table A1).

Table A1. Plains Village cultural-temporal units for the Middle Missouri subarea.

Cultural-Temporal Unit	Date Range
Initial Middle Missouri	1000-1300
Extended Middle Missouri	1200-1400
Terminal Middle Missouri	—[a]
Initial Coalescent	1300-1500
Extended Coalescent	1450-1650
Post-Contact Coalescent	1650-1886

[a] See text for discussion of the Terminal variant of the Middle Missouri tradition.

Northern Middle Missouri Taxonomies

In this dissertation I have elected to downplay the study of archaeological systematics. The most important reason for this decision is conceptual. As a method, culture history makes

a number of assumptions about the nature of the units under study, about the tempo of culture change, and about the processes responsible. These assumptions are at odds with one of the principal goals of this project, which is to describe and interpret contemporaneous inter-community variability. In any case, a simple enumeration of the criteria used to build culture-historical taxa is unlikely to advance a better understanding of the sociohistorical processes that are my principal objects of study.

There are practical reasons for downplaying taxonomy as well. For one thing, traditional culture-historical analysis is simply not necessary. Absolute and relative chronological data are abundant in sites around the Heart River, data that are largely independent of the kinds of stylistic and technological properties of artifacts used to construct archaeological taxonomies. For another, in my view, each of the taxonomies proposed for the region suffer from serious theoretical or substantive problems. Devising a coherent system appropriate to the archaeology of the Heart region would be a substantial undertaking in itself. For these reasons, I make no effort to define new culture-historical taxa for the Heart River towns. However, I do make use of certain taxonomic terms to simplify discussion and to connect aspects of Heart region history to the broader cultural landscape. In this section I explain why I have elected to use these particular terms but omit others. To put that explanation in context I begin with a quick overview of the four main systems archaeologists have applied to data from the northern Middle Missouri. I then turn to a discussion of their most pressing conceptual and evidentiary shortcomings. Additional details on Middle Missouri subarea systematics can be found in Ahler (1993c), Johnson (2007a), Krause (1977, 1994, 1998), Tiffany (1983), and Wood (1986).

Summary of Northern Middle Missouri Systematics

Prior to the Smithsonian Institution's River Basin Surveys (RBS) projects that began in the late 1940s, archaeologists working in the northern Middle Missouri conceived two

rather different taxonomic systems. The first was a four-part developmental sequence devised by George Will and Thadeus Hecker (1944), using surface collections and limited excavation data from about 120 village sites scattered throughout the river valley from the Grand River in South Dakota to the Knife River in North Dakota. Their system is based largely on pottery styles and architectural forms, though they incorporated limited stratigraphic and documentary data as well. They assigned the oldest villages to the "Archaic Mandan" period, which they believed represented the Mandan's initial migration to the region. Their "Middle Mandan" period embodies a gradual evolution of technology and subsistence practices from the Archaic Mandan; the Middle Mandan also marked the peak of Mandan power and population.

While they could not provide dates for the Archaic and Middle Mandan periods, they put the beginning of their third period, the "Later Heart River," at around 1650 or earlier, and, importantly, well before the introduction of European trade goods to the region. The Later Heart River period represented the peak of Mandan technological accomplishment, if not population. The communities described by Verendrye fall into the Later Heart River period. This third period also includes settlements occupied by the Hidatsas. Will and Hecker's fourth and final period, the "Decadent Mandan" post-dates 1800. Decadent period sites also include those occupied by the Hidatsas and Arikaras near the mouth of the Knife River.

The other pre-RBS system was devised by Alfred Bowers, based on his numerous excavations in the Heart and Knife regions and on his understanding of Mandan and Hidatsa oral history (Ahler 1993c; Bowers 1940, 1948). Conceptually, his taxonomy is based on Will C. McKern's Midwest Taxonomic Method. However, recognizing that each of the Mandan and Hidatsa divisions has its own origin narratives and history, he grouped his archaeological taxa into three "traditions," the Northern Mandan, the Southern Mandan, and the Hidatsa. For the Southern Mandan he defined three sequential foci: the Lower Grand, confined to northern South Dakota, the Upper Grand, represented by sites in both North Dakota and South Dakota, and the Heart River. Similarly, he defined three foci for the Northern Mandan, including the Cannonball,

the Huff, and the Heart River. He thought that the earliest two foci, the Lower Grand and Cannonball, likely dated between about 1300 and 1500, while the two succeeding foci, the Upper Grand and Huff, post-dated 1500. It was during this period, between 1500 and 1650, that the Southern and Northern Mandan traditions coalesced into the historically known Mandan tribe, represented by the Heart River focus.

For the Hidatsas, he defined just two foci. The earliest, dating between 1500 and 1650, is called the Painted Woods focus and comprises settlements occupied by the Awaxawi and Awatixa divisions. It was coeval with the Southern and Northern Mandan's Upper Grand and Huff foci, respectively. The second Hidatsa focus, the Heart River, comprises the settlements of all three Hidatsa divisions and is contemporaneous with the Mandans' Heart River focus. Though laudable, in my view, for its inclusion of Native oral tradition, Bowers's classification never has caught on with other researchers.

The third system, which remains today the dominant taxonomic framework for Middle Missouri subarea archaeology, is a product of RBS work. The system was devised initially by Donald J. Lehmer (1954, 1971; Lehmer and Caldwell 1966). Lehmer (1954) began by sorting known Plains Village pattern settlements into three archaeological "traditions," the Coalescent, the Middle Missouri, and the Central Plains. The provisional definitions he gave each tradition are based first and foremost on architectural form but also include aspects of community plan, pottery design and technology, and the presence of certain stone and bone tool forms. Sites representative of two of his traditions occur in the Middle Missouri subarea. Middle Missouri tradition groups built long-rectangular lodges and produced pottery exhibiting coarse paste, straight and S-shaped rims, and tool- and cord-impressed decoration. Bearers of the Coalescent tradition built circular, four-post lodges and produced pottery with compact paste, straight to outflared rims, and trailed or tool-impressed decoration. Lehmer rather tentatively linked the Middle Missouri tradition to the prehistory of the Mandans (and, presumably, the Hidatsas) and the Coalescent to the prehistory of the Arikaras. Today, those linkages are taken as nearly

axiomatic.

Later, drawing explicitly on Gordon Willey and Philip Phillips's (1962) recently articulated classificatory principles, Lehmer and Warren Caldwell (1966) partitioned the Middle Missouri and Coalescent traditions into three horizons, including an Initial, Extended, and Terminal horizon for the Middle Missouri tradition and an Initial, Extended, and Post-contact horizon for the Coalescent. Eventually, recognizing certain problems with this formulation, Lehmer (1971:32; see also Krause 1977, 1994) devised a new integrative concept he calls the "variant," which he defines as "a unique and reasonably uniform expression of a cultural tradition which has a greater order of magnitude than a phase, and which is distinguished from other variants of the same tradition by its geographic distribution, age, and/or cultural content." He also added a fourth variant to the Coalescent tradition, the Disorganized Coalescent (Lehmer 1971:Table 2). Lehmer brackets the temporal spans of his seven defined variants but more recent work has almost completely revised his dating scheme (Johnson 2007a).

Lehmer (1971) subsumed a number of previously defined foci, now considered phases, into this general taxonomic framework. He also proposed a new set of taxonomic subdivisions for the Post-contact and Disorganized Coalescent variants. More recently, archaeologists have defined, or redefined, a host of additional phases to describe particular sites or groups of sites. For the Knife region, for instance, Francis Calabrese (1972) used data from his excavations at the Cross Ranch site to define the Nailati phase of the Extended Middle Missouri variant. Wood (1986a) defines the Clark's Creek phase to encompass the earliest Extended variant communities in the Knife region. Lehmer, Wood, and Dill (1978) put all of the Mandan and Hidatsa settlements dating to the late eighteenth and early nineteenth centuries in the Knife River phase of the Disorganized Coalescent. For Mandan and Hidatsa sites occupied between 1450 and 1780, Wood (1986a) defines the Heart River phase of the Coalescent tradition. For the Cannonball region, Lehmer (1966) defines the Fort Yates phase of the Extended variant, which he contrasts with the coeval Thomas Riggs phase thought to encompass Extended variant sites farther south

on the river.

Ahler (1993a) developed the fourth northern Middle Missouri taxonomic system specifically for sites in the KNRI and the Knife region. Citing a number of specific concerns with Lehmer's system, which I reiterate later, Ahler devised a new system based in part on a careful reading of Willey and Phillips's concepts and in part on the specific goals he set for the KNRI work. He adopted, more-or-less without modification, two of Willey and Phillips's basic cultural units, the "component" and the "phase." To this he added the "subphase," anticipating that differences between Mandan and Hidatsa archaeological sequences might eventually be recognized below the phase level. As a major integrative device he defined the "complex" as "a group of components which lies within a single cultural tradition and which exhibits a common dominant stylistic trait or common set of recurring, nondominant stylistic traits or other traits" (Ahler 1993a:61). It is worth emphasizing that, under Ahler's formulation, the complex has no temporal or spatial properties. Instead his complexes are defined, with one minor exception, on the qualitative and quantitative properties of ceramic assemblages.

Ahler also makes use of a higher-order integrative device, which he calls the "ethnic tradition." Though not fully defined, Ahler uses the concept as a means to synthesize archaeological and oral historical data, with the goal of tracing "the historical development, through time and space, of the distinctive ethnic groups which can be identified in historic records" (Ahler 1993a:63). Importantly, Ahler's ethnic tradition is, in terms of archaeological systematics, precisely the opposite of Bowers's. Where Bowers uses his knowledge of oral history to structure his taxonomy, Ahler uses oral tradition as one element of a broad synthesis that, conceptually, is the final product of multidisciplinary research.

Ahler defines five complexes and, for the Knife and Garrison regions specifically, nine phases spanning the period from 1200 to 1886. Most of his phases are about a century long. The two earliest, the Clark's Creek and Nailati phases, are taken up from previous investigators and together equate roughly to Lehmer's Extended variant of the Middle Missouri tradition. The

remaining seven post-date 1400 and encompass sites previously assigned by researchers to a large number of different phases and foci.

Evaluating Northern Middle Missouri Taxonomic Systems

The most acute problem with existing Middle Missouri subarea taxonomies relates to the Terminal variant of the Middle Missouri tradition. Lehmer (1971:120-124) uses a set of criteria to define it, including predominantly (but not exclusively) long-rectangular lodge form; elaborate fortifications; a large, densely settled community plan; and a pottery assemblage combining elements of Extended Middle Missouri ceramic forms with elements of Extended Coalescent forms. He assigns 11 sites to the Terminal variant, all of them confined to the Heart and Cannonball regions and tentatively dated between 1550 and 1675. The most recent chronological assessment puts the Terminal variant between about 1300 and 1500 (Johnson 2007a:178).

Archaeologists subsequently have revised Lehmer's list of Terminal variant sites. Based on more detailed ceramic analyses, three of the sites—Tony Glas, Jake White Bull, and Helb—have been reassigned to the Extended variant. The pottery assemblage from a fourth putative Terminal variant settlement, the Shermer site, is also made up exclusively of Extended variant types (Ahler, Metcalf, and Graham 2000). Among the remaining seven, excavations only have been carried out at the Huff site (Ahler and Kvamme 2000; Wood 1967). Will and Hecker (1944) assign Huff and the other six sites remaining on Lehmer's list (along with quite a few others) to their Middle Mandan period. However, except for Huff, the only data available for any of them comes from cursory surface inspections. Will (1924:334) and Herbert Spinden may have mapped three of the sites on Lehmer's list, but those maps have never been published. In fact, Will and Hecker's brief descriptions suggest that, as a group, Middle Mandan sites are rather heterogeneous. Some seem to incorporate multiple components, while others have since been proven to be Extended variant sites. Moreover, it is not clear whether their ceramic assemblages

are at all similar to the well-studied collections from Huff. As Johnson (2007a:118) notes, the Terminal variant's material heterogeneity minimizes its utility as a taxonomic unit.

Another of Lehmer's criterion was the presence of bastioned fortifications. In fact, at least four of the six remaining settlements on Lehmer's list are surrounded by a ditch and palisade system featuring regularly-spaced bastions (Wood 2001:Figure 2). However, two others (Eidelbrock and Holbrook) are not. Moreover, bastioned fortifications encircle sites assigned to the Initial Coalescent and Initial and Extended Middle Missouri variants. The founding communities at Double Ditch and Larson, which have ceramic assemblages rather different than the Huff assemblage, also are enclosed by bastioned defenses. From this is it clear that details of fortification design should be interpreted primarily in functional, rather than culture-historical, terms (Mitchell 2007).

Lehmer (1971:122) also considered large size and a regular community plan to be diagnostic of Terminal Middle Missouri communities. Indeed, the sites in his list are all rather large, though Will and Hecker's descriptions hint that not all of them were as densely settled as Huff. In any case, lodge count data are not available for any of them. (Evidence for the reported high lodge density at Shermer is examined in appendix 2.) Moreover, several Extended variant sites show evidence of plazas and house rows, though perhaps not as regular as those at Huff.

What this boils down to is that the Terminal variant, as it now stands, is defined solely on the basis of data from the Huff site. While Lehmer's criteria certainly apply to Huff, the temporal and spatial limits, as well as the material content, of the Terminal variant, as a culture-historical taxon, are currently undefined. For that reason I have elected not to use the term here.

A second problem with Middle Missouri subarea taxonomies is widespread concern about the whether or how Lehmer's system applies to the post-1400 archaeology of the Knife and Heart regions. On a practical level, research in the KNRI shows that Lehmer's framework simply does not fit well with the specific archaeological sequences found there (Ahler 1993a:63, 1993c:35). Another, more serious concern has to do with Lehmer's definition of the Post-Contact

variant of the Coalescent tradition. Recall that Lehmer made a fundamental distinction, based primarily on architecture but also on pottery, among three cultural traditions within the Plains Village pattern, two of which occupied portions of the Missouri River valley. Middle Missouri tradition communities built long-rectangular lodges, while Coalescent tradition communities built circular, four-post lodges. For Lehmer, the culmination of the Mandan's (and, presumably, the Hidatsa's) transition from the use of Middle Missouri-style long-rectangular lodges to Coalescent-style four-post lodges marks the end of the Middle Missouri tradition, which he put at about 1675. Accordingly, he assigns the Mandan's (and Hidatsa's) post-1675 settlements to the Post-Contact Coalescent. What this means, though, is that the coherent Heart River ceramic sequence—interpreted by all archaeologists as an expression of long-term cultural continuity—spans two separate cultural traditions, a violation of the basic definition of a tradition. Moreover, Post-Contact Coalescent pottery, at least in North Dakota, has more in common technologically with Middle Missouri tradition pottery than it does with earlier Coalescent tradition pottery.

As Ahler (1993c:38) points out, Lehmer chose the term "Coalescent" to describe the repeated episodes of cultural amalgamation he believed defined the tradition. But, in itself, the fact or the process of coalescence does not constitute a necessary or sufficient criterion for defining a culture-historical taxon. In effect, Lehmer's extension of the Coalescent tradition to incorporate all of the Middle Missouri subarea's communities after the appearance of European trade goods violates the system's own "internal logic," built around the notion of a variant (Krause 1994:31). For earlier periods, the system conceptualizes cultural identity or ethnicity at the level of the tradition. After the universal adoption of circular, four-post architecture, and the initial influx of European trade goods, identity is conceptualized at the level of the phase or even subphase.

Furthermore, there are a number of unresolved questions about the criteria on which the definition of the Post-Contact Coalescent depends. Little is known, for instance, about precisely when the transition from long-rectangular to four-post architecture took place in the Heart

and Knife regions, or, more importantly, about the specific social and cultural circumstances under which it occurred. It is relevant to note, too, that the circular, four-post lodges built in the eighteenth and nineteenth centuries by the Mandans, Hidatsas, and Arikaras differ in a number of ways from the lodges built earlier by Initial and Extended Coalescent groups. Questions also remain about what "contact" means, and about when it began. If one defines contact as the earliest historically documented face-to-face interaction, as the acculturation researchers of the 1930s did (Redfield, Linton, and Herskovits 1936), then it did not occur until 1738, which, it should be pointed out long post-dates the architectural transformation. If one simply means the availability of European trade goods, then contact began a century earlier, a period for which no specific architectural data are available. Of course, one might also wonder, as I do in this dissertation, whether the mere availability of such goods made a cultural difference for the peoples of the Northern Plains. In any case, many archaeologists engaged in the study of colonial-era American Indian and First Nations groups now argue that the notion of contact confusingly mingles process with time (Mitchell and Scheiber 2010; Silliman 2005). The upshot of all this is that the term "Post-Contact Coalescent" carries only the barest shred of taxonomic meaning but is too laden with processual assumptions to be used merely as a temporal marker.

For all of these reasons I have chosen not to use Lehmer's terminology for the post-architectural transition communities of the Heart region. However, I do make use of several terms he devised to classify earlier communities, especially the Extended variant of the Middle Missouri tradition and the Extended variant of the Coalescent tradition. In my view, these terms recognize meaningful cultural differences (see Krause 1994, 1999) and using them helps tie developments in the Heart region to developments elsewhere in the Middle Missouri.

A number of phases are defined for both variants, but I have not discussed them in part to streamline the narrative by reducing terminological overload, but also because the differences among them are not especially germane to the questions at hand and because there remain nagging uncertainties about how they should be defined. It is worth noting, though, that there

is far more spatial variability within the Extended Coalescent than within the Extended Middle Missouri; in fact, my discussion of the Extended Coalescent draws mostly on data from sites in the Grand-Moreau region, which nominally are assigned to the Akaska and Le Compte foci (Johnson 2007a), and which differ in important ways from Extended Coalescent sites found farther south. I also briefly mention the Initial Middle Missouri and Initial Coalescent variants. Considerable work has been done on the former and it is generally well understood, apart from a number of specific issues such as the taxonomic position of the Great Oasis complex (Henning and Toom 2003; Tiffany 2007a, 2007b; Tiffany and Alex 2001; Toom 1992a). Much less is known about the Initial Coalescent (Steinacher and Carlson 1998), but an assessment of its spatial, temporal, and material properties is well beyond the scope of this project.

