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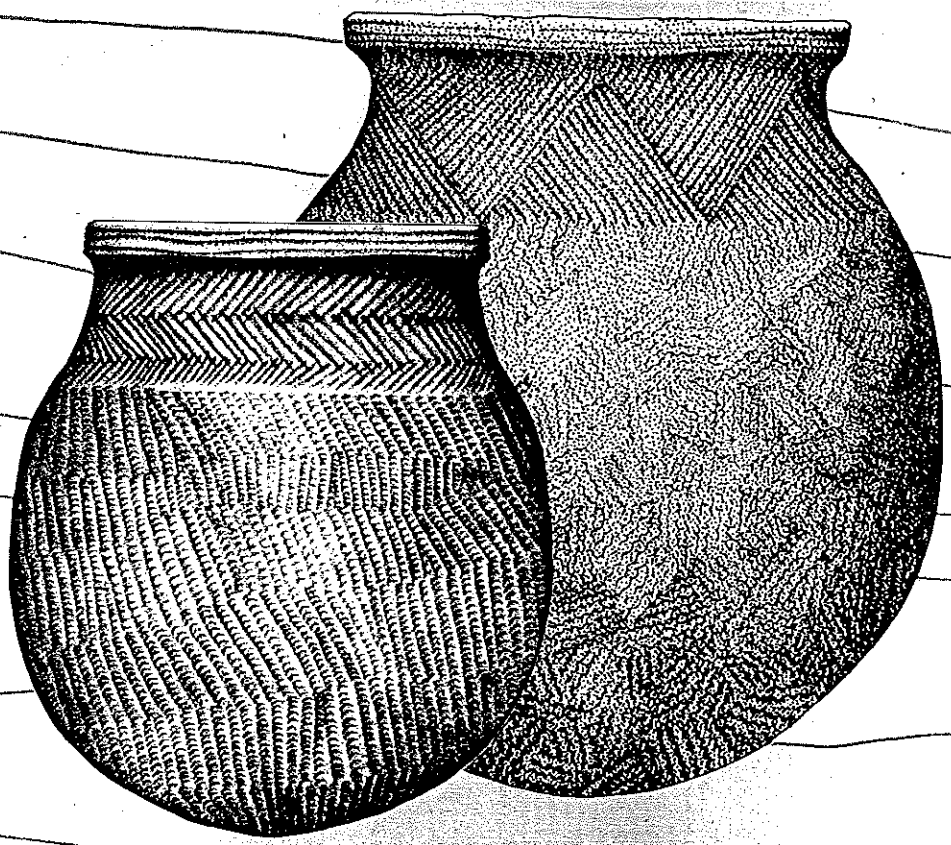
THE ARCHAEOLOGY OF CENTRAL PENNSYLVANIA, VOLUME 1

THE FISHER FARM SITE

A LATE WOODLAND HAMLET IN CONTEXT

EDITED BY JAMES W. HATCH



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THE ARCHAEOLOGY OF CENTRAL PENNSYLVANIA

VOLUME I

THE FISHER FARM SITE

A LATE WOODLAND HAMLET IN CONTEXT

JAMES W. HATCH, EDITOR

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ACKNOWLEDGMENTS

Prehistoric site survey in the Bald Eagle watershed during the summer of 1978 and excavations at the Fisher Farm Site (36 Ce 35) from 1976-1978, both part of the Bald Eagle Archaeological Research Program, are the subject of this volume. The success of both efforts has been the collective responsibility of a number of people, all of whom I would like to thank here.

The 1978 survey in the Bald Eagle watershed (Chapters 4-6) was conducted as part of a state-wide site survey effort sponsored by the National Register Program and directed by the Pennsylvania Historical and Museum Commission. Dr. Barry C. Kent, State Archaeologist, was charged with the responsibility of establishing guidelines for the implementation of the program as well as monitoring its operation. Our ability to collect significant new settlement information in the Bald Eagle watershed as a result of this porgram is a direct reflection of his careful forethought and his sincere interest in anthropological archaeology.

The excavations at Fisher Farm were conducted as part of The Pennsylvania State University's field school in archaeology during the summers of 1976-1978. Financial support for the field school program during these years derived in part from the Department of Anthropology and the College of Liberal Arts. The personal interest in the field school of Dr. Stanley Paulson, Dean of the College, Dr. Thomas Magner, Associate Dean of Research, and Dr. Warren T. Morrill, Head of the Department, has been greatly appreciated. A grant from the American Philosophical Society for radiocarbon dates added significantly to our interpretation of the site, especially the stratified ceramic material (Chapter 18). Research assistance from other departments was provided by Professors Carl Keener, Department of Biology, and Paul C. Kersavage, School of Forest Resources. Dr. Betty Brandeu, Center for Applied Isotope Studies of the University of Georgia, also played an important advisory role. The individual contributions of Ira F. Smith, III of the Pennsylvania Historical and Museum Commission as well as Robert B. Eckhardt, Edward E. Hunt, Jr., and Michele H. Hayward of the Department of Anthropology, The Pennsylvania State University, are also gratefully acknowledged.

The actual participants in the projects must also be acknowledged. All have contributed to this volume, not only through their sheer hard work and field skills, but also through ongoing discussions of the meaning and significance of our discoveries.

I was fortunate to put together a survey crew during 1978 with a great deal of experience and drive. The quantity and reliability of our data from that project reflects both. Ira Beckerman, Richard Geidel, Christopher Hamilton, Paul Raber, Christopher Stevenson, Rebecca Storey, Deborah Swartz, Gary Webster, and Randolph Widmer worked well as a team and will no doubt go on to make important individual contributions in the discipline.