I also have elected not to use Ahler's Knife region terminology, but the reasons for this are comparatively straightforward. Ahler's phase definitions are based largely on qualitative and quantitative archaeological data from the sites in the KNRI regional study. While he anticipated that a cognate phase structure eventually would be developed for the Heart region, in the absence of adequate datasets from that region he chose not to export his phase definitions. More importantly, though, I judge his KNRI phases to be largely chronological, rather than culture-historical, constructs. Though they are named, they primarily designate geographically bounded slices of time, within which material content varies. I have taken a similar approach here .

Ahler's rather open-ended approach to archaeological systematics suggests to me that crucial questions about architectural and material change are best answered not by taxonomic work, but instead by developing new methods for dating analytic units and then comparing and contrasting their content. Potentially promising but so far untested methods include archaeomagnetic and optically stimulated luminescence (OSL) dating of archaeological sediments and thermoluminescence dating of ceramic sherds.

Appendix 2:

Site Data

Extended Middle Missouri Sites

I used a number of criteria to select the sample of Extended Middle Missouri sites for this study. The sample initially included only those sites for which high-quality radiocarbon dates are available. I then narrowed the sample to those for which the size or general layout of the site is known, or for which one or more architectural plans is available. One exception to this procedure is the White Buffalo Robe site. Although five radiocarbon dates are available for the Extended variant component there, no data are available on its size or layout, or the number or sizes of its lodges. Nevertheless, I include it because it figures prominently in discussions of Extended Middle Missouri faunal exploitation. Finally, seven sites lacking associated radiocarbon dates but for which architectural or community plan data are available were added to the sample. In the end, the sample includes 22 sites (table A2). Sites located in the Garrison, Knife, Heart, and Cannonball regions are assigned to the northern group. Those in the Bad-Cheyenne and Big Bend regions are assigned to the southern group. Calamity Village, located in the southern half of the Grand-Moreau region, is also assigned to the southern group. The spatial limits of these regions are discussed in appendix 1.

Chronology

Site-specific chronological data for the study are drawn largely from Johnson (2007a). Using a variety of criteria, Ahler and others (2007) identify a total of 45 high-quality radiocarbon assays from the 15 dated sites in the sample. Thirteen assays are available for the South Cannonball site but four sites are dated by just one acceptable assay. I use pottery and other

Table A2. Extended Middle Missouri sites in the study sample.

Site	^{14}C Data	Geographical Group	Period[a]	Principal Reference(s)
Fire Heart Creek (32SI2)	Y	N	3	Lehmer 1966
Bendish (32MO2)	Y	N	3	Thiessen 1995
Havens (32EM1)	Y	N	3	Sperry 1995
Paul Brave (32SI14)	Y	N	3	Wood and Woolworth 1964
Jake White Bull (39CO6)	Y	N	3	Ahler 1977b
Clark's Creek (32ME1)	Y	N	3	Calabrese 1972; Wood 1986
Vanderbilt (39CA1)	Y	N	3	Falk and Pepperl 1986
Cross Ranch (32OL14)	Y	N	4	Calabrese 1972
Shermer (32EM10)[b]	Y	N	4	Sperry 1968
South Cannonball (32SI19)	Y	N	4	Griffin 1984
Helb (39CA208)	Y	N	4	Falk and Ahler 1988; Zalucha 1983; Kay 1994
White Buffalo Robe (32EM7)	Y	N	4	Lee, ed. 1980
Ketchen (39ST223)	Y	S	3	Johnson 1979a
Durkin (39ST238)	Y	S	4	Johnson 1979a
Calamity (39DW231)	Y	S	4	Mallory 1964
Tony Glas (32EM3)	N	N	3	Wood, ed. 1999
Grandmother's Lodge (32ME59)	N	N	3 or 4	Woolworth 1956
Ben Standing Soldier (32SI17)	N	N	3 or 4	Johnson 1979a
Bagnell (Early) (32OL16)	N	N	4	Lehmer et al. 1973; Wood 1986
McKensey (39AR201)	N	S	3	Caldwell 1966
Thomas Riggs (39HU1)	N	S	3 or 4	Hurt 1953; Johnston 1967; Meleen 1949
Hickey Brothers (39LM4)	N	S	3 or 4	Caldwell et al. 1964

[a] Period 3=1200-1300; Period 4=1300-1400; see Johnson (2007a) for discussion of Middle Missouri subarea periods.
[b] See Site Data Notes for details about the culture-historical assignment of the Shermer site.

data to estimate the ages of the seven sites for which radiocarbon dates are not available; the following paragraphs discuss these data.

Four Extended variant sites in the northern group and three in the southern group lack associated radiocarbon dates. Four of these seven are included in Johnson's (2007a) ceramic ordination study. In two cases the ceramic data support relatively precise age determinations. The moderately large pottery sample from the Tony Glas site is strikingly similar to assemblages from the nearby Paul Brave and Bendish sites, both of which are dated by radiocarbon to the 1200s. The age of McKensey Village is less certain, but it may also date to the 1200s (Johnson 2007a:174). The ceramic ordination results for the remaining two sites—Ben Standing Soldier and Thomas Riggs—are equivocal. Radiocarbon dates have been published for both sites, but Ahler and others (2007) reject all of them for a variety of reasons. However, the ceramic

assemblages from both sites, made up almost exclusively of Riggs ware and Fort Yates ware, leave little doubt that each was occupied sometime between 1200 and 1400.

Pottery from the three remaining sites in the sample has not been studied in detail. Only small collections are available for two of the three, the Grandmother's Lodge site (the northernmost Extended variant settlement and the only one known from the Garrison region) and the Hickey Brothers site (one of the southernmost Extended variant settlements). However, only Extended Middle Missouri types are present in the assemblage from Grandmother's Lodge. The Hickey Brothers assemblage includes a few Initial Middle Missouri sherds, but Lehmer (1971:66) considers it to be an Extended variant settlement. Finally, Wood (1986:11) places the early component at the Bagnell site in the Nailati phase, which Ahler (1993a:78) dates between 1300 and 1400; however, the site's large, complex assemblage only has been briefly examined. Ahler (1993a:79) suggests that this component post-dates 1400, but the chronological significance of the ceramic criterion he uses to make that argument has since been called into question (Ahler 2001).

Site Data

Data collected on each settlement in the sample include its size, the number of lodges present, and the presence of village fortifications and public plazas (table A3). Data were also compiled on settlement occupation duration (table A4).

Settlement Size

With few exceptions the dimensions of each site in the sample were measured in U. S. customary units directly from published maps. Calculated areas were then converted to metric units. Owing to the typical orientation of most Extended Middle Missouri lodges, perpendicular

Table A3. Extended Middle Missouri site size, residential density, and layout.

Site	Complete?	Site Area (ha)	Number of Houses	Density (houses/ha)	Fortification?	Plaza?
Ketchen	Y	1.4	12	8.6	N	Y?
Durkin	Y	2.1	15	7.1	N	Y
Tony Glas	Y	5.2	46	8.8	Y	Y
Bendish	Y	6.2	45	7.3	N	Y?
Havens	Y	5.9	56	9.5	N	N
Thomas Riggs	Y	3.4	22	6.5	Y	Y?
Shermer	Y	3.8	ND	ND	Y	Y
Paul Brave	Y	1.5	14	9.3	N	N
South Cannonball	Y	6.5	35	5.4	N	Y?
Clark's Creek	Y	2.0	14	7.0	N	Y?
McKensey	Y	0.8	ND	ND	N	Y?
Vanderbilt	Y	3.5	22	6.3	N	Y?
Hickey Brothers	Y	5.5	ND	ND	Y	ND
Cross Ranch	N	1.3	9	6.9	N	ND
Fire Heart Creek	N	ND	ND	ND	N	ND
Helb	N	1.3	15	11.5	Y	ND
Jake White Bull	N	1.6	11	6.9	Y	ND
White Buffalo Robe	N	ND	ND	ND	ND	ND
Ben Standing Soldier	ND	ND	ND	ND	N	ND
Calamity	ND	ND	ND	ND	Y	ND
Bagnell (Early)	ND	ND	ND	ND	ND	ND
Grandmother's Lodge	Y?	n/a	1	n/a	N	n/a

measurements of each site were usually made along the intercardinal directions. Two different formulas were used to calculate area, depending on the overall layout of the settlement. In most cases, the formula for an ellipse was used. A rectangular area was calculated for a few. In all cases, the measurements and calculations were designed to yield a minimum size. To ensure comparability among fortified and unfortified sites, the dimensions of fortified sites were defined by the spatial extent of houses within the palisade, rather than by the extent of the fortification itself.

Sites lacking obvious major impacts were considered to be substantially complete. Sites which clearly have been impacted by recent development or by substantial erosion were considered to be incomplete and were not included in mean area calculations. In cases where bank erosion has destroyed an unknown but seemingly small number of lodges the site was considered to be substantially complete.

Number of Houses

The house count data in table A3 are taken directly from published reports on each site. Because long-rectangular Middle Missouri tradition houses were semi-subterranean, and because most Extended variant occupations were relatively brief (see the section on Occupation Duration), modern surface topography often can provide unambiguous evidence for the location and number of houses present. In some cases, investigators also use aerial photographs showing vegetation differences inside subtle lodge depressions to augment the topographic data (Thiessen 1995). In cases where it is clear that a portion of the site has been lost to erosion or other processes, only the number of substantially complete houses located within the remaining site area is reported.

Settlement Layout

Defensive works are among the most conspicuous features of Middle Missouri tradition villages. The presence of a fortification ditch typically is indicated by a clear if sometimes partially obliterated swale; when present, site investigators usually describe them in some detail. One exception is the Thomas Riggs site. Neither Meleen (1949) or Hurt (1953) mention such a feature, but one is clearly visible in the aerial photograph published by Johnston (1967), who confirmed its existence through testing.

Of course, it is possible that fortification ditches were filled during or after the occupation of these sites, leaving no modern surface expression. Such is the case at Larson Village (Mitchell, ed. 2007, 2008), Double Ditch Village (Ahler, ed. 2003, 2004, 2005), and Boley Village (Ahler, ed. 2006). However, each of those settlements were occupied for a lengthy period, in contrast to most of the Extended Middle Missouri settlements in this sample, a circumstance providing more opportunity for various kinds of surface modification to have taken place. In the current sample,

seven sites exhibit clear evidence of a defensive ditch, while 13 do not; the presence or absence of fortifications could not be determined in two cases.

Many Middle Missouri subarea settlements exhibit obvious open areas generally interpreted as public plazas, but in many cases remote sensing or excavation data are needed to confirm their presence. For one thing, recognition depends on settlement size: if the community consists only of a small number of houses their arrangement may not clearly demarcate a common activity area. In this sample, the McKensey site provides the clearest instance of this. The site consists of a single row of at least six lodges and one other lodge located on the far side of what could be a small plaza. Even at larger settlements, though, the patchy arrangement of lodges sometimes makes it difficult to determine whether a gap between them should be considered a public plaza. Bendish and South Cannonball are examples of this phenomenon. In the sample of 22 settlements, five exhibit definite evidence for the presence or absence of an interior plaza, while seven exhibit equivocal evidence. No data are available for the remaining 10.

Occupation Duration

I use three variables to assess the occupation duration of each settlement (table A4). Ahler and others (2007) and Toom (1992) provide the basic rationale for the use of these particular variables in the Middle Missouri subarea. I examined published architectural drawings for evidence of feature superimposition and structure remodeling. Data on the occurrence of surface visible middens were drawn from descriptions provided by the original investigator. I use three attributes to code each variable: none, minor, and moderate. Certainly, other categories are possible; however, none of the sites in this sample exhibited extensive house remodeling or deep midden deposits.

In this sample, only three sites exhibit evidence for what Ahler and others (2007:66)

Table A4. Extended Middle Missouri settlement occupation duration data.

Site	Remodeling	Superimposition	Midden
Ketchen	None	None	No
Durkin	None	None	No
Cross Ranch	Minor	None	No
Tony Glas	Minor	None	No
Fire Heart Creek	Minor	Minor	No
Bendish	Minor	None	ND
Havens	Moderate	Moderate	Minor
Thomas Riggs	Minor	Minor	No
Shermer	Moderate	Moderate	Minor
Paul Brave	None	None	No
South Cannonball	Minor	Minor	No
Helb	ND	ND	ND
Jake White Bull	ND	ND	No
White Buffalo Robe	None	None	No
Clark's Creek	ND	ND	No
Grandmother's Lodge	None	None	No
McKensey	Minor	None	No
Vanderbilt	ND	ND	ND
Ben Standing Soldier	ND	ND	ND
Hickey Brothers	None	None	No
Bagnell (Early)	Moderate	Moderate	ND
Calamity	None	None	ND

call "primary evidence for long-term occupation," by which they mean an occupation duration longer than about 50 years. Havens and Shermer each exhibit several indicators of somewhat longer term occupation. Surface-visible middens are evident at both and excavation data revealed superimposed features and evidence of house rebuilding. At Bagnell, a later occupation overlies the Extended Middle Missouri component (Wood 1986), but Lehmer and others (1973:163) nevertheless believe that the long-rectangular house there was remodeled or rebuilt on more than one occasion.

Architectural Data

Most of the data on the sizes of excavated lodges are taken from Johnson (1979a:Table 20) (table A5). In some instances, lodge sizes were measured from published drawings using

Johnson's method (1979a:130, Figure 15). Lehmer, Meston, and Dill (1973) demonstrate that at least some long-rectangular lodges incorporated a perimeter storage area known to the nineteenth-century Hidatsas as an *atuti*. However, because it is not known how widespread such features were, lodge size measurements only include the floor area defined by the lateral wall posts and the major support posts. In all cases, published architectural plans depict house dimensions in U. S. customary units; calculated floor areas were subsequently converted to metric units.

Table A5. Mean sizes of Extended Middle Missouri houses.

Site	Number of Excavated Houses	Mean Floor Area (sq. m)	S.D.	Coefficient of Variation (3 or more houses)
Thomas Riggs	6	132.4	64.5	48.7
South Cannonball	6	109.6	28.7	26.2
Havens	4	109.6	12.5	11.4
Shermer	4	158.0	71.1	45.0
Durkin	3	118.9	7.3	6.1
Fire Heart Creek	3	85.6	10.6	12.4
Paul Brave	3	120.4	21.0	17.4
Ben Standing Soldier	3	122.5	22.2	18.1
Cross Ranch	2	68.1	8.7	
Tony Glas	2	152.8	43.1	
Bendish	2	109.2	4.9	
Helb	2	75.6	9.2	
Ketchen	2	87.5	14.4	
Grandmother's Lodge	1	138.3		
McKensey	1	98.5		
Bagnell (Early)	1	92.5		
Calamity	1	87.0		
Total	46	114.5	43.0	37.6

Extended Middle Missouri Sites Data Notes

Ketchen (39ST223)

Site Area: Calculated from a published map (Johnson 1979a:Figure 2) using the formula for an ellipse; area excludes three large depressions on the east end of the site that Johnson

(1979a:10) argues may be part of 39ST222.

Number of Houses: Includes only the largest of the three circular depressions adjacent to the cluster of 11 rectangular depressions; excludes three large circular depressions on the east end of the site.

House Size(s): Data from Johnson (1979a:Table 20), except XU2 (Feature 3) and XU11 (Feature 12) which were calculated from published plan maps (Johnson 1979a:Figure 2, Figure 5).

Durkin (39ST238)

Site Area: Calculated from published map (Johnson 1979a:Figure 10) using the formula for an ellipse.

Number of Houses: Data from Johnson (1979a:50).

House Size(s): Data from Johnson (1979a:Table 20).

Cross Ranch (32OL14)

Site Area: Data from Ahler (1993b:Table 24.2); area does not represent the original site area.

Number of Houses: Data from Calabrese (1972:6, Figure 2); does not represent the total number of houses originally present.

House Size(s): Calculated from published plan maps (Calabrese 1972:Figure 3, Figure 4). Area of H3 is 827 sq. ft.; area of H7 is 639 sq. ft.

Faunal Data: Data on unmodified faunal remains is reported in Ahler et al. (1993) and Calabrese (1972); the sample includes specimens from both screened and unscreened contexts.

Tony Glas (32ME3)

Site Area: Area inside the fortification calculated from published map (Mead 1999:Figure 2), using formula for a rectangle.

Number of Houses: Data from Mead (1999:5).

House Size(s): Calculated from published plan maps (Biddle 1999:Figure 3, Figure 4). Area of H1 is 1181 sq. ft.; area of H2 is 2109 sq. ft.

Fire Heart Creek (32SI2)

Site Area: Lodge depressions only were visible in a portion of the site and therefore the site area is not known (Lehmer 1966).

Number of Houses: Three lodges were excavated, but more likely were originally present.

House Size(s): Data from Johnson (1979a:Table 20).

Bendish (32MO2)

Site Area: Calculated from published map (Thiessen 1995:Figure 2), using the formula for an ellipse.

Number of Houses: Data from Thiessen (1995:115).

House Size(s): Calculated from published maps (Thiessen 1995:Figure 3, Figure 4). Area of H6 is 1122 sq. ft.; area of H3 is 1228 sq. ft.

Havens (32EM1)

Site Area: Calculated from published map (Sperry 1995:Figure 2), using the formula for an ellipse.

Number of Houses: Data from Sperry (1995:10).

House Size(s): Calculated from published maps (Sperry 1995:Figure 3, Figure 4, Figure 5, Figure 6). Johnson (1979a:Table 20) reports data for H1 and H2 only and her data differ slightly from the values calculated from the published maps. Area of H1 is 1087 sq. ft.; area of H2 is 1248 sq. ft.; area of H3 is 1363; area of H4 is 1020 sq. ft.

Thomas Riggs (39HU1)

Site Area: Calculated from published map (Hurt 1953:Figure IV). The measured dimensions are slightly larger than those reported either by Hurt (1953) or Meleen (1949), but somewhat smaller than the area enclosed by the fortification. The formula for an ellipse was used to calculate the area.

Number of Houses: Data from Hurt (1953); Meleen (1949) reports 23 houses.

House Size(s): Data from Johnson (1979a:Table 20).

Shermer (32EM10)

Site Area: Calculated from published map (Sperry 1968:Figure 2) using the formula for an ellipse. Sperry reports an area of 10.5 ac (4.2 ha). A map drawn by Stout and Steinbrueck (Sperry 1968:Figure 3) shows a rectangular area of about 10.8 ac (4.4 ha).