The field school courses held at Fisher Farm were directed in 1976 by Dr. Mark Aldenderfer (SUNY-Buffalo), then a graduate student at The Pennsylvania State University, and in 1977 and 1978 by myself. Mark's clever design for the site's excavation and recording systems was maintained by me in subsequent years, and his overall management that first year in the face of dissertation pressures was highly commendable.

Like Mark, I selected as graduate student assistants persons whose prior training and demeanor commanded the respect of the participants. Susan Evans (1976), Dr. E. Randolph Turner, III (1976-1977), Christopher Stevenson (1977), Ira Beckerman (1977-1978), and Gary Webster (1978) are acknowledged here for their excellent archaeological and educational efforts.

Despite the fact that the crews commuted from the University Park campus in State College each day, the comradery that developed among the participants was as great as I have seen on any archaeological project. This ingrediant clearly had a positive effect on both their own perception of the educational value of the experience and the quality of their efforts as crew memebers. Joseph Baker (1976), Cheryl Balensky (1976), Patrice Bamat (1977), Suzanne Blouch (1977), Stephen Campbell (1987), Patrick Casey (1976), Carin Copeland (1978), Marshall Crowthers (1976), Joyce Daugirda (1977), Ellen Derey (1977), Melissa Diamanti (1977), David Dinger (1977), David Dyer (1976-1977), William Embick (1978), Rex Green (1977), Patrica Hauck (1976), Donna Heesen (1978), Susan Kelley (1978), Katharine Koontz (1978), Margaret Lennon (1977), Johanna Leos (1977), Kevin Lessig (1977), Barbara Little (1978), John MacLachlan (1976), Mary Manget (1978), Sandi McCall (1976). James Moll (1976), Cynthia Mushrush (1976), Gail Newlon (1977), Karen Pickarski (1977), Amy Savicki (1978), Debra Schindler (1978), Diane Sickert (1978), Sherry Silverman (1977), Robert Tudek (1978), Leon Williams (1978), and Don Wright (1978) are all thanked here for their contributions.

The greatest personal satisfaction that I received from these associations was watching the impact of field school participation on the further educational development of the students. For several of the contributors to this volume Fisher Farm was their first field experience and the chapters their first attempt at research. My role in the design of their research obviously had to be a major one, but happily I see individuality in their results. For others, Fisher Farm helped shape career decisions. Participants have gone on to be graduate students and teachers of anthropology at SUNY-Binghamton, University of Massachusetts, Eastern New Mexico University, Dickinson College, and other institutions.

In preparing this volume I was helped by a number of talented people. Melissa Diamanti did most of the art work, including the cover and the ceramic illustrations. Other contributing artists were Ira Beckerman, Christopher Stevenson, Jeffry Rich, Jo Ann Baldwin Mallory, and Peter Refsnider. Sandra Hay, who typed the principal part of the manuscript, was assisted by Shelvia Hummel. Finally, my editorial assistant was Mary Alice Graetzer. I sincerely appreciate these individual efforts.

A final and special thanks goes to some of the residents of Bald Eagle Valley itself. Nelson and Ivan Fisher freely gave permission to excavate on the Fisher property. Walter and Willis Flick cooperated by arranging for areas of the site's active farmland to be left unplanted. Most importantly I want to express my sincerest thanks for the help and friendship of Mr. Edward Barton of Unionville, Pennsylvania. Ed Barton not only showed us the site for the first time, but arranged permissions, loaned us collections of material from this and other sites, and actively sought to broaden both his and our knowledge of the area's prehistory.

TABLE OF CONTENTS

Chapter		Page
1	An Introduction to the Central Pennsylvania Archaeological Research of The Pennsylvania State University; 1976-1978 James W. Hatch	1
2	The Research Framework of the Bald Eagle Archaeological Research Program James W. Hatch	6
3	A Paleoenvironmental Reconstruction of District 9 Ira C. Beckerman	12
4	The Methodological Basis for the 1978 Site Survey Program in District 9 James W. Hatch	42
5	An Analysis of the Chipped Stone Assemblages from the National Register Survey--1978 Conran A. Hay	65
6	Predictive Models of Site Distribution Within the Bald Eagle Creek Watershed Conran A. Hay and James W. Hatch	83
7	Introduction to the Fisher Farm Excavation James W. Hatch	92
8	Surface Collections from Plow Zone Sites: The Processes of Distortion Christopher M. Stevenson	100
9	An Analysis of Plow Disturbed Activity Areas at Fisher Farm Christopher M. Stevenson	107
10	The Analysis of Flotation Samples from the Fisher Farm Site Lorraine M. Willey	136

Chapter		Page
11	A Functional Analysis of the Fisher Farm Features James W. Hatch and Christopher M. Stevenson	140
12	The Semi-Subterranean Keyhole Structure at Fisher Farm--Feature 28 James W. Hatch and Joyce Daugirda	171
13	An Analysis of the Human Remains from the Fisher Farm Site Diane E. Sickert	191
14	The Economics of Weed Seed Subsistance in the Ridge and Valley Province of Central Pennsylvania Joseph A. Baker	205
15	Geomorphological and Pedological Analyses at Fisher Farm Jeffery J. Gryta, William J. Waltman, and James W. Hatch	223
16	The Palynology of the Stream Channel at Fisher Farm Larry J. Gorenflo	248
17	Radiocarbon Dates from the Fisher Farm Site James W. Hatch	257
	Appendix--The Identification of an Archaeological Wood Specimen Paul C. Kersavage	264
18	An Analysis of the Ceramics from the Stratified Deposits at Fisher Farm James W. Hatch	266
19	The Fisher Farm Projectile Points Robert E. Tudek, Jr. and James W. Hatch	306
20	A Synthesis and Prospectus of the Program's Late Woodland Research James W. Hatch	320
Bibliography		329