Number of Houses: Sperry (1968:4) gives a count of 79 lodges, based mainly on a map made in 1908 by Ernst R. Steinbrueck and A. B. Stout. Sperry argues that, in general, Stout and Steinbrueck's many maps of Heart region settlements are accurate and therefore that there is little reason to think their count is substantially in error. However, two observations throw doubt on Sperry's assessment. Comparisons between Stout and Steinbrueck maps and more recent maps of other sites suggest that they commonly overestimated the number of lodges present. For instance, Steinbrueck's maps of Huff Village show a much higher lodge density than later maps (Wood 1967:Map 3). In addition, recent work carried out at Double Ditch Village (Ahler et al. 2005) and Larson Village (Mitchell, Swenson, and Picha 2008) suggests that at certain sites the number of depressions does not accurately reflect the number of lodges present. These projects have shown that, at sites occupied for longer periods of time, many depressions in fact represent borrow basins or other features. Shermer does exhibit some evidence of longer-term occupation (Ahler et al. 2007:77-78), suggesting that Steinbrueck's count is inflated. In fact, vegetation patterns visible in aerial photographs published by Sperry (1968:Plate 1A) and Wood (2001:Figure 7) appear to show a much smaller number of lodges; this lower density also is reflected in Sperry's (1968:Figure 2) own plan map. Owing to these factors, the number of lodges at Shermer cannot currently be estimated.

Lodge Size(s): Calculated from published maps (Sperry 1968: Figure 5, Figure 6, Figure 7, Figure 8). Area of H1 is 1179 sq. ft.; area of H4 is 1493 sq. ft.; area of H6 is 1128; area of H7 is 3004 sq. ft.

Comment: Most archaeologists assign the Shermer site to a culture historical unit called the

Terminal variant of the Middle Missouri tradition (Johnson 2007a:77). However, I believe there are good reasons to re-assign it to the Extended variant. Ahler and others (2000:360) argue that pottery from the site is made up exclusively of Extended Middle Missouri types. Johnson (2007a:Table C.3) reports a mid- to late-1300s date for the site, an age consistent with the current understanding of the Heart region ceramic chronology. It should be noted, however, that Ahler and others (2007:77-78) describe several problems with the suite of dates obtained for the site. These problems may reflect the comparatively lengthy occupation of the site. They may also be due to laboratory errors; for instance, two assays run on a single maize sample apparently produced two non-contemporaneous ages. Given these data, it is evident that the assignment of Shermer to the Terminal variant is based solely on two criteria: the presence of a bastioned fortification surrounding the community and the reported high lodge density. As I explained above, Stout and Steinbrueck's lodge count is likely too high. The use of bastions, it now seems clear, reflects the needs of defense and therefore cannot be considered a valid temporal or cultural marker. Not every site currently assigned to the Terminal variant incorporates them (Wood 2001:Figure 2) but several assigned to the Extended variant do. They are present at the Thomas Riggs site (Johnston 1967:395), at the Hickey Brothers site (Caldwell et al. 1964), and at several other southern Extended Middle Missouri settlements (Caldwell 1964:2). Bastions also are present in the fortifications surrounding Initial Coalescent communities dating to the 1300s and later. In the sixteenth century, fortifications incorporating bastions were built around Double Ditch and Larson villages (Ahler, ed. 2005; Mitchell, ed. 2008). Additional discussion on Shermer's chronological and cultural placement can be found in appendix 1.

Paul Brave (32SI14)

Site Area: Calculated from published map (Wood and Woolworth 1964:Map 2) using the formula for an ellipse. Wood and Woolworth (1964:2) report an area of 4.0 ac (1.6 ha).

Number of Houses: Data from Wood and Woolworth (1964).

House Size(s): Data from Johnson (1979a:Table 20). No plan map is available for House 4, excavated in 1947.

South Cannonball (32SI19)

Site Area: Calculated from published map (Griffin 1984:Figure 1) using the formula for an ellipse.

Number of Houses: Data from Griffin (1984:5).

House Size(s): Data from Johnson (1979a:Table 20); however, Feature 23 (House 6) is mistakenly reported as Feature 93. This structure is excluded because its width cannot be measurement directly from the published plan map.

Helb (39CA208)

Site Area: Calculated from published map (Falk and Ahler 1988:Figure A.1) using the formula for a rectangle. The calculated size represents only a fraction of the original size of the settlement. In 1966, 40 houses were scattered over about 4 ha (Falk and Ahler 1988:86).

Number of Houses: Data from Falk and Ahler (1988:Figure A.1, 86).

Houses Size(s): Calculated from published map (Zalucha 1983:Figure 3). Area of H15 is 913 sq. ft.; area of H14 is 715 sq. ft.

Comment: The dating of the Helb site has been problematic. Based on eleven radiocarbon dates Thiessen and Nickel (1975) argue for an eleventh century occupation (see also Falk and Calabrese 1973), followed by a second occupation in the 1500s. Kay (1994) argues for three components. However, Ahler and others (2007:67), observing that the site lacks evidence for long-term or repeated use, put the occupation in their Period 4 (1300-1400).

Jake White Bull (39CO6)

Site Area: Calculated from published map (Ahler 1977b:Figure 4) using the formula for a rectangle. The calculated size represents only a fraction of the original size of the settlement. In 1966, some 30 houses were scattered over about 4.7 ha (Ahler 1977b:11).

Number of Houses: Data from Ahler (1977b:19).

House Size(s): No data available.

Clark's Creek (32ME1)

Site Area: Calculated from published map (Wood 1986:Figure 1) using the formula for a rectangle. Wood (1986:7) reports an equivalent area.

Number of Houses: Data from Wood (1986:7).

House Size(s): No data available.

White Buffalo Robe (32ME7)

Site Area: No data available.

Number of Houses: No data available.

House Size(s): Portions of one and perhaps several other houses were excavated, but insufficient data are available to calculate their sizes (Lee and Hetland 1980:114, 132).

Grandmother's Lodge (32ME59)

Site Area: No area is calculated because only one structure was documented (Woolworth 1956).

Number of Houses: Data from Woolworth (1956).

House Size(s): Calculated from published plan map (Woolworth 1956:Plate 2). Area of the lodge is 1489 sq. ft. Johnson (1979a:Table 20) reports an area of 1751 sq. ft., but this calculation appears to be in error.

McKensey (39AR201)

Site Area: Calculated from published map (Caldwell 1966:Figure 2) using the formula for an ellipse.

Number of Houses: Caldwell (1966:5) reports 18 depressions, but only seven are clearly rectangular and of appropriate size. For these reasons the number of houses present cannot be determined.

House Size(s): Calculated from published plan map (Caldwell 1966:Figure 3). Area of H4/ Feature 1 is 1060 sq. ft. Only one length measurement is possible.

Calamity (39DW231)

Site Area: No data available.

Number of Houses: No data available.

House Size(s): Calculated from a field sketch (Mallory 1964). Area of F43 is 936 sq. ft. Mallory's field notes give an area of 837 sq. ft., but the distribution of pits and hearths suggest that the structure is somewhat larger than that.

Vanderbilt (39CA1)

Site Area: Calculated from published map (Falk and Pepperl 1986).

Number of Houses: Data from Falk and Pepperl (1986).

House Size(s): No data available.

Ben Standing Soldier (32SI17)

Site Area: No data available.

Number of Houses: No data available.

House Size(s): Data from Johnson (1979a:Table 20).

Hickey Brothers (39LM4)

Site Area: Calculated from published map (Caldwell et al. 1964) using the formula for a rectangle. Caldwell and others (1964:272) inexplicably report an area of "slightly less than 2 acres," but give the site's dimensions as 1150 ft. by 700 ft. The smaller dimensions used here represents the area inside the fortification which likely would have been occupied by lodges had they been built.

Number of Houses: Substantial structures apparently were never constructed at the site.

House Size(s): No data available.

Bagnell (Early) (32OL16)

Site Area: No data available.

Number of Houses: No data available.

House Size(s): Calculated from published map (Lehmer et al. 1973). Area of H3 is 996 sq. ft,

excluding the *atuti*.

Comment: The age of the early component at Bagnell is not known with certainty. Wood (1986) puts it in the Nailati phase. Ahler (1993a) believes that it post-dates 1400, but the ceramic criteria he uses are no longer considered valid (Ahler 2001). Three radiocarbon dates from H3 place the long-rectangular house component in the sixteenth or seventeenth century, a date that seems too late, though not out of the question. In fact, new data from Chief Looking's Village in the Heart region, indicates that long-rectangular structures continued to be built into the sixteenth century there (Mitchell, ed. 2011).

Post-1400 Sites

A number of factors complicate the selection of sites for the post-1400 sample. The most significant is the complex occupation histories of most post-1400 settlements in the Knife and Heart regions. The problem is best illustrated at Double Ditch Village (Ahler, ed. 2003, 2004, 2005). The size of the site changed dramatically during the course of the occupation, diminishing from 7.7 ha to 1.7 ha over about 300 years. As a result, the current surface expression of the site preserves information about several different periods of occupation. More importantly, reliable house count data only are available for the most recent period of occupation. Similarly complex occupation histories have been documented at Larson Village (Mitchell, ed. 2008), Big Hidatsa Village (Ahler and Swenson 1986), Boley Village (Ahler, ed. 2006), Fort Clark Village (Ahler, ed. 2003b; Wood 1993b), and other sites.

A second problem is the magnitude and extent of recent impacts to these sites. Particularly in the Knife region, many sites have been damaged or destroyed by highways, railroads, power plants, gravel pits, modern houses, public buildings, and looting. As a result, only fragmentary data are available for many sites.

Dating these sites is also problematic. Owing to the major plateau in the radiocarbon

calibration curve spanning all of the sixteenth century, as well as to large-scale fluctuations after 1650, radiocarbon assays only can be used to date sites assigned to Johnson's (2007a) Period 5 and Period 6, and then, especially for the latter period, only cautiously. Investigators use a variety of other methods to assign sites to more recent periods, including pottery seriation, trade goods density calculations, site stratigraphy, and historical documents. Investigators typically partition data from settlements with long occupations into shorter-duration segments or site-specific periods. However, nearly all of these sites appear to have been occupied continuously, so the period designations should be seen as approximate. In some cases, the occupation periods defined by the original site investigators differ slightly from Johnson's (2007a) time periods.

The purpose of the post-1400 site sample is primarily to provide comparative population data, so I selected sites for which reasonably reliable house count and settlement size data are available. Ahler (1993b:Table 24.2) and Wood (1986:Table 4, Table 5) tabulate these data for a number of sites in the Knife region. I excluded the sites on their lists lacking house count data, as well as the Molander, Deapolis, Shoreline, and Upper Sanger sites, for which the number of houses are uncertain. I also excluded the Dennison site, which was not included in the KNRI regional study, and the Black Cat site, the size of which is not known. Finally, the Nightwalker's Butte site is omitted because its history, content, and setting set it apart from the permanent villages that are the primary focus of this study. More recent size or house count data are available for a few of the sites in Ahler's and Wood's lists.

Swenson (2007) presents size data for six settlements in the Heart region. However, lodge counts only are available for two of the six (Larson and Double Ditch villages), and then only for the most recent occupations. Moreover, given the demonstrated complexity of the occupation histories of several other Heart region sites, it is difficult to relate the mapped sizes of the other four villages to a particular time period. For these reasons, Sperry, Motsiff, On-A-Slant, and Boley are omitted here. Size and lodge count data are available for the Huff site (Wood 1967), the only fifteenth-century Heart region site included in the sample.

Finally, I added to the sample three sites, Like-A-Fishhook, Boley, and Elbee, for which architectural data, but not house count or settlement size data, are available. In the end, 21 sites are included in the post-1400 sample (table A6). Admittedly, this is a rather eclectic mix. They represent a variety of culture-historical taxa, many of which are incompletely defined; additional discussion on regional systematics can be found in appendix 1. The sample includes sites occupied by the Hidatsas, the Mandans, and, for Period 12 and Period 13, the Arikaras. It is evident that inter-ethnic differences exist in site layout—public plazas, for instance, seem to have been more prominent at Mandan and Arikara settlements than at Hidatsa settlements—and, possibly, in house size, but those differences are not considered here because the focus is on diachronic changes in settlement population.

Table A6. Sites in the post-1400 sample.

Site	^{14}C?	Period[a]	KNRI Period[b]	Reference(s)
Bagnell (Late) (32OL16)	N	5	42	Wood 1986
Huff (32MO11)	Y	5	n/a	Wood 1967, Ahler and Kvamme 2000
Mandan Lake (32OL21)	N	5	42	Wood 1986; Ahler 1993b
Larson (32BL9)	Y	6	n/a	Mitchell, ed. 2007, 2008
Double Ditch (32BL8)	Y	6	n/a	Ahler, ed. 2003a, 2004, 2005
Elbee (32ME408)	Y	6/7	None	Ahler, ed. 1984; Toom, ed. 2004
Lower Sanger (32OL11)	N	6/7	50	Wood 1986; Ahler 1993b
Hensler (32OL18)	N	6/7	50	Wood 1986; Ahler 1993b
Smith Farm (32OL9)	N	6/7	50	Wood 1986; Ahler 1993b
Big Hidatsa (32ME12)	N	8-13	61, 62, 71, 72, 1790-1830, 1830-1845	Ahler 1993b; Ahler and Swenson 1985
Lower Hidatsa (32ME10)	N	9, 10/11	62, 71/72	Ahler 1993b; Ahler and Weston 1981
Double Ditch (32BL8)	N	10/11	n/a	Ahler, ed. 2003a, 2004, 2005
Larson (32BL9)	N	10/11	n/a	Mitchell, ed. 2007, 2008
Boley (32MO37)	N	10/11	n/a	Ahler, ed. 2006
Rock (32ME15)	N	12	1780-1845	Hartle 1960; Lehmer, Wood, and Dill 1978
Greenshield (32OL17)	N	12	1790-1800	Nicholas and Johnson 1986
Sakakawea (32ME11)	N	12	1800-1845	Ahler, Weston, and McMiller 1980
Amahami (32ME8)	N	12	1800-1845	Lehmer, Wood, and Dill 1978
Fort Clark (32ME2)	N	13	1822-1862	Ahler, ed. 2003b; Wood 1993b
Like-A-Fishhook (32ML2)	N	13	1845-1886	Smith 1972
Star (32ME16)	N	13	1861-1862	Metcalf 1963

[a] Period 5=1400-1500; Period 6=1500-1550; Period 7=1550-1600; Period 8=1600-1650; Period 9=1650-1700; Period 10=1700-1750; Period 11=1750-1785; Period 12=1785-1830; Period 13=1830-1886; see Johnson (2007a) for discussion of Middle Missouri subarea time periods.
[b] Period 42=1400-1450; Period 50=1525-1600; Period 61=1600-1650; Period 62=1650-1700; Period 71=1700-1740/1745; Period 72=1740/1745-1790; see Ahler (1993a) for a discussion of KRNI time periods.

Site Data

Data collected on each settlement in the sample include its size, the number of lodges present, and the presence of village fortifications and public plazas (table A7). Data were not compiled on settlement occupation duration.

Settlement Size

In most cases site area estimates are based on the extent of mapped surface features, including lodge depressions and mounds. A number of the sites in the sample were mapped in the early twentieth century, before they were impacted by construction and other activities. However, little is known about the accuracy of some of these early maps. Aerial photographs, systematic coring, and hand excavation were used to determine the sizes of several sites in the Knife region. The most reliable settlement size data come from the Heart region, where high-resolution topographic mapping, magnetic gradiometry surveys, and hand coring were used to determine the extent of Double Ditch, Larson, and Huff villages. Several sites occur more than once in table A7 because their sizes are known for more than one period of occupation. For the fortified settlements in the post-1400 sample, the estimates encompass the total area inside the fortified perimeter, in contrast to the fortified sites in the Extended Middle Missouri sample where the estimate only includes the area occupied by houses. The area encompassed by the low, linear mounds radiating out from Big Hidatsa and Lower Hidatsa villages is excluded from the size estimates for those settlements.

Number of Houses

In most cases, the number of topographic depressions is used as proxy for the number

Table A7. Post-1400 site size, residential density, and layout.

Site	Period	Complete?	Site Area (ha)	Number of Houses	Density (houses/ha)	Fortification?	Plaza?
Mandan Lake	5	Y	3.5	97	27.7	ND	ND
Bagnell (Late)	5	Y	3.9	97	24.9	Y?	ND
Huff	5	Y	4.4	103	23.4	Y	Y
Larson	6	Y	5.1	ND	ND	Y	Y
Double Ditch	6	Y	7.7	ND	ND	Y	Y
Lower Sanger	6/7	Y	1.6	34	21.3	Y?	ND
Hensler	6/7	Y	4.0	125	31.3	ND	ND
Smith Farm	6/7	Y	1.8	27	15.0	Y	ND
Big Hidatsa	8	Y	2.4	ND	ND	ND	N?
Big Hidatsa	9	Y	3.2	ND	ND	ND	N?
Lower Hidatsa	9	Y	2.0	ND	ND	N	N?
Big Hidatsa	10	Y	4.1	ND	ND	ND	N?
Lower Hidatsa	10/11	Y	2.0	57	28.5	N	N?
Double Ditch	10/11	Y	1.7	33	19.4	Y	Y
Larson	10/11	N	0.6	15	25.0	Y	Y
Boley	10/11	N	ND	ND	ND	Y	ND
Big Hidatsa	11	Y	5.2	ND	ND	Y	N?
Amahami	12	N	1.3	21	16.2	Y	Y?
Greenshield	12	Y	1.5	40	26.7	Y	Y
Rock	12	N	1.3	35	26.9	Y	Y?
Sakakawea	12	N	2.2	41	18.6	Y	Y?
Big Hidatsa	12	Y	4.7	86	18.3	Y	N?
Big Hidatsa	13	Y	2.2	ND	ND	Y	N?
Fort Clark	13	Y	7.2	86	11.9	Y	Y
Like-A-Fishhook	13	Y	11.9	ND	ND	Y	Y
Star Village	13	Y	5.8	85	14.7	Y	Y

of houses. Because research in the Heart region has shown that, at sites occupied for a lengthy period, this procedure is only valid for the most recent period of occupation (Ahler et al. 2005; Mitchell, Swenson, and Picha 2008), house count data for the initial periods of occupation at several villages is omitted. As was the case for the site size data, the best house count data come from the Double Ditch, Larson, and Huff sites, where topographic, magnetic, and hand coring data are available.