LIST OF TABLES

Table		Page
2.1	Relationship Between Program Resources and Fieldwork	9
2.2	Foci of Settlement System Studies in the Bald Eagle Archaeological Research Program	11
3.1	Soil Series Attributes	30
3.2	Tree Species Characteristics	34
3.3	Stream Bank Forest Composition Near Egg Hill	35
3.4	Composition of the Alan Seeger-Ravine Flats Canopy	35
3.5	Valley Floor Forest Composition in Penns and Georges Valleys	36
3.6	Composition of the Alan Seeger Lower Slope Forest	37
3.7	Ridge Top Forest Composition for Nittany and First Mountains	37
4.1	Target Population of Survey Squares for 1978	48
4.2	Equipment and Supplies for Survey Teams	52
4.3	Survey Squares Actually Inspected in 1978	60
4.4	Statistical Summary of Survey Squares	62
4.5	Interval Comparisons of Site Discovery Techniques	64
4.6	Comparative Summary of Site Discovery Techniques	64
5.1	Projectile Point Type Chronological Assignments and Frequencies of Occurrence	72
5.2	Raw Material of Diagnostic Projectile Points and Frequencies of Occurrence	76
6.1	Environmental Variables and Habitat Desirability Point Score Assignments	85
6.2	Survey Squares and Habitat Desirability Scores	86

Table		Page
6.3	Survey Square Rank Order and Site Densities	87
6.4	Chi-square Evaluation of the Late Woodland Site Association with Productive Soils	89
8.1	Correlation of Surface to Subsurface Counts (2 m x 2 m, n=21)	103
8.2	Correlation of Surface to Subsurface Counts (4 m x 4 m, n=8)	104
8.3	Proportional Comparison--Surface to Subsurface	105
9.1	Measures of Association in the Subsurface Assemblage--Area A	115
9.2	Measures of Association in the Subsurface Assemblage--Area B	118
9.3	Measures of Association in the Subsurface Assemblage--Area C	121
9.4	Measures of Association--House Area versus High Density Areas	125
9.5	Measures of Association--Surface to Excavated Area	129
9.6	Measures of Association in the 1977 Surface Collection--Northern Half Only	134
11.1	Attributes of the 59 Features Excavated in 1978 at the Fisher Farm Site	143
11.2	Locations and Probable Functions of the 59 Fisher Farm Features Excavated in 1978	150
11.3	Flotation Contents of Feature 41	158
11.4	Flotation Contents of Feature 4	160
11.5	Remaining Fire-Associated Features	163
11.6	Flotation Contents of Feature 12	164
11.7	Flotation Contents of Features 29 and 52	165
12.1	Postmold Characteristics for Feature 28	175

Table		Page
12.2	Field Number Provenience and Description--Features 28 and 48	178
12.3	Botanical Remains in Feature 28 Quadrants and Feature 48	179
14.1	Plant Stands and Average Plant Size--Stone Valley Survey	215
14.2	Yield and Density Volume--Centre County Survey	217
14.3	Comparative Energy Investment for Collecting and Processing--Maize versus Weed Seeds	218
14.4	Plant Harvest Statistics	220
14.5	Comparative Caloric Values by Species and Habitat	221
15.1	Soil Profiles from Auger Tests	228
15.2	Soil Profile at N12E37.5	242
15.3	Soil Profile at N12E42.5	244
15.4	Relationship of Soil Profiles to Master Levels in the Stream Channel	246
16.1	Estimated Dates of the Lower Sequence Pollen Samples	251
16.2	Pollen Percentages at Fisher Farm	252
18.1	Radiocarbon Dates for Late Point Peninsula and Oswasco Culture Components in New York	271
18.2	Owasco Ceramic Variation Between and Within Watersheds in Central New York	272
18.3	Phase Duration of Late Point Peninsula and Owasco Ceramics	274
18.4	Stratigraphic Distribution of Identifiable Sherds--1978 Excavation	299
18.5	Collapsed Stratigraphic Distribution of the Revised Ceramic Sample	300
18.6	Stratigraphic Distribution of the Typologically Compressed Sample	302

Table		Page
18.7	Stratigraphic Trends in the Ceramic Series at Fisher Farm--I) Raw Counts and II) Percentages per Level	303
19.1	Attributes of Diagnostic and Untyped Triangular Projectile Points from Fisher Farm	308

LIST OF FIGURES

Figure		Page
1.1	The Bald Eagle Watershed and District 9 in Central Pennsylvania	3
1.2	Major Geographic Features in the Bald Eagle Watershed	4
3.1	The Environmental Model	13
3.2	USGS 7-1/2 Minute Quadrangles in District 9	14
3.3	Counties within District 9	15
3.4	Principal Geographic Features in District 9	16
3.5	Major Streams in District 9	18
3.6	Geologic Formations in District 9	19
3.7	Composition of the Geologic Formations in District 9	22
3.8	Geologic Evolution during the Mesozoic and Cenezoic Eras (after D.W. Johnson 1931 Stream Sculpture on the Atlantic Slope)	24
3.9	Major Lithic Resource Areas in District 9	26
3.10	Soil Associations within District 9	29
4.1	Survey Squares in Quad A--The Beech Creek Quadrangle	45
4.2	Survey Squares in Quad B--The Bellefonte Quadrangle	46
4.3	Survey Squares in Quad C--The State College Quadrangle	47
4.4	Schematic Hydrologic Diagram of the Bald Eagle Drainage	49
4.5	Collector Identification Card	51
4.6	Land Use and Ownership Form	51
4.7	Survey Procedure Form	54
4.8	Site Form--Field Copy	55
4.9	Survey Square Checksheet	58