Settlement Layout

Data on the presence of village fortifications and public plazas were compiled from

published maps and descriptions. However, it should be noted that there is considerable uncertainty in these data, owing, again, to the complexity of the post-1400 archaeological record. At some sites, such as Lower Sanger, a fortification ditch is clearly evident, but its age is not known with certainty (Wood 1986:15). In the absence of geophysical or excavation data, it is often difficult to determine whether an opening between house depressions should be counted as a public plaza.

Architectural Data

Ahler (1993b:Table 24.1) summarizes the sparse house size data available for the Knife region. Data sufficient to determine lodge size are available for just six sites post-dating 1400. As I mentioned, the Nightwalker's Butte in the Bull Pasture site (32ML39) is omitted, a decision bolstered by the unusually small sizes of the lodges there (averaging just 25.9 sq. m, or less than a fifth of the mean of the other structures in the sample reported here). One structure from the Alderin Creek site (32ME4) and three from the Amahami site (32ME8) also are excluded because they are poorly defined (Ahler 1993b:36-37). The Elbee site is not assigned to a KNRI period, but lodge size data are available for one structure there. House size data also are available for Huff, Boley, and Like-A-Fishhook villages, three sites not included in the KNRI study (table A8).

When possible, lodge sizes were calculated from measurements taken from published drawings. In all cases, the sizes of circular lodges only include the floor defined by the ring of wall posts. Even though peripheral storage areas, known as an *atuti*, were a common feature of circular lodges in the nineteenth century, published maps often do not show their extent. Length and width measurements were used to calculate the areas of the few log structures in the sample.

Table A8. Mean sizes of post-1400 houses.

Site	Period	Number of Excavated Houses	Mean Floor Area (sq. m)	S.D.	Coefficient of Variation (3 or more houses)
Like-A-Fishhook	13	14	198.8	76.8	38.6
Rock	12	13	85.2	14.8	17.4
Huff	5	10	122.8	35.1	28.6
Star Village	13	5	137.2	71.9	52.4
Boley	10/11	1	84.4		
Sakakawea	12	1	147.3		
Elbee	6/7	1	113.1		
Total		45	136.6	69.5	50.9

Post-1400 Sites Data Notes

Like-A-Fishhook (32ML2)

Site Area: Calculated from published map (Smith 1972:Figure 3), using the formula for an ellipse.

Number of Houses: No data available. Smith's (1972:Figure 3) map shows the locations of numerous structures, but it is not clear whether all of them are houses. Extensive structure superimposition is also evident.

House Size(s): Calculated from published maps (Smith 1972). Area of H1 is 4536 sq. ft.; area of H2 is 1195 sq. ft.; area of H4 is 1590 sq. ft.; area of H5 is 2376 sq. ft.; area of H6 (a log cabin [Smith 1972:Figure 12]) is 1050 sq. ft.; area of H7 is 1810 sq. ft.; area of H8 is 2376 sq. ft.; area of H9 is 1886 sq. ft.; are of H10 is 1320 sq. ft.; area of H12 is 1963 sq. ft.; area of H13 is 2552 sq. ft.; area of H14 is 2552 sq. ft.; area of H15 is 2463 sq. ft.; are of H18 is 2290 sq. ft. Maps of several other structures (H3, H11, H16, H17, H19, and H20) are published in Smith (1972), but floor their floor areas cannot be calculated due to remodeling or to ambiguous post configurations.

Comment: With the exception of H6, and possibly H3, all of the excavated structures are circular in plan. However, photographs of the settlement taken in the late 1870s and 1880s

show that many of the buildings there were rectangular log cabins. Smith (1972) does not discuss the reason for this bias, but it no doubt affects the calculation of mean household size.

Huff (32MO11)

Site Area: Calculated from published map (Wood 1967:Map 4), using the formula for a rectangle. An unknown, though likely small, portion of the site has been lost to bank erosion.

Number of Houses: Data from Wood (1967). Recent magnetometer and microtopographic surveys of the site (Kvamme, McKinnon, and Weiwel 2009) suggest that the number of houses reported by Wood may be slightly too low; the current estimate is 116 houses.

House Size(s): Calculated from published maps (Wood 1967). Area of H1 is 1178 sq. ft.; area of H2 is 2145 sq. ft.; area of H3 is 598 sq. ft.; area of H4 is 1158 sq. ft.; area of H5 is 1369 sq. ft.; area of H6 is 1300 sq. ft.; area of H7 is 1563 sq. ft.; area of H8 is 1420 sq. ft.; area of H10 is 1457 sq. ft.; area of H12 is 1027 sq. ft.

Boley (32MO37)

Site Area: Swenson puts the minimum area of Boley Village at 4.5 ha. Magnetic surveys carried out in 2005 defined a portion of the site boundary, but much of the site has been impacted by bank erosion, railroad and residential construction, large-scale unprofessional digging, and agriculture (Ahler, ed. 2006). Because the extent of the site lost to these factors is not known, no site area data are reported.

Number of Houses: No data available.

House Size(s): Calculated from published map (Swenson 2006:Figure 10). Area of F4 is 908 sq. ft.

Comment: Data from the 2005 excavations indicate that Boley Village was occupied for a lengthy period, probably beginning in early 1500s (Ahler et al. 2006). Several lines of evidence suggest that it may have been abandoned for a short period then reoccupied in

the late 1600s or early 1700s. Given the position of the excavated lodge in the core of the village it likely dates to Johnson's (2007a) Period 10 or Period 11 (1700-1750 or 1750-1785).

Star (32ME16)

Site Area: Calculated from published map (Metcalf 1963:Map 3) using the formula for a rectangle. Metcalf (1963:69) estimates a slightly larger area (6.1 ha or 15.1 ac).

Number of Houses: Data from Metcalf (1963).

House Size(s): Calculated from published maps (Metcalf 1963). Area of H1 is 1075 sq. ft.; area of H3 is 1195 sq. ft.; area of H5 is 1018 sq. ft.; area of H8 is 1075 sq. ft.; area of H12 is 3019 sq. ft. Maps of two other structures of uncertain function are published in Metcalf (1963). They may represent log cabins, which likely were in use at nearby Like-A-Fishhook Village at about the same time Star Village was occupied.

Rock (32ME15)

Site Area: Calculated from published map (Lehmer, Wood, and Dill 1978:Figure 3.1), using the formula for an ellipse.

Number of Houses: Data from Lehmer, Wood, and Dill (1978:13).

House Size(s): Calculated from published maps (Lehmer, Wood, and Dill 1978). Area of H1/F69 is 924 sq. ft.; area of H2/F53 is 973 sq. ft.; are of H3/F60 is 1058 sq. ft.; area of H4/F9 is 784 sq. ft; area of H5/F108 is 1257 sq. ft.; area of H6/F8 is 1001 sq. ft.; area of H7/F19 is 804 sq. ft; area of H8/F10A is 845 sq. ft.; area of H9/F10B is 1069 sq. ft.; area of H10/F48 is 913 sq. ft.; area of H11/F111 is 845 sq. ft.; area of H12/F119 is 871 sq. ft; area of H13/F72 is 573 sq. ft.

Comment: H8 and H9 are superimposed, as are H5 and H12. H13 appears to have been remodeled.

Sakakawea (32ME11)

Site Area: Data from Ahler (1993b:Table 24.2) and Ahler, Weston, and McMiller (1980:Figure

2). A substantial portion of the site has been lost to bank erosion.

Number of Houses: Data from Ahler (1993b) and Ahler, Weston, and McMiller (1980).

House Size(s): Data from Ahler (1993b:Table 24.1). Area of H28 is 147.3 sq. m.

Larson (32BL9)

Site Area: Data are available for two occupation periods: the founding of the settlement (during or immediately prior to Johnson's [2007a] Period 6 [1500-1550]) and the abandonment of the settlement (during Period 10 [1700-1750] or Period 11 [1750-1785]) (Mitchell, ed. 2008). The estimate for Period 6 represents the total area occupied at that time, but the estimate for Period 10/11 represents only a portion of the total area. Area estimates are derived from magnetic gradiometry and high-resolution topographic data. An unknown, but likely small, portion of the site has been lost to bank erosion.

Number of Houses: Data from Mitchell, Swenson, and Picha (2007). Data are available only for the final period of occupation (Period 10 [1700-1750] or Period 11 [1750-1785]). House counts are based on magnetic gradiometry and hand coring data.

House Size(s): No data available.

Double Ditch (32BL8)

Site Area: Data are available for two occupation periods: the founding of the settlement (during or immediately prior to Johnson's [2007a] Period 6 [1500-1550]) and the abandonment of the settlement (during Period 11 [1750-1785]) (Ahler, ed. 2005). Both estimates represent the total area occupied. Area estimates are derived from magnetic gradiometry and high-resolution topographic data.

Number of Houses: Data from Ahler and others (2005). Data are available only for the final period of occupation (Period 11 [1750-1785]). House counts are based on magnetic gradiometry and hand coring data.

House Size(s): No data available.

Fort Clark (32ME2)

Site Area: Data from Ahler (ed. 2003b).

Number of Houses: Data from Ahler (ed. 2003b)

House Size(s): No data available.

Big Hidatsa (32ME12)

Site Area: Data from Ahler (1993b:Table 24.2). Area estimates are available for five of Johnson's (2007a) periods, including Period 8 (1600-1650), Period 9 (1650-1700), Period 10 (1700-1750), Period 12 (1785-1830), and Period 13 (1830-1886). Excavation data, reported in Ahler and Swenson (1985) were used to determine the extent of the settlement during each period.

Number of Houses: Data from Ahler (1993b:Table 24.2). Only data from Johnson's (2007a) Period 12 (KNRI Period 1790-1830 [Ahler 1993a] or Big Hidatsa Period 2 [Ahler and Weston 1985]) are used here. House count data are derived from modern surface topography and from historic data (Ahler and Swenson 1985:267). House count data reported in Ahler (1993b:Table 24.2) for other periods are based on the calculated density for Period 2 and so are excluded here.

House Size(s): No data available.

Lower Hidatsa (32ME10)

Site Area: Data from Ahler (1993b:Table 24.2). The site was occupied for about 100 years, from the late 1600s to the late 1700s (Johnson's (2007a) Period 9, Period 10, and Period 11). The site appears to have changed little in size during its period of occupation.

Number of Houses: Data from Ahler (1993b:Table 24.2). House counts, derived from topographic data, only are available for the eighteenth century (Period 10 and Period 11).

House Size(s): No data available.

Bagnell (Late) (32OL16)

Site Area: Data from Ahler (1993b:Table 24.2) and Wood (1986).

Number of Houses: Data from Ahler (1993b:Table 24.2) and Wood (1986). Data are derived from a map of the site produced by A. B. Stout (Wood 1986:Table 4).

House Size(s): No data available.

Comment: As is the case for the early component, the age of the late component at Bagnell is not known with certainty. Wood (1986:13) includes the late component in his Heart River phase, which he dates from about 1450 to 1780. Lehmer, Meston, and Dill (1973) excavated two structures at that site, which they interpret as circular earthlodges dating to that phase. However, Ahler (1993a:84) is skeptical that the excavated structures were in fact circular.

Amahami (32ME8)

Site Area: Data from Ahler (1993b:Table 24.2). Data are derived from a map made in 1909 by A. B. Stout (Lehmer, Wood, and Dill 1978:Figure 7.2).

Number of Houses: Data from Ahler (1993b:Table 24.2). Data are derived from a map made in 1909 by A. B. Stout (Lehmer, Wood, and Dill 1978:Figure 7.2).

House Size(s): Chris Dill excavated three structures at the site (Lehmer, Wood, and Dill 1978:Figure 7.4). Ahler (1993b:Table 24.1) calculates the sizes of these structures as 147.3 sq. m. (H1); 65.0 sq. m (H2); and 67.9 sq. m (H3). However, owing to the complexity of the archaeological deposits encountered in the excavation blocks, Ahler (1993b:36-37) questions the validity of these data and they are omitted here.

Greenshield (32OL17)

Site Area: Data from Ahler (1993b:Table 24.2), based on a map published in Nicholas and Johnson (1986:Figure 54).

Number of Houses: Data from Nicholas and Johnson (1986).

House Size(s): No data available.

Elbee (32ME408)

Site Area: Ahler (1993b:Table 24.2) puts the size of the settlement at 3.1 ha, but this figure is not included here because the site is not assigned to a KNRI regional time period.

Number of Houses: No data available.

House Size(s): Data from Ahler (1984b:26). The area of H1 is estimated at 113.1 sq. m.

Other Sites

Wood (1986) presents site area and house count data for several sites in Oliver County, North Dakota, including Mandan Lake (32OL21), Smith Farm (32OL9), Lower Sanger (32OL11), and Hensler (32OL18) (see also Ahler 1993b:Table 24.2). Wood derived these data from inspection of aerial photographs, from maps drawn by A. B. Stout, and from field notes prepared in 1909 by Frank J. V. Kiebert (Wood 1986:Table 4). No house size data are available for these sites.

Appendix 3:

Datasets and Analytic Methods

This appendix gives an overview of the field and lab methods used in the study. It begins with a brief summary of the techniques used during the field investigations at the six Heart region sites that are the focus of the project. Information about of the sample selection procedures I used follows, accompanied by provenience and other data on the analytic units in the four-site subsample selected for detailed analyses of pottery vessels and stone tools. The appendix concludes with a discussion of the analytic methods applied to these collections.

The Study Sites

With the exception of On-A-Slant Village, field investigations at the Heart region sites included in this study took place between 1996 and 2007 (table A9). Work at Boley, Double Ditch, and Larson villages was funded by the State Historical Society of North Dakota and carried out cooperatively with Paleocultural Research Group (PCRG), a non-profit membership organization dedicated in archaeological research in the Plains and Southern Rocky Mountains. Field investigations at Scattered and Bypass villages were carried out by Metcalf Archaeological Consultants and the North Dakota Department of Transportation. The University of North Dakota conducted the fieldwork at On-A-Slant Village. With the exception of the Larson Village

Table A9. Technical reports describing field and lab investigations carried out at six Heart region sites.

Site	Field Year(s)	Reference
Boley (32MO37)	2005	Ahler, ed. 2006
Double Ditch (32BL8)	2001-2004	Ahler, ed. 2003, 2004, 2005
Scattered (32MO31)	1998	Ahler, ed. 2002
On-A-Slant (32MO26)	1980	Ahler, ed. 1997
Larson (32BL9)	2006, 2007	Mitchell, ed. 2007, 2008
Bypass (32MO291)	1996, 1997	Ahler, Graham, and Metcalf, eds. 2000

analysis, which I directed, Stanley A. Ahler supervised and coordinated all analytic work on each of these collections.

A uniform set of field and lab procedures were used for all of these projects. In most cases, the basic fieldwork strategy centered on obtaining well-controlled samples suitable for answering diachronic research questions. Accordingly, the field investigations focused on isolating and excavating discrete cultural features, especially trash-filled storage pits, and on sampling well-stratified midden deposits. At Larson, Double Ditch, and Boley villages, the research team used extensive geophysical surveys to guide the placement of excavation units (Kvamme 2008; Kvamme and Ahler 2007). Real-time integration of geophysical data, especially magnetic gradiometry data, with hand coring and excavation enabled the team to maximize the data obtained through testing by targeting the field effort on archaeological contexts best suited to answering the research questions guiding each project. Another crucial component of the field methodology for these projects was complete waterscreen recovery of all items larger than 1/16 inch. Complete descriptions of the field methods used for each project are provided in the reports listed in table A9.

Collection processing included size grading and sorting of individual provenience lots into a standard set of material classes. Pottery, modified stone, faunal remains, and other complex material classes were further sorted into subclasses, each of which received focused analysis. With the exception of the Bypass Village collection, this work was accomplished at PCRG's lab in Flagstaff, Arizona. Subsequent analytic work was carried out by numerous specialists working in various institutional settings around the country. The scope of these analyses varied somewhat, depending on the size and complexity of the collection and on the specific research questions under consideration. However, a consistent set of analytic methods were used in all cases.

Analytic Unit Selection

A crucial step in each investigation was the development of an analytic structure for the excavated collection. Building an analytic structure begins by assigning temporal, spatial, and depositional attributes to the individual catalog numbers associated with each plotted artifact or level lot. These assignments are based on a wide variety of data, including radiocarbon assays, artifact densities, stratigraphic relationships, spatial relationships, and field observations on the properties of excavated sediments. Using these attributes, artifacts associated with each catalog number can be aggregated into analytic units, based on the spatial, temporal, or depositional properties of the excavation contexts from which they derive. Most commonly, such units are defined by a combination of their spatial and temporal attributes and so represent an aggregate of artifacts deposited in a particular place during a particular time period. Analytic units can also be combined into higher-order aggregates by site, by regional time period, or by depositional context. With two exceptions (described in a footnote following table A10) the analytic units defined by the original investigators were retained here.

I applied several criteria in selecting the analytic units comprising the four-site subsample. Because one of this study's central concerns is diachronic change I chose analytic units with the most precise chronological placement. For analytic units pre-dating 1600, I gave first priority to those for which radiocarbon data are available. Because later contexts are dated primarily by their trade goods density I gave first priority to the analytic units with the greatest volume. In all cases, I examined excavation unit profiles and level forms to identify analytic units with the greatest depositional integrity. I then balanced the sample spatially and temporally, to ensure approximately even coverage across each site and over time. When several contexts satisfying these criteria were available I chose units with the highest artifact density, in order to maximize the representativeness of the sample. In the end, I selected a total of 80 analytic units; the spatial, temporal, and depositional properties of each are listed in table A10.

Table A10. Data on 80 analytic units included in the four-site sample.