Figure		Page
5.1	Site Categories by Artifact Count	68
5.2	Tool Types by Site Categories	70
5.3	Raw Material Preference Clusters	74
7.1	The Fisher Farm Site Environs	93
7.2	High Productivity Soils Near the Fisher Farm Site	94
7.3	Upland Oak Site Quality Near the Fisher Farm Site	95
7.4	Excavation Units at Fisher Farm--1976 to 1978	97
9.1	Grid Provenience of Excavation Units	109
9.2	Relationship of Areas A, B, and C to Zone Surface Collected in 1977	110
9.3	Excavation History of Areas A, B, and C	111
9.4	Feature and Postmold Arrangement in Areas A, B, and C	112
9.5	SYMAP of Area A--Lithic Weight, Lithic Count, Jasper, Flint	116
9.6	SYMAP of Area A--Chert, Utilized Flakes, Bifacial Tools, Ceramic Weight	117
9.7	SYMAP of Area B--Utilized Flakes, Chert, Flint, Jasper	119
9.8	SYMAP of Area B--Bifacial Tools, Ceramic Weight, Lithic Count, Lithic Weight	120
9.9	SYMAP of Area C--Ceramic Weight, Jasper, Flint, Chert	122
9.10	SYMAP of Area C--Lithic Count, Lithic Weight, Utilized Flakes, Bifacial Tools	123
9.11	Hypothesized Activities in Areas A, B, and C	127
9.12	SYMAP of 1977 Surface Collected Area--Flint, Ceramic Weight	130
9.13	SYMAP of 1977 Surface Collected Area--Jasper, Chert	131
9.14	SYMAP of 1977 Surface Collected Area- Utilized Flakes, Bifacial Tools	132

Figure		Page
9.15	SYMAP of 1977 Surface Collected Areas--Lithic Count, Lithic Weight	133
11.1	Artifact Contents of 59 Fisher Farm Features	145
11.2	Association Threshold of Fire-Cracked Rock and Botanical Density	146
11.3	Scatterplot of 59 Fisher Farm Features	147
11.4	Scatterplot of the Fire-Associated Features	148
11.5	Scatterplot of Features Not Associated with Fire	149
11.6	Features in Area C	151
11.7	Features in Area A	152
11.8	Features in Area B	153
11.9	Features in Area D	154
11.10	Features in Area E	155
11.11	Activity Zone Model For Fisher Farm	168
12.1	Features 28 and 48	172
12.2	Profile of Idealized Keyhold (above) Versus Feature 28 (below)	174
12.3	Postmolds and Feature within Feature 28	176
12.4	Locations of Field Numbers and Organic Blocks in Feature 28	177
12.5	Patterning of Organic Material in the Western Half of Feature 28	184
15.1	Location of the Terrace, Stream Channel, and Floodplain Formations	225
15.2	Location of the 19 Auger Tests--1978	227
15.3	Principal Excavation Units in the Stream Channel--Profile Key	233
15.4	Stratigraphic Profile--N26E37-41	234

Figure		Page
15.5	Stratigraphic Profile--N20 and 20.2E37.5-42	235
15.6	Stratigraphic Profile--N14-20E40	236
15.7	Stratigraphic Profile--N16.25E40-42	237
15.8	Stratigraphic Profile--N14-20E42	238
15.9	Stratigraphic Profile--N12E36.3-44	239
15.10	Stratigraphic Profile--N4E32-36	240
16.1	Pollen Profile for Samples 1002-1005	253
17.1	Means and Standard Deviations of Ten Radiocarbon Dates from Fisher Farm (Samples 1-10)	262
18.1	Type 1 - Levanna Cord-on-Cord, Type 2 - Clemson Island Cord-on-Cord, and Type 3 - Clemson Island Platted Horizontal	281
18.2	Type 4.1 - Clemson Island Corded Horizontal, Variant 1	282
18.3	Type 4.2 - Clemson Island Corded Horizontal, Variant 2	283
18.4	Type 5.1 - Clemson Island Gashed, Variant 1, and Type 5.2 - Clemson Island Gashed, Variant 2	284
18.5	Type 6 - Clemson Island Horizontal Complicated	286
18.6	Type 7 - Clemson Island Dentate, Type 8 - Fisher Farm Irregular Cordmarked, and Type 9 - Clemson Island Enlarged Rim	287
18.7	Type 10.1 - Clemson Island Platted Oblique, Variant 1, Type 10.2 - Clemson Island Platted Oblique, Variant 2, and Type 10.3 - Clemson Island Platted Oblique, Variant 3	289
18.8	Type 11 - Clemson Island Flared Rim, and Type 12 - Clemson Island Fine Impressed	290
18.9	Type 13.1 - Shenks Ferry Incised - Multiple Banded	291
18.10	Two Shenks Ferry Vessels. a) Type 13.1 - Multiple Banded, b) Type 13.2 - Complex	293