Site	Analytic Unit	Volume (cu. m)	Site-specific Period (TP)	Regional Time Period	Deposit Type
Scattered	Block 8 House Floor	0.774	1	1600-1700	Floor or Roof
(32MO31)	Block 8 House Roof	0.910	1	1600-1700	Floor or Roof
	Pit F120	1.109	1	1600-1700	Pit
	Pit F127	1.302	1	1600-1700	Pit
	Pit F132	1.486	1	1600-1700	Pit
	Pit F14	0.837	1	1600-1700	Pit
	Pit F26	1.020	1	1600-1700	Pit
	Block 1 Lower Midden	1.592	2[a]	1600-1700	Midden
	Block 1 Upper Midden	2.197	2	1600-1700	Midden
	Block 6 House Floor	1.067	2	1600-1700	Floor or Roof
	Block 6 House Roof	2.080	2	1600-1700	Floor or Roof
	Pit F133	0.405	2[a]	1600-1700	Pit
	Pit F140	0.061	2	1600-1700	Pit
	Pit F142	0.360	2	1600-1700	Pit
	Pit F144	0.134	2	1600-1700	Other
	Pit F178	0.958	2	1600-1700	Pit
	Pit F47	0.810	2	1600-1700	Pit
	Pit F73	0.341	2	1600-1700	Pit
	Block 3 House Floor	1.628	3	pre-1600	Floor or Roof
	Pit F101	0.509	3	pre-1600	Pit
	Pit F104	0.460	3	pre-1600	Pit
	Pit F4	0.235	3	pre-1600	Pit
	Pit F99	0.307	3	pre-1600	Pit
	Pit F119	0.586	4	pre-1600	Pit
	Pit F68	0.196	4	pre-1600	Pit
	Pit F97	0.179	4	pre-1600	Pit
Total	26 units	21.543			
Slant	Pit F48	0.275	1	post-1700	Pit
(32MO26)	Pit F71	0.163	1	post-1700	Other
	Pit F81	0.206	1	post-1700	Pit
	Unit 15	0.797	1	post-1700	Floor or Roof
	Unit 9	0.566	1	post-1700	Floor or Roof
	Pit F21	0.166	2	1600-1700	Pit
	Pit F41	0.789	2	1600-1700	Pit
	Pit F5	0.242	2	1600-1700	Pit
	Unit 11	0.300	2	1600-1700	Midden
	Unit 12/2	0.600	2	1600-1700	Midden
	Pit F10	0.127	3	pre-1600	Pit
	Pit F11	0.049	3	pre-1600	Pit
	Pit F51	0.370	3	pre-1600	Pit
	Pit F8	0.136	3	pre-1600	Pit
	Pit F92	0.371	3	pre-1600	Pit
	Unit 12/3	0.552	3	pre-1600	Midden
	Unit 16	0.271	3	pre-1600	Floor or Roof
	Unit 2	0.578	3	pre-1600	Midden
	Unit 3	0.442	3	pre-1600	Midden
Total	19 units	7.000			

Table A10. Data on 80 analytic units included in the four-site sample, continued.

Site	Analytic Unit	Volume (cu. m)	Site-specific Period (TP)	Regional Time Period	Deposit Type
Bypass	Pit F50	0.143	7	pre-1600[b]	Pit
(32MO291)	Pit F58	0.141	7	pre-1600[b]	Pit
	Midden F25	0.061	8	pre-1600[b]	Midden
	Pit F40	0.147	8	pre-1600[b]	Pit
	Pit F44	0.124	8	pre-1600[b]	Pit
	Pit F48	0.130	8	pre-1600[b]	Pit
	Midden F11	0.073	9	pre-1600[b]	Midden
	Pit F35	0.117	9	pre-1600[b]	Pit
	Pit F60	0.313	9	pre-1600[b]	Pit
	Pit F76	0.183	9	pre-1600[b]	Pit
Total	10 units	1.432			
Double Ditch	Md. B,X1213	1.531	1	post-1700	Midden and Earth
(32BL8)	Md. I2	2.972	1	post-1700	Midden
	Md. JJw	2.746	1	post-1700	Midden
	Md. P1,UP	1.278	1	post-1700	Midden and Earth
	Md. C1	2.178	2	1600-1700	Midden
	Md. D1e,UP	0.541	2	1600-1700	Midden
	Pit F605UP	1.532	2	1600-1700	Pit
	Pit F614	0.613	2	1600-1700	Pit
	Pit F623	0.463	2	1600-1700	Pit
	Md. E,LO	0.956	3	1600-1700	Midden and Earth
	Md. H	3.177	3	1600-1700	Midden and Earth
	Md. V,UP	2.829	3	1600-1700	Midden
	Pit F333	0.735	3	1600-1700	Pit
	Pit F706	1.009	3	1600-1700	Pit
	Pit F708	0.577	3	1600-1700	Pit
	Md. D1e,LO	0.828	4	pre-1600	Midden and Earth
	Md. F,LO	0.809	4	pre-1600	Midden and Earth
	Md. V,LO	1.646	4	pre-1600	Midden
	Pit F202	1.133	4	pre-1600	Other
	Pit F319	0.667	4	pre-1600	Pit
	Pit F320	0.720	4	pre-1600	Pit
	Pit F332	0.579	4	pre-1600	Pit
	Pit F616	1.003	4	pre-1600	Pit
	Pit F701	0.698	4	pre-1600	Pit
	Pit F704	0.469	4	pre-1600	Pit
Total	25 units	31.689			

[a] These units are reassigned to the 1600-1700 regional time period based on the presence of metal cutmarks on bone; Pit F133 originally was included in TP3 and Block 1, Lower originally was included in TP4. See Ahler and Falk (2002:13.40-13.41) for additional information.
[b] Analytic units from Bypass Village are combined with other pre-1600 contexts for stone tool analysis, but segregated for the pottery analysis.

To enable between-site comparisons, I assign each of the site-specific time periods defined by the original investigators to one of three broad regional time periods. Table A11 summarizes the relationships between each local time period and the regional time periods.

Table A11. Synonymy between site-specific (TP) and regional time periods.

	Regional Time Period		
Site	post-1700	1600-1700	pre-1600
Double Ditch	TP1 (1675-1700)	TP2 (1650-1700)	TP4 (1490-1600)
		TP3 (1600-1650)	
On-A-Slant	TP1 (1725-1785)	TP2 (1625-1725)	TP3 (1575-1625)
Scattered		TP1 (1650-1700)	TP3 (1550-1600)
		TP2 (1600-1650)	TP4 (1550-1600)
Bypass			TP7 (1415-1460)
			TP8 (1415-1460)
			TP9 (1415-1460)

Data Collection

I used paper coding sheets designed for the purpose to record data on the stone tools and pottery vessels associated with the chosen analytic units. A portion of the metric data on the pottery assemblage from Double Ditch Village was collected electronically, using an input tool connected to a digital caliper. A uniform dataset was collected on each batch of artifacts; however, because data on some variables already had been collected by the original investigators, the scope of the effort varied somewhat by site. To ensure data comparability I systematically checked existing data, adjusting attribute codes or measurements as necessary.

Data recorded on the code sheets were then entered into Microsoft Access 2003 tables. I ran a series of cross-tabulations on the data tables for each site to search for potential data entry or coding errors. When suspect values were identified, the artifact in question was re-examined and recoded as necessary. I then built queries combining the artifact data with provenience and other data for each analytic unit. Queries for each site were exported to PASW Statistics 17.0, where they were combined into two tables, one for the stone tool data and one for the pottery data.

To minimize the effects of certain kinds of observer bias I randomized data collection across sites and time periods. To do so, I successively coded batches from different sites and kept information about the time periods to which each batch was assigned separate from the

spatial data. I also alternated my efforts between large and small batches. After the initial phase of data collection, I re-examined the first group of batches I coded to check for the possibility of classificatory drift. In addition, I selectively re-examined data on certain variables to confirm the consistency of my observations.

Stone Tool Analysis

The chipped stone tools I examined for this study include all of the small patterned bifaces, large patterned bifaces, and unpatterned bifaces associated with the 80 analytic units in the four-site subsample (see table 18 in chapter 6 for tool class definitions). I used a variety of methods to isolate tools in these three technological classes, depending on the site. For Scattered, On-A-Slant, and Bypass villages, the procedure was relatively straightforward: I used existing data to tabulate tools in the technological classes of interest, then extracted them from the larger aggregate of stone tools for further study. Some artifacts were individually labeled, but for the most part this process required me to examine all of the tools in each batch and use various kinds of information to identify the items in the initial tabulation. During the course of this initial sort I discovered that the technological class definitions applied by different analysts varied slightly. As a consequence, a few items were either added to or eliminated from the initial tabulation. I used the RECODE variable to capture these changes (see table A13 for a list of stone tool variables). Later, I used these data to adjust the aggregate counts of stone tools in all technological classes for each site; this adjustment is described in chapter 6. The procedure for extracting a subset of artifacts for detailed study from the Double Ditch Village collection was somewhat more laborious. Technological class data only are available for the collection obtained during the 2003 field investigation. For the 2002 and 2004 collections I examined all of the chipped stone tools, setting aside artifacts in the three technological classes of interest.

Each of the resulting artifact subsets included a small number of much older items

brought back to the villages by their Plains Village occupants. Some of these artifacts are quite old: the Double Ditch Village subset, for instance, included the base of a Folsom point. Others likely are Archaic in age, judging by their pronounced patination. I removed these items from the aggregates examined in the detailed study. I also limited my study to artifacts in the size grades 1 through 3 fractions. Table A12 summarizes the spatial and temporal distribution of the stone tools batches in the four-site subsample.

Methods and Variables

The basic approach to stone analysis I take in this project was developed by Ahler over the course of nearly 40 years. The roots of Ahler's system can be traced to his study of the Rogers Shelter collection in the late 1960s (Ahler 1971). He greatly expanded the scope of the system for his dissertation research, which focused on two Extended Coalescent sites located in the Grand-Moreau region (Ahler 1975a, 1975b). Ahler and his colleagues further refined the method during a lengthy series of projects carried out in North Dakota involving Plains Village as well as earlier occupations (Ahler 1986, 1989a, 1989b, 1992, 1995, 2002b; Ahler, Kellet, and Crawford 2003; Ahler, Minor, and Smail 1997; Ahler, Ritter, and Crawford 2003; Ahler, Root, and Feiler 1994; Ahler and Toom 1993).

Ahler's attribute-based system partitions material variation into three principal dimensions: technology, function, and morphology or style. Because this study is concerned mainly with stone tool production, including manufacturing techniques and stages, raw materials, and production errors, I focused my data collection efforts on the first of Ahler's three dimensions. The most important production variable is technological class. A tool's technological class is defined primarily by the dominant method used in its production and secondarily by the initial form of the raw material (Ahler, Root, and Feiler 1994). Each class encompasses a sequence of techniques used to produce a tool. Production steps may be complex and sequential

Table A12. Stone tool sample size data.

Site	Analytic Unit	Volume (cu. m)	Site-specific Period (TP)	Regional Period	Sample Size
Scattered	Block 8 House Floor	0.774	1	1600-1700	4
	Block 8 House Roof	0.910	1	1600-1700	10
	Pit F120	1.109	1	1600-1700	53
	Pit F127	1.302	1	1600-1700	26
	Pit F132	1.486	1	1600-1700	53
	Pit F14	0.837	1	1600-1700	32
	Pit F26	1.020	1	1600-1700	39
	Block 1 Lower Midden	1.592	2	1600-1700	74
	Block 1 Upper Midden	2.197	2	1600-1700	66
	Block 6 House Floor	1.067	2	1600-1700	9
	Block 6 House Roof	2.080	2	1600-1700	36
	Pit F133	0.405	2	1600-1700	10
	Pit F140	0.061	2	1600-1700	2
	Pit F142	0.360	2	1600-1700	9
	Pit F144	0.134	2	1600-1700	1
	Pit F178	0.958	2	1600-1700	15
	Pit F47	0.810	2	1600-1700	29
	Pit F73	0.341	2	1600-1700	17
	Block 3 House Floor	1.628	3	pre-1600	24
	Pit F101	0.509	3	pre-1600	57
	Pit F104	0.460	3	pre-1600	48
	Pit F4	0.235	3	pre-1600	8
	Pit F99	0.307	3	pre-1600	5
	Pit F119	0.586	4	pre-1600	6
	Pit F68	0.196	4	pre-1600	10
	Pit F97	0.179	4	pre-1600	4
Total	26 studied units	16.356			647
Slant	Pit F48	0.275	1	post-1700	23
	Pit F71	0.163	1	post-1700	5
	Pit F81	0.206	1	post-1700	15
	Unit 15	0.797	1	post-1700	16
	Unit 9	0.566	1	post-1700	10
	Pit F21	0.166	2	1600-1700	3
	Pit F41	0.789	2	1600-1700	70
	Pit F5	0.242	2	1600-1700	17
	Unit 11	0.300	2	1600-1700	8
	Unit 12/2	0.600	2	1600-1700	22
	Pit F10	0.127	3	pre-1600	2
	Pit F11	0.049	3	pre-1600	[3]
	Pit F51	0.370	3	pre-1600	12
	Pit F8	0.136	3	pre-1600	1
	Pit F92	0.371	3	pre-1600	4
	Unit 12/3	0.552	3	pre-1600	12
	Unit 16	0.271	3	pre-1600	4
	Unit 2	0.578	3	pre-1600	5
	Unit 3	0.442	3	pre-1600	3
Total	19 studied units	7.000			235

Table A12. Stone tool sample size data, continued.

Site	Analytic Unit	Volume (cu. m)	Site-specific Period (TP)	Regional Period	Sample Size
Bypass	Pit F50	0.143	7	pre-1600	25
	Pit F58	0.141	7	pre-1600	8
	Midden F25	0.061	8	pre-1600	24
	Pit F40	0.147	8	pre-1600	26
	Pit F44	0.124	8	pre-1600	12
	Pit F48	0.130	8	pre-1600	2
	Midden F11	0.073	9	pre-1600	2
	Pit F35	0.117	9	pre-1600	11
	Pit F60	0.313	9	pre-1600	6
	Pit F76	0.183	9	pre-1600	13
Total	10 studied units	1.432			129
Double Ditch	Md. B,X1213	1.531	1	post-1700	68
	Md. I2	2.972	1	post-1700	96
	Md. JJw	2.746	1	post-1700	65
	Md. P1,UP	1.278	1	post-1700	21
	Md. C1	2.178	2	1600-1700	78
	Md. D1e,UP	0.541	2	1600-1700	38
	Pit F605UP	1.532	2	1600-1700	54
	Pit F614	0.613	2	1600-1700	52
	Pit F623	0.463	2	1600-1700	23
	Md. E,LO	0.956	3	1600-1700	22
	Md. H	3.177	3	1600-1700	21
	Md. V,UP	2.829	3	1600-1700	175
	Pit F333	0.735	3	1600-1700	4
	Pit F706	1.009	3	1600-1700	18
	Pit F708	0.577	3	1600-1700	34
	Md. D1e,LO	0.828	4	pre-1600	56
	Md. F,LO	0.809	4	pre-1600	9
	Md. V,LO	1.646	4	pre-1600	72
	Pit F202	1.133	4	pre-1600	9
	Pit F319	0.667	4	pre-1600	8
	Pit F320	0.720	4	pre-1600	16
	Pit F332	0.579	4	pre-1600	19
	Pit F616	1.003	4	pre-1600	40
	Pit F701	0.698	4	pre-1600	23
	Pit F704	0.469	4	pre-1600	18
Total	25 studied units	24.271			1039

or simple and expedient. For example, patterned small thin bifaces are produced by the staged application of pressure flaking to flake blanks or tabular pieces of stone. Flake tools, by contrast, exhibit nothing more than simple edge modification.

Because unfinished tools are classified according to the inferred final product, assessment

of technological class requires a series of interconnected judgments about the actual methods used to manufacture a tool as well as the desired or intended outcome of the manufacturing process. Determinations about manufacturing stage and technological trajectory also depend in part on the concept of "patternedness." Patterned tools exhibit bilateral symmetry. By contrast, the form of an unpatterned tool is determined largely by the shape of the original input blank and frequently is irregular. Most of the other variables I studied relate to aspects of production technology, though I also collected metric and nominal data on aspects of artifact morphology and nominal data on tool function. A list of the variables coded in this analysis is given in tables A13 and A14. Figure A2 illustrates the locations of measurements made on Plains side-notched arrowpoints.

Table A13. Variables and attributes used in the stone tool study.

SITE	site number	
105-Slant Village 202-Scattered Village 203-Double Ditch Village 291-Bypass Village		
LOCUS	analytic unit	
TP	site-specific time period (see table A3.1 for references)	
PERIOD	regional time period	
1- post-1700 2- 1600-1700		3- pre-1600 4- 1400-1450
CONTEXT	deposit type	
1- pit 2- midden 3- midden and earth		4- floor or roof 5- other
CATNO	catalog number	
TOOLID	unique object identifier	
SIZE	size grade	
1- size grade 1 (> 1 inch) 2- size grade 2 (1 inch>1/2 inch)		3- size grade 3 (1/2 inch>1/4 inch)
TECH	technological class (detailed study limited to artifacts in classes 1, 2, and 3)	
1- patterned small thin biface **2- patterned large thin biface** **3- unpatterned small to medium biface** 4- patterned steeply beveled flake tool 5- unpatterned other flake tool, retouched or use-modified 6- large, thick bifacial core-tool		7- nonbipolar core and core-tool 8- bipolar core and core-tool 9- unpatterned pecked or ground tool 10- patterned pecked or ground tool 11- radial break tool 12- retouched tabular piece or plate

Table A13. Variables and attributes used in the stone tool study, continued.

RAWM	raw material type	
1- smooth gray Tongue River silicified sediment		28- Knife River flint
2- coarse yellow Tongue River silicified sediment		29- Rainy Buttes silicified wood
3- coarse red Tongue River silicified sediment		30- tough gray-green chert
4- solid quartzite (fine-grained orthoquartzite)		31- blonde French flint
5- Swan River chert (porous quartzite)		32- Thames River (Dover) flint
6.0- miscellaneous jasper/chert		33- light yellow pigment stone
6.5- dendritic yellow (no longer used)		34- historic period glass
6.6- dendritic red (no longer used)		35- metaquartzite (not class 4)
6.7- dendritic chert (all colors)		36- scoria
7- White River Group silicates		37- siltstone/limestone/mudstone
8- clear/gray chalcedony (not obvious silicified wood)		38- steatite
9- yellow/light brown chalcedony (not obvious silicified wood)		39-
10- dark brown chalcedony (non-KRF, non-silicified wood)		40- non-volcanic natural glass
11- plate chalcedony		41- opal
12- burned chalcedony, not identifiable (no longer used)		42- felspar
13- basaltic material		43-
14- other unclassifiable		50- Charlie Creek chert
15- Bijou Hills silicified sediment		51- Miocene flint (Sentinel Butte flint)
16- milk or vein quartz		52- obvious silicified wood
17.1- porcellanite (gray)		53- moss agate
17.2- porcellanite (red or purple)		54- Antelope chert
18- obsidian (any source)		55- gray silcrete (non-Tongue River types)
19- granitic material		56- Scenic chalcedony
20- coarse porous sandstone		57- Hartville Uplift chert (no longer used)
21- compact sandstone		58- Yellowstone agate (no longer used)
22- fossil or concretion		59- Turtle Valley orthoquartzite (not used w/ Slant)
23- clinker		60-68-
24- catlinite		69- Schmidtt chert (not used w/Slant)
25- hematite (red ochre)		70- shist
26- limonite (yellow ochre)		71- Hixton silicified sandstone
27- gypsum		72-
RMGRP	raw material group	
1- near-local southwest		4- exotic southwest
2- near-local west		5- exotic west
3- near-local northwest		6- coarse local
BURN	burning	
0- absent		9- indeterminate
1- present		
HEAT	heat treatment	
0- absent		2-definitely present
1- possibly present		9-not applicable due to raw material or indeterminate

Table A13. Variables and attributes used in the stone tool study, continued.

CLASS	morphological class	
1- bipointed biface		56- acute snap break with crack
2- triangular, symmetrical biface		57- transverse hinge
3- triangular, asymmetrical biface		58- transverse lip
4- ovoid biface		59-
5- ovoid, pointed biface		61- irregular
6- rectangular biface		62-
7- crescent-shaped biface		71- complex patterned ground stone tool
8- notched crescent		72- complex core-tool form
9- asymmetrical biface with notched haft element		73- bead
10- hafted drill form		74- grooved maul form
11- ovoid biface fragment		75- celt form
12- triangular or rectangular biface fragment		76- sphere
13- pointed biface fragment		77- paired grooved abrader form; shaft smoother
14- drill tip fragment		78- unpaired grooved abrader form
15- indeterminate biface fragment		79- pipe
16- side-hafted knife		80- grooved ax form
21- generalized end scraper form (unspurred)		101-159- various Paleoindian and Archaic point forms
22- spurred or angled end scraper		144- misc. Late Plains Archaic
23- double ended end scraper form		161- small, tanged, eared side-notched point
24- bilaterally symmetrical, side-notched end scraper form		162- small, shallow side-notched point
25- hafted beak form		163- Avonlea point
26-		164-
31- unpatterned retouched flake, one working edge		171- Prairie Side-Notched arrow point
32- unpatterned retouched flake, two isolated working edges		172- Plains Side-Notched arrow point
33- unpatterned retouched flake, three isolated working edges		173- isosceles triangular arrow point
34- unpatterned retouched flake, two connecting edges		174- tri-notched arrow point
35- unpatterned retouched flake, three connecting edges		175- other miscellaneous arrow point forms
36-		176- oversized Plains side-notched arrowpoint form
41- unpatterned utilized flake, one working edge		179- arrow point fragments
42- unpatterned utilized flake, two isolated working edges		
43- unpatterned utilized flake, three isolated working edges		
44- unpatterned utilized flake, two connecting working edges		
45- unpatterned utilized flake, three connecting working edges		
46-		
51- transverse snap break without crack		
52- transverse snap break with crack		
53- obtuse snap break without crack		
54- obtuse snap break with crack		
55- acute snap break without crack		

COMP	completeness	
1-complete		6-indeterminate end
2-nearly complete, primary part of core or tested raw material		7-margin fragment
3-distal end		8-
4-proximal end		9-other fragment
5-medial fragment or segment		

Table A13. Variables and attributes used in the stone tool study, continued.

BLANK	original input blank form	
1-tabular cobble/pebble (>10 mm thick; w/th ratio >2.5)		12-other nonbipolar flake from prepared core; platform ground and/or dorsally reduced
2-thin plate (thickness < 10 mm)		13-finished patterned biface used as blank
3-subrounded, rounded, spherical cobble or pebble		14-unfinished patterned biface used as blank
4-blocky/angular cobble or pebble (thickness >10 mm; w/th ratio < 2.5)		15-unpatterned flake tool or ret. tabular piece used as blank
5-split cobble		16-patterned flake tool used as blank
6-other nonbipolar flake, with no platform present or with unprepared platform present		17-simple flake (code 24 used with Scattered Village)
7-bifacial thinning flake		18-complex flake (code 25 used with Scattered Village)
8-bipolar flake		19-non-bipolar core or core fragment
9-blade or bladelet		20-bipolar core
10-shatter		21-fire-cracked rock
11-indeterminate		22-unpatterned biface
		23-complex/patterned ground stone tool
FUNC	functional class (see Ahler 2002b for a complete list of codes)	
0-unknown function; also radial tools which show no wear		47-nonutilitarian item of uncertain specific function
1-projectile point		53-edge or corner ground tool
2-perforator, drill		56-practice pieces and miscellaneous chipped stone tool
3-light duty bilateral cutting tool		71-wood working adz
5-basal scraper/grinder		72-lance tip or symbolic weapon tip
7-bilateral, heavy duty 1 bifacial cutting tool		74-chipped marble-like object
8-expedient, general purpose cutting tool		99-unknown due to fracture
9-heavy duty 3 ripping, sawing, tearing tool		
10-heavy duty 1 asymmetrical or unilateral bifacial cutting tool		
11-stone saw		
12-bifacial cutting tool used on hard material		
13-lateral scraper used on soft material		
15-generalized patterned bifacial cutting tool		
18-denticulated flake or edge modified tool		
23-retouched or utilized flake used on variable material		
26-punch/wedge/chisel		
31-tested raw material		
USEPH	use-phase class	
1-unfinished, usable (unbroken)		3-finished, usable (unbroken; includes usable cores)
2-unfinished, unusable (broken or rejected)		4-finished, unusable (broken, burnt, exhausted, rejected; includes exhausted cores)
REJECT	reason for rejection, failure, disuse	
1-has potential for further work or use		10-heat or thermal fracture
2-bending fracture or end shock		11-lateral break
3-perverse fracture		12-broken by radial fracture
4-material flaw or poor quality stone		13-crescentic chunk from tool margin
5-outré-passé fracture		14-channel flake or fragment
6-compound hinge/step occurrence		15-recycled into another form or use, by bipolar process
7-impact fracture		16-burination spall
8-small size or exhaustion		17-resharpening flake coded as a tool; no further use possible
9-indeterminate		18-recycled into another form or use, by non-bipolar process
CASE	case number, for single and mutiple records for a single artifact	
1-first record and case for the artifact		2-second record and case for the artifact (implies different technological class)
RECY	recycling	
0-absent		1-present

Table A13. Variables and attributes used in the stone tool study, continued.

STAGE	reduction stage	
2- initial edging (Tech 1 and 2)		5- notching (Tech 1 only)
3- initial or primary thinning (Tech 1 and 2)		6- resharpening (Tech 1 only)
4- secondary or final thinning (Tech 1 and 2)		7- recycling (Tech 1 only)
		9- Tech 3 or indeterminate
GRIND	basal grinding	
0- no preparation		3- basal and lateral grinding
1- basal grinding		9- broken away
2- lateral grinding		
SKILL	production skill	
1- mindless flaking (not used for Tech 1-3)		4- average
2- limited		5- high
3- moderate		9- indeterminate
RECODE	new technological class	
same as TECH		
WEIGH	weight to 0.1 gram	
LENG	maximum length to nearest 0.1 mm	
WIDE	maximum width to nearest 0.1 mm	
THICK	maximum thickness to nearest 0.1 mm	
DHEL	distal haft element length to nearest 0.1 mm (DISHAFLN in Ahler and Toom 1993)	
BLADE	blade element length to nearest 0.1 mm (BLADLNG in Ahler and Toom 1993)	
DHEW	distal haft element width to nearest 0.1 mm (DISTWID in Ahler and Toom 1993)	
PHEW	proximal haft element width to 0.1 mm (PROXWID in Ahler and Toom 1993)	
BASEWID	blade base width to nearest 0.1 mm (BASEWID in Ahler and Toom 1993)	
NOTWID	notch width to nearest 0.1 mm (NOCHWID in Ahler and Toom 1993)	
NOTDP	notch depth to nearest 0.1 mm (NOCHDEP in Ahler and Toom 1993)	
COMMENT	1- comment exists, recorded outside dataset on note sheets	

Complete definitions of most of the variables I coded are provided in Ahler (2002b), Ahler, Kellet, and Crawford (2003), Ahler, Root, and Feiler (1994), Ahler and Toom (1993), and Root and others (1999). Here, I describe slight modifications I made to the definitions of a few variables and provide definitions for two variables new to this study.

Modified Variables

Basal Grinding (GRIND). Ahler and Toom (1993) recorded the presence or absence of haft element grinding in their study of projectile points in the KNRI regional collections. Here, I

Table A14. Metric variables recorded on patterned bifaces.

Key	Variable	Description
—	WIDE	Maximum width; recorded only if original maximum width is present
—	THICK	Maximum thickness; recorded only if maximum width can be measured
a	LENG	Total length; recorded only if artifact is complete
c	DHEL	Distal haft element length
b	BLADE	Blade element length
f	DHEW	Distal haft element width
e	PHEW	Proximal half element width
g	BASEWID	Blade base width
i	NOTWID	Mean notch width
j	NOTDP	Mean notch depth; measured on distal end of haft

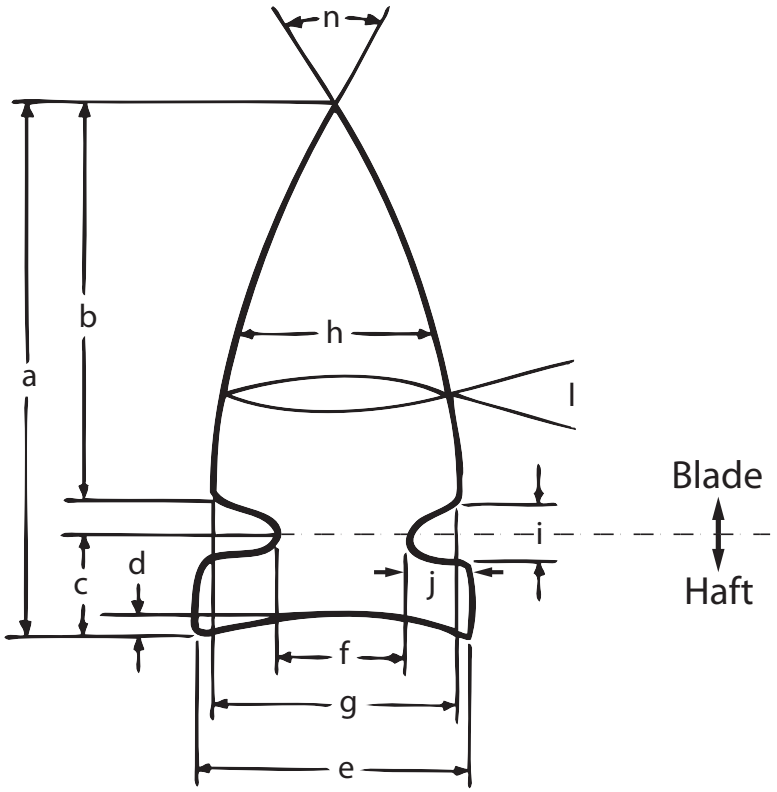

Figure A2. Generalized drawing of a Plains side-notched arrowpoint showing measurement locations.

expand the attribute set to include three distinct modes of basal grinding. A GRIND code only is assigned to artifacts in CLASS codes 172, 173, 175, and 176.

Maximum Length (LENG), Maximum Width (WIDE), and Maximum Thickness (THICK).

Each of these measurements only was recorded when the specimen was complete enough to determine whether the original maximum dimension is preserved.

Morphological Class (CLASS). A specimen only is assigned to one of the arrowpoint classes (CLASS codes 172, 173, 175, or 176) if it is finished (USEPH codes 3 or 4). Unfinished arrowpoints (USEPH codes 1 or 2) and all proximal fragments are assigned to CLASS code 179.

Newly Defined Variables

Reduction Stage (STAGE). Because different knapping techniques are appropriate to different stages in the manufacturing process I assigned each tool in the study to a reduction stage class. I used the classes defined by Callahan (1979) for technological class 2 tools (large patterned bifaces) and by Ahler (1992) for technological class 1 tools (small patterned bifaces). No reduction stage sequence is available for unpatterned bifaces (technological class 3). Because many of the specimens in the four-site subsample are fragmented, I focused especially on edge angle, edge sinuosity, and the placement of flake removals to make reduction stage assignments.

The stage codes interact in complex ways with the use-phase codes. For small patterned bifaces, reduction stage is equivocal in distal fragments; I often assigned such fragments (in CLASS code 179) to STAGE code 4, unless there was clear evidence that the object was unfinished (USEPH code 1 or 2). Some large patterned bifaces assigned to STAGE code 2 or 3 exhibit use wear and so are put into USEPH code 3 or 4.

Production Skill (SKILL). In the Heart region, a production skill measure was first coded for a sample of tools from Boley Village (Ahler, Burns, and Madden 2006). Here, I modify the attribute definitions slightly (table A15). As I lay out in more detail in chapter 6, the skill classes are based on object symmetry and on the rate and severity of production errors. Large and small patterned bifaces are assessed separately, with the skill assessments tied to reduction stage. SKILL code 1 (mindless flaking) is not used to assess production proficiency for specimens

Table A15. Stone tool production skill categories.

Code	Definition
1	Mindless flaking. Haphazard battering producing no usable flakes or effective tool edges. Coded only for technological class 7 objects (cores and tested raw material).
2	Limited knowledge of fracture mechanics. Characterized the presence of numerous knapping errors, including stacked step fractures, hinge fractures, poor platform placement, multiple hammer strikes, and so forth. Tool is usually asymmetrical, in plan or cross-section.
3	Moderate knapping ability. Some knapping errors (such as step fractures or poor platform placement). Errors likely limited the recyclability or use life of the tool, but not its initial function. Poorly sequenced flake removals. Some tools in this class are asymmetrical.
4	Average knapping ability. Effective use of appropriate knapping techniques, but a few errors may be present. Tool has a regular or symmetrical plan and cross-section.
5	Advanced knapping ability. Efficient use of percussion or pressure techniques to produce a symmetrical, well-designed tool. Attention to detail in platform preparation and flake removal. No knapping errors evident.
9	Indeterminate or not applicable. The object is too small or fractured/burned to determine the skill level. This code is also used when skill is not expressed in the manufacture of the object, for instance in a bipolar wedge.

assigned to TECH codes 1, 2, or 3. SKILL code 5 is only assigned to specimens in USEPH 3 or 4 (finished items), because items broken during manufacture by definition exhibit at least one fatal production error. The validity of the skill assessments for unpatterned bifaces (TECH code 3) is uncertain, given the absence of a reduction stage sequence model; accordingly, those data are not incorporated into the analysis.

Pottery Analysis

The ceramic vessels comprising the four-site subsample come from 71 of the 80 analytic units originally defined for the project. The remaining nine units, three from Scattered Village and six from Double Ditch Village, were excluded either because the pottery associated with them was especially fragmented or because they effectively duplicated the content of other analytic units.

Prior to analysis, rim sherd batches from each analytic unit were subjected to an intensive refitting effort. In some instances, parent vessels were created by physically joining individual rim sherds. More commonly, though, a laborious process of "vesselization" was used, where

rims exhibiting similar formal, technological, and decorative attributes are combined into a virtual parent vessel. All the size grades 1 and 2 rims from each analytic unit were examined simultaneously and only rims exhibiting substantial or marked similarities were combined. In some cases, size grade 3 rim or neck sherds were combined with other larger or more complete sherds to form a single vessel. However, none of the studied vessels are composed exclusively of size grade 3 sherds. The decision to exclude rims in this small size grade likely introduces a number of biases. Anecdotal data on Heart region pottery collections from several sites suggests that rims sherds from small, straight-rim pots are more common in the size grade 3 fraction than they are in larger fractions. These vessels include small, special-purpose pots as well as undersized practice pieces made by children or novices. The magnitude of this bias likely varies by time period and deposit type. Assemblages dating to the 1400s usually include more of the unbraced, straight-rim vessels that are likely to be underrepresented in the largest size grades. Such vessels may also be underrepresented in highly fragmented assemblages, such as those from midden deposits subject to repeated trampling. I examined these issues to a limited extent during the Larson Village analysis (Mitchell, Madden, and Ahler 2007), but for the most part the practical effects of this type of bias are not known. However, the large number of rim fragments in the size grade 3 fraction makes it impossible to include them in a detailed stylistic or technological analysis and in any case their small size limits their usefulness in such studies.

A subset of the vessels from each analytic unit was then selected for detailed study. Previous research on Heart region pottery technology shows that rim fragments, especially those consisting of just one zone, provide limited and often equivocal technological data (Ahler, Madden, and Mitchell 2006). For that reason, this study excludes vessels represented only by rim fragments, including rim form classes 1, 15, 16, 19, 20, 21, 26, and 27. (A complete list of rim form classes is presented in table A19). Vessels represented only by these rim form classes can make up 10 to 40 percent of each analytic unit's assemblage, depending on the processes responsible for its deposition; in general, such vessel fragments are more common in

midden contexts than in pit contexts. One practical effect of the decision to exclude such vessel fragments from the analysis is that the proportions of each ware and variety class reported here differ somewhat from the proportions reported by the original site investigators. The difference is due to the fact that, under the standard ceramic analysis procedures used for the study of northern Middle Missouri collections, fragments of S-rim vessels usually are assigned to a ware class (and often to a variety group as well), while fragments of straight-rim forms are not. Tables A16, A17, and A18 summarize the spatial and temporal distribution of the pottery vessels in the four-site subsample.

Table A16. Pottery vessel provenience and sample size data.