Figure		Page
18.11	Type 13.2 - Shenks Ferry Incised - Complex, and Type 13.3 - Shenks Ferry Incised, Variant 3	294
18.12	Type 14 - Lancaster Incised, and Type 15 - Funk Incised	295
18.13	Type 16 - Shell Tempered	296
19.1	Projectile Point Frequencies by Period at Fisher Farm	307
19.2	Stratigraphic Position of the Stream Channel Projectile Points	317
19.3	The Distribution of Projectile Points Across the Fisher Farm Site	319

LIST OF PLATES

Plate		Page
19.1	Pre-Late Woodland Projectile Points from Fisher Farm	310
19.2	Jack's Reef and Levanna Projectile Points from Fisher Farm	312
19.3	Shenks Ferry and Susquehannock Projectile Points from Fisher Farm	314

CHAPTER 1

AN INTRODUCTION TO THE CENTRAL PENNSYLVANIA ARCHAEOLOGICAL RESEARCH OF THE PENNSYLVANIA STATE UNIVERSITY: 1976-1978

JAMES W. HATCH

I. BACKGROUND

This volume presents the results of two related projects, a settlement survey conducted in the Bald Eagle watershed of central Pennsylvania in 1978 and archaeological excavations carried out between 1976 and 1978 at the Fisher Farm site (36 Ce 35) by the Department of Anthropology of The Pennsylvania State University. Our concern in both of these projects was to provide a cultural historical and cultural evolutionary frame of reference for the area from an explicitly ecological and settlement system perspective. By doing so it was our belief that the study area could serve as a paradigm for the vast headwaters region in central Pennsylvania, enhancing the work that had already gone on in the area and bringing the region into line with the rest of Pennsylvania, Northeastern, and Middle Atlantic prehistory.

The majority of the published archaeological work carried out in or near the Bald Eagle watershed can be classified into 4 categories:

1. casual archaeological reconnaissance (Stewart 1938)
2. survey and excavation in the Bald Eagle Valley (Webster, et al. 1977; Gruber n.d.)
3. survey and intensive excavation in the Raystown Branch area (Smith 1966; Michels and Smith 1967; Michels and Dutt 1968)
4. survey and excavation in the West Branch Valley (Smith 1976; Turnbaugh 1977).

Categories 1 and 2 have directly, and categories 3 and 4 have indirectly affected our knowledge of the prehistory of the Bald Eagle watershed. Due to the narrow scope of the research carried out in categories 1 and 2, much of the current information for the area has been derived from the better known adjacent zones of categories 3 and 4. We have, for example, identified significant Middle Archaic (Brewerton and Lamoka) and Late Woodland (Clemson Island, Shenks Ferry, and shell tempered) occupations in the watershed. However, neither the detailed population profile known for the Raystown Branch to the south nor the outline of cultural interaction seen in the West Branch Valley to the north could be assessed for the project area given the data available prior to 1976.

The creation of the Bald Eagle Archaeological Research Program in 1976 marked the beginning of a coordinated effort to investigate areas previously overlooked in Pennsylvania, in this case the Bald Eagle watershed, and the investigation of them from an ecological and settlement system perspective. Fisher Farm, a Late Woodland farming hamlet, was selected for excavation in keeping with the Program's mission to build

upon and enhance previous research. Studies of the Late Woodland Period, Pennsylvania archaeology's dominant research focus for decades, have rarely been conducted with ecological and settlement system concepts structuring research. Fisher Farm thus becomes the first Late Woodland hamlet in the state not on a principal water course to receive significant archaeological attention. The settlement survey reported in Chapters 4-6 was carried out as part of Pennsylvania's National Register Program in 1978. Program specifications called for archaeological efforts in any of 11 "districts" positioned throughout the state. The boundaries of District 9 included a large portion of the Bald Eagle watershed as well as adjacent areas to the south and east. It was therefore selected by The Pennsylvania State University for survey (Figure 1.1). All survey units inspected in the 1978 effort were within the Bald Eagle watershed portion of District 9.

The geographic setting for the archaeological work discussed in this volume is the mountainous Applachian Plateau and Ridge and Valley province in central Pennsylvania's Centre and Clinton counties (Figure 1.2). Bald Eagle Valley separates the two provinces. Like virtually all the major topographic features of the region, it is oriented SW-NE. A line oriented perpendicular to the Bald Eagle Valley (NW-SE) would cross the Allegheny Plateau, the Allegheny Foothills, and then a series of topographic features in the Ridge and Valley Province (Bald Eagle Valley, Bald Eagle Mountain, Nittany Valley, Nittany Mountain, etc.) all in the space of 25 km. Bald Eagle Valley is lower in elevation than the valley systems adjacent to it and as a result its principal stream, Bald Eagle Creek, is the recipient of surface water from a vast area. Spring Creek, Fishing Creek, Marsh Creek, Beech Creek, and many others all flow into the Bald Eagle before its confluence with the West Branch of the Susquehanna at Lock Haven, Pennsylvania. The Fisher Farm Site is situated in the Bald Eagle Creek floodplain approximately 4 km southwest, or up valley, from Milesburg.

II. THE BALD EAGLE ARCHAEOLOGICAL RESEARCH PROGRAM--ORIENTATION AND GOALS

The Bald Eagle Archaeological Research Program was developed in 1976 as a means of integrating the growing number of students at The Pennsylvania State University interested in eastern North American archaeology, the newly developed program in "contract" archaeology, and the Department of Anthropology's rekindled interest in Pennsylvania prehistory. It was felt that such a program would provide the needed framework for integrating these several components into a viable research effort and would encourage cross-fertilization and growth.