Site	Locus	Volume (cu. m)	Site-specific Period (TP)	Regional Period	Sample Size	Excluded Vessels[a]	Total[b]
Scattered	Block 8 House Floor	0.774	1	1600-1700	13	2	15
	Block 8 House Roof	0.910	1	1600-1700	not studied		(23)
	Pit F120	1.109	1	1600-1700	46	9	55
	Pit F127	1.302	1	1600-1700	34	8	42
	Pit F132	1.486	1	1600-1700	67	14	81
	Pit F14	0.837	1	1600-1700	47	15	62
	Pit F26	1.020	1	1600-1700	29	10	39
	Block 1 Lower Midden	1.592	2	1600-1700	70	42	112
	Block 1 Upper Midden	2.197	2	1600-1700	not studied		(114)
	Block 6 House Floor	1.067	2	1600-1700	24	5	29
	Block 6 House Roof	2.080	2	1600-1700	not studied		(76)
	Pit F133	0.405	2	1600-1700	18	1	19
	Pit F140	0.061	2	1600-1700	3	2	5
	Pit F142	0.360	2	1600-1700	13	3	16
	Pit F144	0.134	2	1600-1700	2	0	2
	Pit F178	0.958	2	1600-1700	31	7	38
	Pit F47	0.810	2	1600-1700	25	5	30
	Pit F73	0.341	2	1600-1700	21	8	29
	Block 3 House Floor	1.628	3	pre-1600	14	4	18
	Pit F101	0.509	3	pre-1600	12	6	18
	Pit F104	0.460	3	pre-1600	13	5	18
	Pit F4	0.235	3	pre-1600	13	3	16
	Pit F99	0.307	3	pre-1600	7	1	8
	Pit F119	0.586	4	pre-1600	13	7	20
	Pit F68	0.196	4	pre-1600	7	10	17
	Pit F97	0.179	4	pre-1600	5	2	7
Total	23 studied units	16.356			527	169	696 (909)

Table A16. Pottery vessel provenience and sample size data, continued.

Site	Locus	Volume (cu. m)	Site-specific Period (TP)	Regional Period	Sample Size	Excluded Vessels[a]	Total[b]
Slant	Pit F48	0.275	1	post-1700	17	10	27
	Pit F71	0.163	1	post-1700	5	6	11
	Pit F81	0.206	1	post-1700	10	5	15
	Unit 15	0.797	1	post-1700	26	14	40
	Unit 9	0.566	1	post-1700	10	4	14
	Pit F21	0.166	2	1600-1700	7	9	16
	Pit F41	0.789	2	1600-1700	20	13	33
	Pit F5	0.242	2	1600-1700	7	2	9
	Unit 11	0.300	2	1600-1700	21	7	28
	Unit 12/2	0.600	2	1600-1700	31	13	44
	Pit F10	0.127	3	pre-1600	7	5	12
	Pit F11	0.049	3	pre-1600	0	1	1
	Pit F51	0.370	3	pre-1600	13	4	17
	Pit F8	0.136	3	pre-1600	2	2	4
	Pit F92	0.371	3	pre-1600	4	8	12
	Unit 12/3	0.552	3	pre-1600	11	11	22
	Unit 16	0.271	3	pre-1600	8	6	14
	Unit 2	0.578	3	pre-1600	13	10	23
	Unit 3	0.442	3	pre-1600	6	3	9
Total	19 studied units	7.000			218	133	351
Bypass	Pit F50	0.143	7	1400s	14	2	16
	Pit F58	0.141	7	1400s	7	2	9
	Midden F25	0.061	8	1400s	8	1	9
	Pit F40	0.147	8	1400s	18	3	21
	Pit F44	0.124	8	1400s	4	0	4
	Pit F48	0.130	8	1400s	4	2	6
	Midden F11	0.073	9	1400s	6	2	8
	Pit F35	0.117	9	1400s	2	0	2
	Pit F60	0.313	9	1400s	11	1	12
	Pit F76	0.183	9	1400s	10	3	13
Total	10 studied units	1.432			84	16	100
Double Ditch	Md. B,X1213	1.531	1	post-1700	144	74	218
	Md. I2	2.972	1	post-1700	127	85	212
	Md. JJw	2.746	1	post-1700	65	44	109
	Md. P1,UP	1.278	1	post-1700	not studied		n/a[c]
	Md. C1	2.178	2	1600-1700	64	55	119
	Md. D1e,UP	0.541	2	1600-1700	not studied		(83)
	Pit F605UP	1.532	2	1600-1700	63	33	96
	Pit F614	0.613	2	1600-1700	36	21	57
	Pit F623	0.463	2	1600-1700	29	20	49
	Md. E,LO	0.956	3	1600-1700	34	40	74
	Md. H	3.177	3	1600-1700	40	36	76
	Md. V,UP	2.829	3	1600-1700	not studied		(121)
	Pit F333	0.735	3	1600-1700	17	6	23
	Pit F706	1.009	3	1600-1700	18	7	25
	Pit F708	0.577	3	1600-1700	15	4	19
	Md. D1e,LO	0.828	4	pre-1600	not studied		(136)
	Md. F,LO	0.809	4	pre-1600	not studied		(47)

Table A16. Pottery vessel provenience and sample size data, continued.

Site	Locus	Volume (cu. m)	Site-specific Period (TP)	Regional Period	Sample Size	Excluded Vessels[a]	Total[b]
	Md. V,LO	1.646	4	pre-1600	56	32	88
	Pit F202	1.133	4	pre-1600	not studied		(37)
	Pit F319	0.667	4	pre-1600	17	7	24
	Pit F320	0.720	4	pre-1600	20	9	29
	Pit F332	0.579	4	pre-1600	38	23	61
	Pit F616	1.003	4	pre-1600	27	10	37
	Pit F701	0.698	4	pre-1600	30	17	47
	Pit F704	0.469	4	pre-1600	16	17	33
Total	19 studied units	24.271			856	540	1396 (1820)

[a] Unstudied vessels comprise excluded rim forms and a small number of vessels represented only by size grade 3 sherds.
[b] The total number of vessels from analytic units excluded from the pottery study is given in parenthesis.
[c] Md. P1,UP was not vesselized.

Table A17. Summary data on pottery vessel sample size by site.

Site	Number of Loci in Pottery Study	Vessel Sample (Percent of Total)	Unstudied Vessels	Total Vessels
Scattered	23	527 (76%)	169	696
Slant	19	218 (62%)	133	351
Bypass	10	84 (84%)	16	100
Double Ditch	19	856 (61%)	540	1396
Total	71	1685 (66%)	858	2543

Table A18. Summary data on pottery vessel sample size by regional time period.

Period	Number of Loci in Pottery Study	Vessel Sample (Percent of Total)	Unstudied Vessels	Total Vessels
post-1700	8	404 (63%)	242	646
1600-1700	29	845 (68%)	397	1242
pre-1600	34	436 (67%)	219	655
Total	71	1685 (66%)	858	2543

Methods and Variables

Like the methods used to analyze stone tools described previously, the general approach to pottery analysis taken here originally was developed by Ahler, who applied them first to collections from the Knife region (Ahler and Swenson 1985b). Ahler's attribute-based system

is structured around the concept of vessel "zones." Each zone designates a vertical segment of a vessel bounded by inflection points that mark changes in the direction of the curvature of the vessel wall (figure A3) (Ahler and Swenson 1985b:5-7). Seven zones occur on northern Middle Missouri vessels. Zone 1 is the body of the vessel and zone 7 is the lip; all vessels must exhibit at least these two zones. Zones 2 through 6 designate the distinctive features of particular ceramic forms and may or may not be present on any particular vessel. In an analysis of a rim sherd or vessel fragment assemblage, each item is assigned to a rim form class which is defined by a combination of vessel zones (figure A4). For instance, a bowl (rim form class 2) is defined by the presence of zones 1 and 7 only. A recurved S-rim vessel (rim form class 11) is defined by the presence of zones 1, 2, 3, 4, and 7.

The specific observations made on each rim or vessel fragment are tied to the zones that are present. So, for instance, data are collected on the surface treatment applied to zone 2 (the mouth or lower rim) or on the thickness of zone 3, the upper portion of an S-rim vessel. A list of the variables coded in this analysis is given in table A19. It is worth pointing out that the variables I used for this study include only a portion of those making up the KNRI analysis system. Excluded variables relate mainly to decorative patterns.

Ahler and other researchers have used this system to study a large number of pottery assemblages both the Knife and Heart regions. The steps involved in applying it, along with definitions of the constituent variables and attributes, are covered thoroughly in Ahler and Swenson (1985b, 1993), Ahler, Madden and Mitchell (2006), Ahler and Stanford (2004), Ahler, Warner, and Smail (2002), Mitchell, Madden, and Ahler (2007), and Speakman, Ahler, and Breakey (1997). Here, I define the variables developed or modified for this study.

Pottery Types

In part, Middle Missouri pottery types can be seen as classes, defined by necessary and

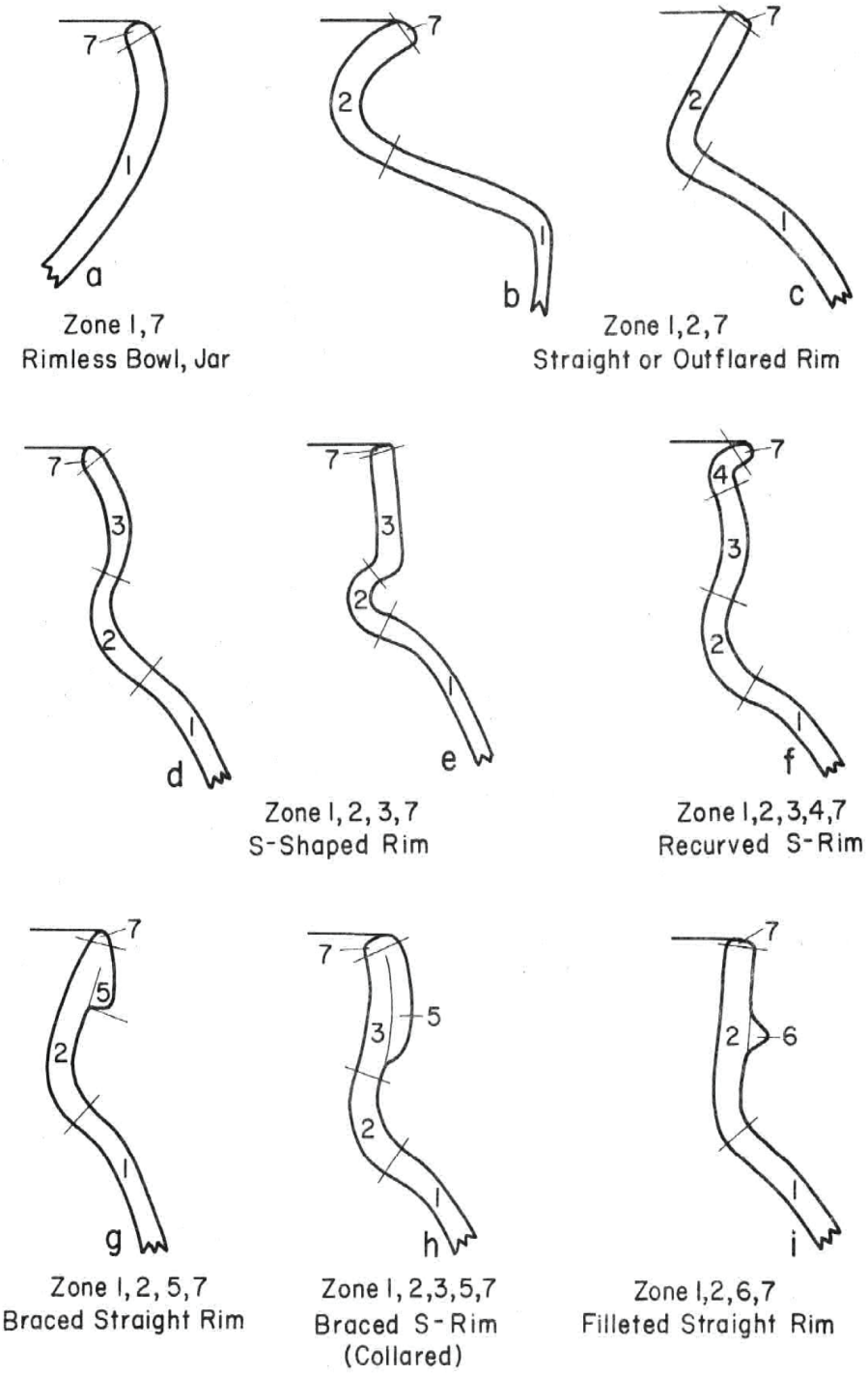

Figure A3. Examples of northern Middle Missouri rim profiles, showing vessel zones and inflection points; vessel exterior to the right (reproduced from Ahler and Swenson 1985:Figure 1).

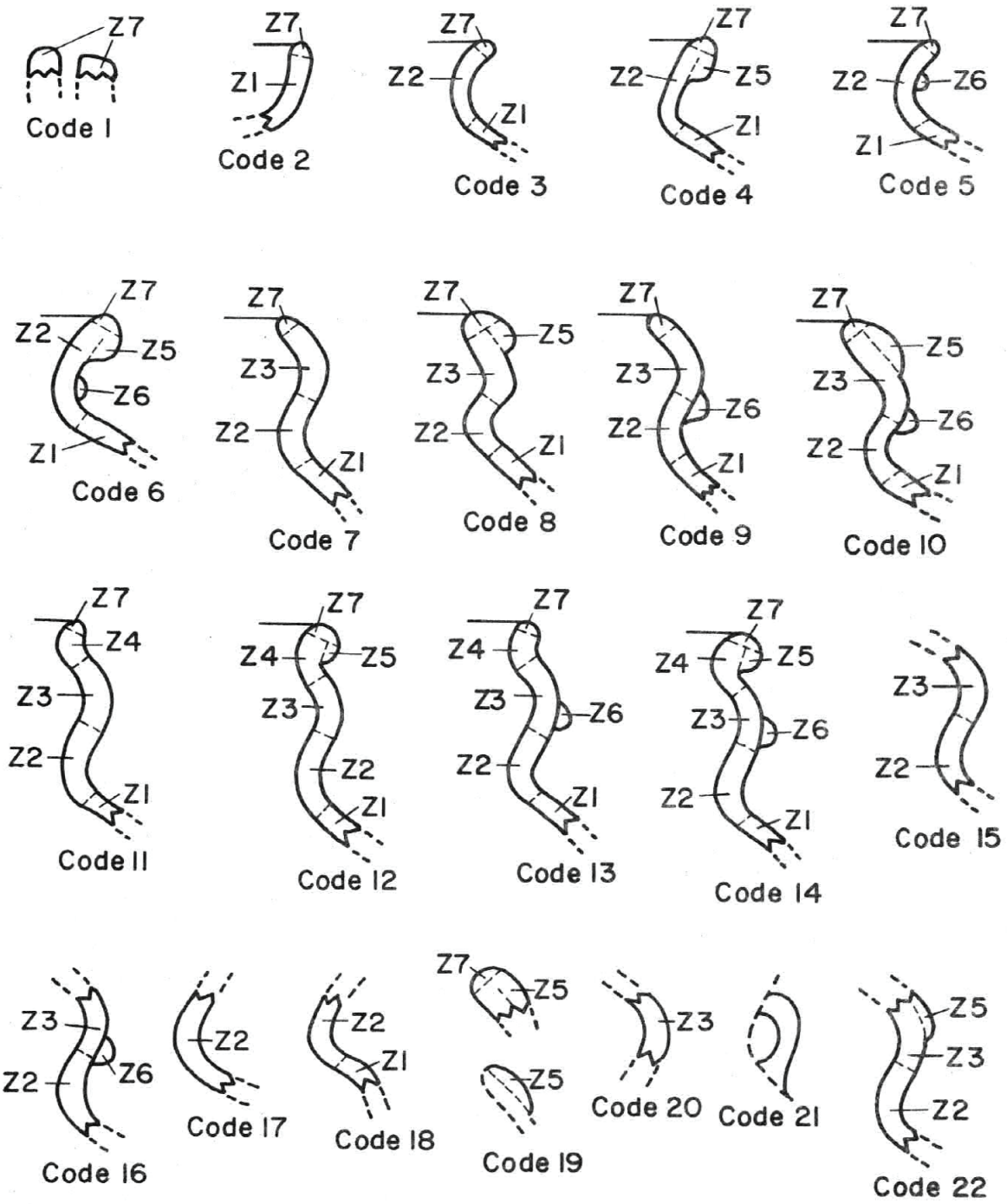

Figure A4. Drawings of rim sherd cross-sections for each rim form class, showing the zones present in each; vessel exterior to the right (reproduced from Ahler and Swenson 1985:Figure 2).

Table A19. Pottery analysis variables and attributes.

SITE	site number	
105-Slant Village 202-Scattered Village 203-Double Ditch Village 291-Bypass Village		
LOCUS	analytic unit	
PERIOD	regional time period	
1- post-1700 2- 1600-1700		3- pre-1600 4- 1400-1450
TP	site-specific time period (see table A3.1 for references)	
CONTEXT	deposit type	
1- pit 2- midden 3- midden and earth		4- floor or roof 5- other
VESSLNUM	unique object identifier	
CN	catalog number for largest sherd	
RIMFORM	rim form class based on zones present and their placement	
1- lip sherd (zone 7 only) 2- bowl or jar (zone 1+7 only) 3- straight or outflared rim (zone 1,2,7) 4- straight rim w/ brace (zone 1,2,5,7) 5- straight rim w/ fillet (zone 1,2,6,7) 7- S-rim (zone 1,2,3,7) 8- S-rim w/ exterior brace (zone 1,2,3,5,7) 9- S-rim w/ fillet (on interior)(zone 1,2,3,6,7) 11- recurved S-rim (zone 1,2,3,4,7) 12- recurved S-rim w/ exterior brace (zone1,2,3,4,5,7) 15- zone 2-3 fragment (zone 2,3 only) 16- zone 3 fragment w/ exterior brace (zone 3,5 only)		19- lip frag. w/ ext. brace (zone 5,7) or brace frag. only (z5) 20- zone 3 fragment (zone 3 only) 21- appendage only (no zone designation) 23- straight rim w/ interior brace(zone 1,2,5,7) 24- S-rim w/ interior brace(zone 1,2,3,5,7) 25- recurved S-rim w/ interior brace(zone 1,2,3,4,5,7) 26- zone 2-3 fragment w interior brace (zone 2,3,5) 27- lip fragment w/ interior brace (zone 5,7) 28- S-rim w/ interior and exterior brace (zone 1,2,3,5,7) 29- straight rim with ext. brace and fillet (zone 1,2,5,6)
ZONE3	condition and shape of zone 3	
1.0- prsnt, shape unknown 2.0- smoothly curved 2.3- slight uneven curve 2.6- uneven curve 3.0- angular		4- present, composite, angular shape 5- present, faintly S-shaped 6- 9- unobservable, broken away
ZONE5	condition and shape of zone 5	
0.0- zone not used 1.0- exterior curved 2.0- prsnt interior 2.1- interior curved 2.5- interior wedged 3.0- int & ext curved 3.1- ext & int curved		3.5- ext & int wedged 4.0- ext collared 5- present on exterior, wedge-shaped 6- present exterior, inverted wedge 7- present, interior, flat collared 8- present on exterior, shape unknown 9- unobservable, broken away
ZONE7	condition and shape of zone 7	
1- rounded 2- flattened 3- in-slanted 4- out-slanted 5- L-shaped 6- T-shaped 7- pointed		8- beaded, round 10- round beaded on exterior 11- round beaded on interior 12- inslanted, beaded interior and exterior 13- irregular 14 99- unobservable, broken away

Table A19. Pottery analysis variables and attributes, continued.

Z3DT	zone 3 decorative technique
0- zone not used on vessel	21- stab under tool
1- plain	22- stab over finger
2- cord-impressed	23- stab under finger
3- cord-wrapped-tool-impressed	24- dentate stamp over tool
4- tool-impressed	25- dentate stamp under tool
5- finger-impressed	26- dentate stamp over finger
6- trailed/incised	27- dentate stamp under finger
7- stab-and-drag	28- cord-wrapped tool over tool
8- dentate	29- cord-wrapped under over tool
9- bead-impressed, sgl	30- cord-wrapped tool over finger
10- bead-impressed, string	31- cord-wrapped tool under fingerf
11- compled	32- paddle-stamped
12- cord over tool	33- tool impression above paddle-stamped
13- cord under tool	34- cord above trailed/incised
14- cord over finger	35-
15- cord under finger	36-
16- trailed over tool	37-
17- trailed under tool	99- unobservable, broken away
18- trailed over finger	
19- trailed under finger	
20- stab over tool	
Z5DT	zone 5 decorative technique
same as Z3DT	
Z7DT	zone 7 decorative technique
same as Z3DT	
INTDT	interior zone 2-4 decorative technique
same as Z3DT	
TWIST	cord twist direction
0- present but indeterminate	2- Z-twist
1- S-twist	3-
	9- not applicable (not cord-impressed)
APEND	appendages or rim/lip modifications
1- node	8- pinched or wavy rim
2- tab	9- vestigial lug or tab
3- loop handle	10- appendage scar visible
4- strap handle	11- flange
5- boss	12- multiple
6- spout	13- asymmetrical orifice
7- castellation	99- absent or not observed
CRDSPC	mean horizontal parallel cord impression spacing above zone 1, 0.1 mm
CRDWDTH	mean cord impression width (diameter) anywhere above zone 1, 0.1 mm
NLINES	count of parallel horizontal lines used in decoration on zone 3
ZN2THICK	zone 2 mean thickness, 0.1 mm
ZN3THICK	zone 3 mean thickness, 0.1 mm
ZN5THICK	mean thickness at zone 5, 0.1 mm
RIMHITE	total rim height, whole mm
ZN2HITE	zone 2 height, whole mm
ZN3HITE	zone 3 height, whole mm
ZN5WDTH	width of brace, whole mm

Table A19. Pottery analysis variables and attributes, continued.

ORIFDIAM	vessel orifice diameter, cm
WARE	ware classification
0.0- unclassified straight rim	6- Knife River ware
0.1- Stanton ware	8- Knife River Fine ware
1.0- unclassified S-rim	9- Transitional ware
1.1- Sanger ware	32- Le Beau Fine ware
2- Riggs ware	99- fragment, unclassifiable
3- Ft. Yates ware	
5- Le Beau ware	
VARIETY	ware-variety classification
1- Ft. Yates	14- Riggs
2- Sanger	15- Stanton
3- unnamed early S-rim	16- unnamed late straight rim without brace
4- Le Beau Classic	16.1- Cross-Hatched straight or S-rim
4.1- Le Beau Fine	17- unnamed late straight rim with brace
4.2- Le Beau Classic T-Lip	19- Transitional
5- Le Beau Recurved	21.0- Knife River Large, lacking interior cord dec
6- Le Beau Sperry	21.1- Knife River Large, with interior cord dec
6.1- Le Beau Sperry Recurved	22.0- Knife River Intermediate, lacking interior cord dec
7- Le Beau High Rim	22.1- Knife River Intermediate, with interior cord dec
8- Le Beau Paddle Stamped	23.0- Knife River Fine, lacking interior cord dec
9- Le Beau Plain	23.1- Knife River Fine, with interior cord dec
10- Le Beau Classic 4 or 5 (zone 3 fragments)	26- rolled rim jar
11- Le Beau Sperry 6 or 6.1 (zone 3 fragments)	27.0- bowl without flange 27.1- bowl with flange
12- unnamed late S-rim	31- unclassifiable Zone 2/3 Fragments (indeterminate Le
13-	Beau Classic or Sperry)
	32-
	33- unclassifiable S-rim (indeterminate Le Beau or Sanger)
	99- fragment, unclassifiable
TYPE	type based on decoration only
0- plain	8- cord-wrapped-tool-impressed
1- cord impressed	9- finger impressed
2- tool impressed	10- simple stamped (paddle stamped)
3- incised (includes trailed)	11- brushed
4- pinched	12-
5- filleted	13- multiple
6- punctate	99- unclassifiable fragment
COMMENT	1-comment exists, recorded outside dataset on note sheets
CNTBRK	count of break surfaces
OCONST	orifice or upper rim construction technique (Zones 2/3, 4, 5, 6, 7)
1- no addition or modification detectable	11- added raised coil on exterior
4- added to exterior	12- added raised coil on interior
5- added to interior	13- added coil folded to interior and exterior
6- added to exterior then smoothed at lip	14- two exterior coils, smoothed
8- lip coil	15- interior and exterior coils
9- double coil added to exterior	16- two lip coils
10- double coil added to interior	17- complex
	99- Not observable or broken away
OCONF	confidence in orifice construction determination
1- high confidence	3- low confidence/guess
2- moderate confidence	9- no confidence, cannot code

Table A19. Pottery analysis variables and attributes, continued.

RCONST	rim construction technique (Zones 2, 3)
1- single strap	4-triple strap
2- double face-to-face strap	9- not observable or broken away
RCONF	confidence in rim construction determination
1- high confidence	3- low confidence/guess
2- moderate confidence	9- no confidence, cannot code
Z1SFT	zone 1 exterior surface treatment
0- zone not used on vessel	8.1- smoothed over brushed
1- plain/rough, temper usually visible	8.2- burnished over brushed
2.1- smoothed, no temper visible	8.3- polished over brushed
2.2- burnished, discontinuous or discrete marks	9.1- smoothed over simple stamped
2.3- polished, marks continuous and blended	9.2- burnished over simple stamped
3- brushed	9.3- polished over simple stamped
4- simple stamped	10.1- smoothed over check stamped
5- check stamped	10.2- burnished over check stamped
6- cord roughened	10.3- polished over check stamped
	99- unobservable or broken away
Z2ST	zone 2 exterior surface treatment
same as Z1ST	
Z3ST	zone 3 exterior surface treatment
same as Z1ST	
Z4ST	zone 4 exterior surface treatment
same as Z1ST	
Z5ST	zone 5 exterior surface treatment
same as Z1ST	
Z7ST	zone 7 surface treatment
same as Z1ST	
INTST	interior surface treatment (uppermost treatment only)
same as Z1ST	
SCOLOUT	exterior surface color
1- buff or brighter	5- firing clouds (two color)
2- brown	6-
3- gray	8- post-firing alteration (refired)
4- black	9- not observable or too small for accuracy
SCOLIN	interior surface color
same as SCOLOUT	
CORE	interior color
1- red or buff throughout, no core	7- gray throughout, no core
2- red or buff (or light gray) both surfaces, dark core w/ diffuse margin	8- black throughout, no core
3- red or buff (or light gray) both surfaces, dark core w/ sharp margin	9- contrastive core expression from place to place
4- black both surfaces, red or buff (or light gray) core	99- indeterminate (too small to assess)
5- gray exterior, black interior (dark interior)	
6- black exterior, gray interior (light interior)	
QUAL	technical quality
1- non-functional	4- well made
2- poorly made	5- exceptional
3- serviceable	9- indeterminate/too small
TECHCOMMENT	1-comment exists, recorded outside dataset on note sheets

sufficient criteria. A Le Beau Recurved variety vessel, for instance, always includes zones 1, 2, 3, 4, and 7, with zones 2 and 3 exhibiting a limited range of metric properties. However, they also are historically constituted groups. For this reason, type definitions have changed somewhat over time and new types have been recognized, as more collections have been studied. The Scattered Village analysis in particular demonstrated the extent of previously unrecognized complexity in pottery rim forms and types (Ahler, Warner, and Smail 2002:11.87). With one crucial exception, the type definitions I used to classify vessels in the four-site subsample are described in Mitchell, Madden and Ahler (2007), which in turn are based on the definitions developed by Ahler (2001), Ahler and Madden (2005), and Ahler, Warner, and Smail (2002).

The exception is Sperry ware. All previous typologies considered Sperry ware a variety of Le Beau ware. However, the technological data collected for this study clearly show that Sperry ware differs fundamentally from other varieties of Le Beau ware and therefore should be designated a separate ware, a modification anticipated by Ahler, Madden, and Mitchell (2006:90). The types present in the four-site subsample are described and illustrated in chapter 7.

Technological Variables

Technological study of Plains Village pottery assemblages began in the Heart region with the Boley Village project (Ahler, Madden, and Mitchell 2006). (Earlier, Fern Swenson [2003] and Richard Krause [2007] had explored the technological properties of pottery from the Late Woodland Menoken site). The variables used in the Boley Village analysis originally were developed during two workshops sponsored by PCRG in 2004 and 2005 (Ahler, Madden, and Mitchell 2006:100). Workshop attendees included Stan Ahler, Richard Krause, and me. The basic approach involved adding variables designed to document methods of vessel construction and finishing, paste preparation, firing characteristics, and so forth to the existing KNRI system. Several pilot studies, using small samples from Double Ditch, On-A-Slant, and Sperry villages

demonstrated the existence of patterned variation among a range of technological and stylistic variables.

When I began work on this project I intended to use the technological variables developed for the Boley analysis essentially without modification. Early on, though, it became clear that several variables were rather difficult to apply consistently and that others varied too little to be of much interest. For those reasons, I dropped some variables and modified several others to improve their validity.

I introduce two terms in the description of the technological variables given here. The rims of many Plains Village pots were built up by the addition of clay to the vessel body during fabrication, either in the form of a "coil" or a "strap." Coils consist of small rolls of clay used to construct the vessel lip or brace. Straps consist of larger slabs of clay usually used to construct the mouth or S-rim.

Count of Break Surfaces (CNTBRK). The number of cross sections through the lip or rim of each vessel. A vessel represented by a single sherd ordinarily will have two break surfaces; one represented by three sherds will have six. The number of break surfaces available for study is a rough proxy for analytic confidence.

Orifice Construction Technique (OCONST). The method use to finish the lip and upper rim of a vessel. The lip and upper rim (zone 7 plus all or part of zones 2, 3, or 5) can be formed in one of 14 different ways. Orifice construction technique is conceptually distinct from rim form. For example, a brace (zone 5) may not necessarily be present, even if the orifice of a vessel was formed by folding the clay to the interior or adding an interior strap. The original attribute set included both "folded" and "added" lip and upper rim categories. Wood (1967) recognized both production techniques in his examination of Huff site pottery. However, during this analysis it became apparent that these two methods could not always be reliably distinguished, particular in small rim sherds lacking fresh breaks. For that reason I collapsed most of the "folded" attribute categories defined for the Boley Village analysis into the "added" categories,

recognizing that additional investigation likely will reveal patterned variation in this domain.

"Added to Exterior/Interior" indicates that the orifice was finished by adding a coil or strap of clay to the upper rim and blending it into the vessel wall. Coils or straps can be added and blended in several ways. A "Lip Coil" refers to a single small coil added to the top of the rim. "Added to Exterior/Interior Then Smoothed at Lip" means that the top of the vessel wall has been pulled over and blended into the top of the coil or strap. "Double Coil Added to Exterior/Interior" refers to an upper rim treatment in which two coils or straps are added. "Added Raised Coil on Exterior/Interior" is used when the added coil or strap projects substantially above the top of the vessel wall. "Strap Folded to Interior and Exterior" means that a strap has been attached to the top of the rim then folded down on both the inside and outside of the vessel.

Confidence in Orifice Construction Technique Determination (OCONF). In some cases, the orifice construction technique is easily determined, due to the number of breaks available for examination or to a flaw in vessel construction, but in others the method of manufacture is difficult to gauge. "High Confidence" is used when two or three fairly clear indicators are present, or when one particularly conclusive indicator is present, and there are no contradictory indicators. "Moderate Confidence" is used when the preponderance of evidence points toward a particular technique, but no definitive indicator is present. "Low Confidence" is used if most breaks are equivocal or if some contradictory evidence is present. "No Confidence" means that no data are available because the lip and upper rim are broken away.

Rim Construction Technique (RCONST). Heart River potters used at least three methods to build up the rim of a vessel. A "single strap" means that the rim (zone 2 or zones 2 and 3) was constructed from one piece of clay. This may or may not mean that clay has been added to the original lump from which the vessel was modeled; sometimes a large strap, described as a "sequent strap," was added to the upper vessel wall to form the rim. However, the presence of such sequent straps only can be assessed for large vessel fragments and so is not coded here. A "double face-to-face strap" indicates that the potter added clay to the interior or exterior of

the vessel wall to increase the thickness of the rim. This method often is indicated by a nearly continuous crack parallel to the surface of the vessel. In the "triple strap" method the rim of the vessel was built from three face-to-face straps.

Confidence in Rim Construction Technique Determination (RCONF). See codes for Confidence in Orifice Construction Technique Determination (OCONF). Not all rim construction techniques are equally visible. Determinations are especially difficult on small vessel fragments and on very well made vessels.

Exterior Surface Treatment (Z1ST, Z2ST, Z3ST, Z4ST, Z5ST, Z7ST). The method used to finish the exterior surface of the vessel. The codes for this variable are based on the Ahler and Swenson system but here three degrees of surface smoothing are recognized rather than one. "Smoothed" indicates that the entire surface of the zone has been smoothed or floated and that few or no temper particles are visible. "Burnished" means that the potter used a burnishing stone (a small, smooth-surfaced pebble) to finish the vessel surface, but that the striations or facets produced by the stone are not continuous. "Polished" indicates that the entire surface of the zone has been burnished and that the burnishing facets are continuous or blend into one another. These three degrees of surface smoothing are used to modify the original surface treatment codes in the Ahler and Swenson system (except "Plain/Rough," which indicates that exterior surface was not smoothed or that smoothing was incomplete). For example, a "Simple Stamped" surface treatment may be smoothed (Code 9.1), burnished (Code 9.2), or polished (Code 9.3). Exterior surface treatment is coded for each vessel zone.

Interior Surface Treatment (INTST). The method used to finish the interior surface of the vessel rim. Only the uppermost treatment is recorded. The codes for this variable are the same as those used for exterior surface treatment.

Exterior Surface Color (SCOLOUT) and (SCOLIN). The dominant color of the vessel surface. Both interior and exterior colors are recorded. Colors range from buff to gray to black. "Firing clouds" indicates that no single color is dominant. In some cases the color of a vessel has

been altered by post-firing processes. Surface colors only are recorded for vessels comprised of at least one size grade 1 sherd.

Interior Color (CORE). The color of the fired paste viewed in cross section. The interior color can be coded either as solid (red, gray, or black) or as variable. If the core color is variable, then a "firing core" of some type may be present. Three types of firing cores may be present: the surfaces may be buff (or light gray) and the core dark (Codes 2 and 3), the surfaces may be dark and the core buff (or light gray) (Code 4), or there may be a color gradient from one surface to the other (Codes 5 and 6).

Quality of Fabrication (QUAL). An assessment of the utility of the vessel and the skill of the potter. Table A20 lists the criteria used to classify pottery production skill levels. The criteria used to judge the quality of the vessel include the preparation of the paste, the skill used to form the vessel, the symmetry of the decoration, and so forth. Poorly made vessels probably were made by children or novices. The best made vessels have thin, even walls, are large and symmetrical, and exhibit carefully applied decoration. Elaborately made smaller vessels may also

Table A20. Pottery production skill categories.

Code	Definition
1	Non-functional. Generally a pinch pot or practice piece made using non-standard vessel forming techniques. Paste is poorly mixed, often with little or no temper. Voids from organic debris often are present. Wall thickness varies significantly. Little or no attention paid to surface finish. Decoration is atypical or poorly applied. Temper particles protrude. Lip is uneven in horizontal plane.
2	Poorly made. Paste is poorly mixed and temper is poorly sorted or unevenly distributed. Firing is poorly controlled, resulting in an underfired vessel with comparatively soft paste. Vessels walls vary in thickness. Decoration is haphazardly applied and little attention is given to surface finish. Temper particles can be seen on the vessel surface. Lip is uneven in horizontal plane.
3	Serviceable. Walls vary somewhat in thickness. Temper is moderately well sorted and distributed, with only a few large particles (greater than half the thickness of the wall) present. Vessel walls are not fully compacted. Straps and coils are not fully bonded or blended into vessel wall. Firing is fairly well-controlled, but paste is not sintered. Decoration is uneven or asymmetrical.
4	Well made. Walls are uniform in thickness. Temper is well sorted and paste is thoroughly mixed. Walls are compact, with few voids. Straps and coils are well bonded and blended. Firing is complete and well-controlled and paste is at least partially sintered. Decoration is carefully applied.
5	Exceptional. Walls are uniform and thin relative to vessel size. Temper is well sorted and paste is thoroughly mixed. Walls are very compact. Firing is complete and well controlled and paste is sintered. Straps and coils are well bonded and blended. Decoration is very well executed and symmetrical.
9	Unknown. Sherd is too small or fragmented to code. Also used for sherds exhibiting contrasting properties.

be coded as high quality.