Six goals were created for the program.

1. Define and explain major aspects of the cultural trajectory evident in the Bald Eagle watershed.

2. Structure research to maximize its applicability to other areas in central Pennsylvania.

3. Investigate problems relevant to Northeastern and Middle Atlantic prehistory specifically and to anthropological research dealing with hunters and gatherers and shifting agriculturalists generally.

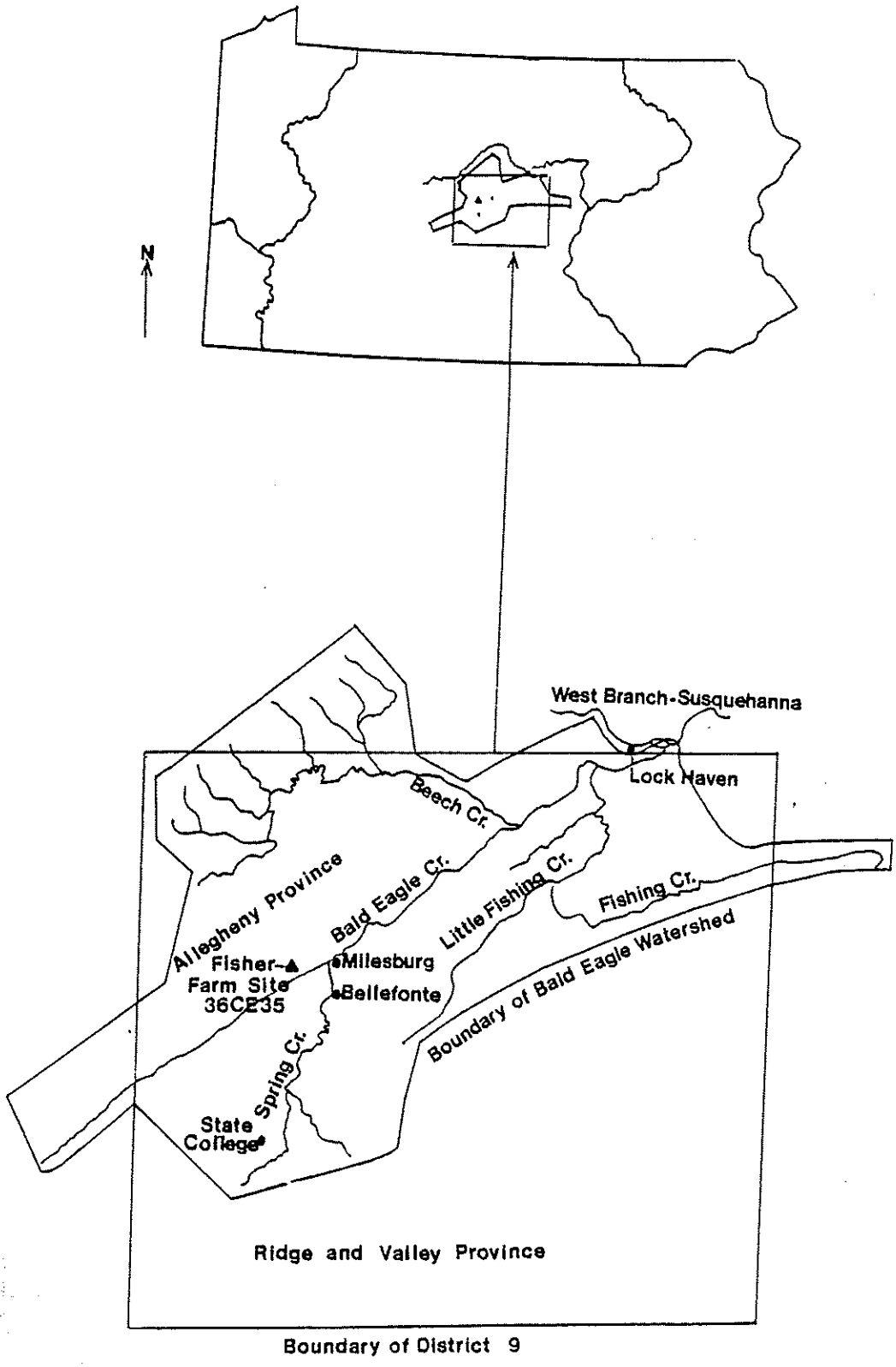


Figure 1.1: The Bald Eagle Watershed and District 9 in Central Pennsylvania

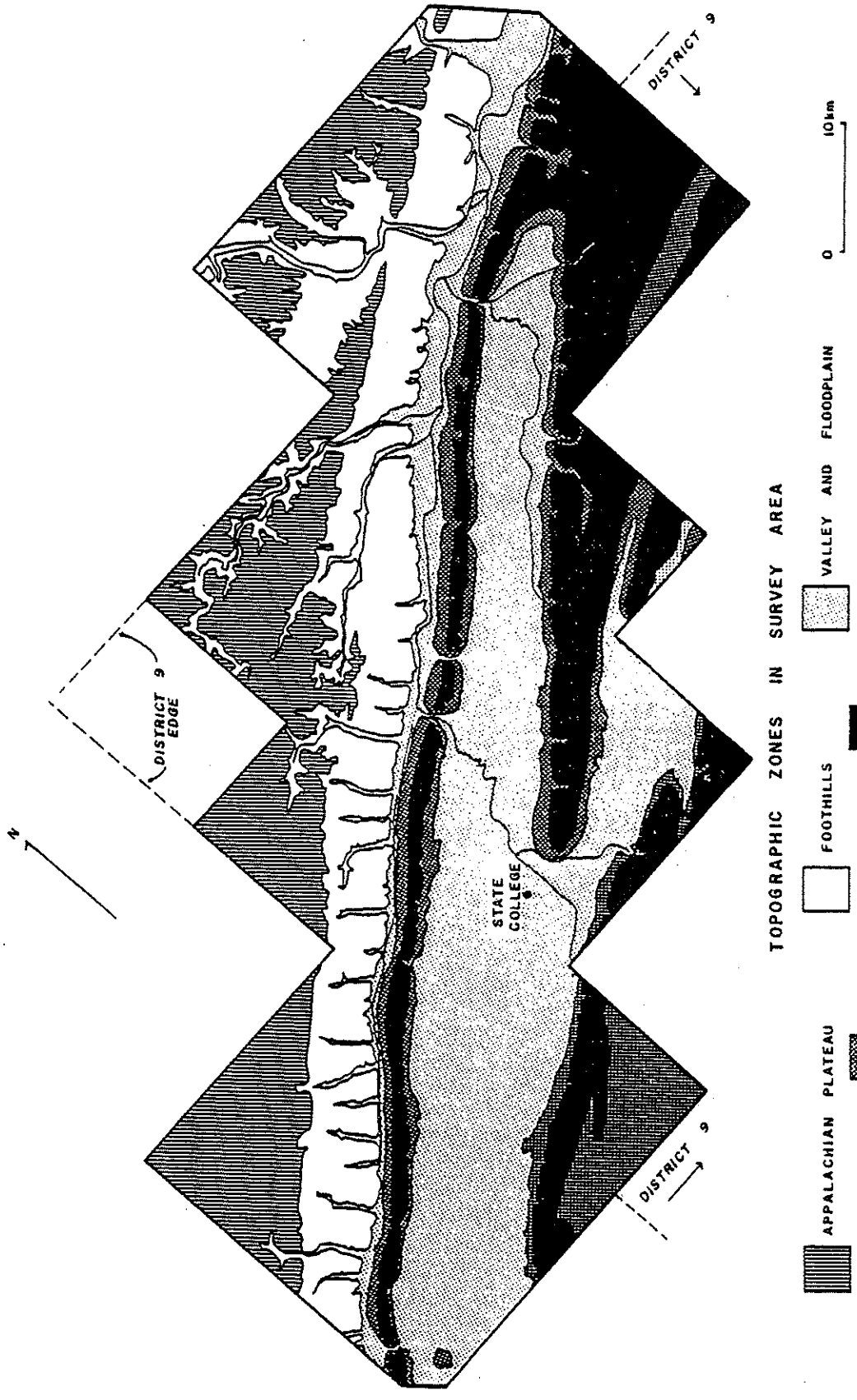


Figure 1.2: Major Geographic Features in the Bald Eagle Watershed

4. Develop new field and research methods suitable for studies of Northeastern and Middle Atlantic prehistory.

5. Enhance the value of sponsored or "contract" research to both the agency and the archaeological community by integrating discrete projects into a larger data base and a broader research perspective.

6. Service the needs of the undergraduate and graduate student population at The Pennsylvania State University by providing ongoing, coordinated research opportunities in regional prehistory.

The output of the program to date has been encouraging. Four Master's papers, several papers presented at regional archaeological meetings, and articles in preparation for wider archaeological dissemination are its most visible result. At the same time a number of students have participated in agency-sponsored projects that have helped finance their schooling and broaden their understanding of the discipline generally. This publication series will continue to serve as an outlet for research contributions to all of the program's goals. The following chapter will discuss the framework within which these efforts are being made.

III. AN OUTLINE OF VOLUME CONTENTS

The chapters in the present volume deal with the National Register Survey in District 9 in 1978 and 3 seasons of excavation at Fisher Farm. The survey discussed in Chapters 4-6 represents only one of the archaeological surveys conducted to date in portions of District 9 and in the Bald Eagle watershed. The information from it is included here because it is the most extensive survey yet carried out and its results provide the reader with a valuable perspective of the several periods of occupation of the area. To appreciate the diversity of adaptations in the area, the environmental summary for District 9 presented in Chapter 3 is also important.

Following the introduction (Chapter 7), the chapters related to the Fisher Farm Site fall into 3 groups. Chapters 8-10 all address aspects of the methodology used at Fisher Farm. Each critically considers the question "How do we best interpret the patterns we perceive given the biases inherent in the data?" The results of Stevenson's work with the spatial distribution of plow zone artifacts and Willey's with macrobotanical remains come together in the first chapter of our second group, dealing with feature and activity area identification. This group (Chapters 11-13) deals with features excavated in 1976 and 1977 from the multicomponent terrace occupation. The final group (Chapters 15-19) assesses the chronology of both the filled-in stream channel adjacent to the terrace and its archaeological contents. Baker's chapter (14) is somewhat unique in that it addresses problems related to weed seed economics that transcend Fisher Farm and the Bald Eagle region. It was included here because of the frequency of weed seed remains in the terrace features and it serves as a reminder of the value of these plants both prior to and during the Woodland Period. Chapter 20 evaluates the results of the work discussed in the volume and relates them to the goals of the Bald Eagle Archaeological Research Program.

CHAPTER 2

THE RESEARCH FRAMEWORK OF THE BALD EAGLE ARCHAEOLOGICAL RESEARCH PROGRAM

JAMES W. HATCH

I. OBJECTIVES

Of the several goals of the Bald Eagle Archaeological Research Program discussed in Chapter 1, the principal one from a research perspective is the delimitation and explanation of the evolutionary trajectory for the Bald Eagle watershed in sufficient detail that it can be used as a paradigm for archaeological studies in the Ridge and Valley and Allegheny Plateau provinces of Pennsylvania. The theoretical position that forms the basis for our work is that of cultural ecology. As originally presented by Steward (1955), cultural ecology consists of both a series of theoretical concepts relating human existence to its dynamic environmental setting through demographic, social, and material adaptations, and a methodology by which to examine the important dimensions of behavior in the adaptive process. By adopting the concepts of cultural ecology, we accept the primacy of ecological variables in effecting adaptations.

Willey et al. (1965), Winters (1969), Sanders et al. (1979), and others have satisfactorily demonstrated that analyses of prehistoric settlement systems provide important information concerning the types of adaptations prehistoric groups made to past environments. Since the demographic, social, and material dimensions of a culture's adaptation to its environment are represented in its settlement system (herein defined as the number, position, and variety of sites used by a group in its adaptation to a region), it follows that by delimiting a settlement system one can also recognize major aspects of cultural adaptation. Diachronically, a series of settlement systems in a region should reflect the important adaptational changes over time as consequences of cultural and non-cultural stimuli.

To effectively address the goal of trajectory explanation through a cultural ecological and settlement system perspective, two major research directions must be followed: settlement pattern research on a regional basis and diachronic environmental modeling. The settlement pattern research in the Bald Eagle watershed can be viewed as an attempt to construct a comprehensive three-dimensional matrix of site data. One dimension consists of a number of analytically defined "phases" or episodes within which little significant adaptational or settlement system change is detectable. Another deals with the paleoenvironmental settings within which prehistoric sites are known to occur. A third dimension distinguishes the several types of sites occupied or used in the settlement system. Information related to the population using the site, the season of its use, the types of activities taking place at the site, and the resources being exploited from it must all be considered in the site defining process.

Diachronic environmental modeling not only provides us with a means of classifying the landscape for one dimension of the matrix, it also forms the basis for our evolutionary evaluations. Once the matrix is filled, a procedure is needed for comparing settlement systems with respect to their structure and function. For this we need a predictive, ecologically based model of prehistoric resource exploitation under given population and environmental parameters against which we can evaluate our discovered prehistoric adaptations. Such a model must not only be dynamic, adjusting for appropriate phase-specific conditions in the systems being compared, but also its output must be in a form that allows for the discrete evaluation of alternative adaptive strategies (e.g., Minimax, Maximin, etc.).

II. OPERATIONALIZATION OF THE RESEARCH OBJECTIVES

Our main concern in the early design and subsequent growth of the Bald Eagle Archaeological Research Program has been the realistic application of these research objectives. Given the scarcity of previous anthropological research in the area, it was clear that progess had to be made along numerous lines simultaneously. Fieldwork carried out before the development of our paleoecological model would threaten the suitability of the archaeological data base once comparative analyses began. At an even more problematic level, the collection of settlement data over such a diverse landscape demanded the application of methods that were largely unproven as to their practicality and accuracy of results. Our phasing of sites depended upon cross-dating artifacts that were only tenuously assumed to be chronologically sensitive. Finally, the piecemeal availability of personnel and finances made it clear that the principal research goal of the Bald Eagle Archaeological Research Program had to be viewed as a target and that the execution of the Program in its entirety would be a considerable challenge.

Realistically operationalizing the research design under these conditions has called for the fullest use of the resources available to us. These can be grouped under five headings.

1. Agency Sponsored or "Contract" Archaeology--The results of work carried out under the Department of Anthropology's contract archaeology program have been an important source of information to the Program. Divided into Reconnaissance (literature review and spot collector interviews), Phase I (comprehensive collector interviews and spot field work), Phase II (problem-specific field work), and Phase III (intensive excavation) levels of analysis, this work has to date provided information on a number of linear transects that have crosscut several of the major environmental zones of the region.

2. National Register Survey Program--Guildelines for an extensive program of site survey in Pennsylvania were prepared by the Pennsylvani Historic and Museum Commission in 1978. The goals of this program were twofold: 1) the discovery of large numbers of sites in environmentally diverse settings and under tightly controlled archaeological conditions that could serve as a control over the existing state site

files and could be used for coarse scale site prediction, and 2) the discovery of National Register candidate sites. Eleven large areas were selected by the State Archaeologist as target study areas. One of them, District 9, overlapped major portions of the Bald Eagle Creek watershed and drew The Pennsylvania State University's immediate attention. Some of the important environmental characteristics of District 9 are presented in Chapter 3 while Chapters 4-6 detail the design and results of the survey carried out in portions of the District in 1978. We have included this material in the volume dealing with Fisher Farm since all areas surveyed in 1978 were within the Bald Eagle Creek watershed and many of the discoveries made by the survey bear directly on problems related to the local Late Woodland settlement pattern of which Fisher Farm is one component. The National Register Survey Program in District 9 has developed into a multi-year research effort and our data base from the Bald Eagle Creek watershed and adjacent areas is constantly growing.

3. Masters and Ph.D. Research--Students in the graduate program at The Pennsylvania State University have participated directly in the Bald Eagle Archaeological Research Program. The topics addressed in their research range from critical evaluations of methods to model building. Without the constraints imposed by agency-sponsored surveys, their research has filled spatial and topical gaps in the regional program.

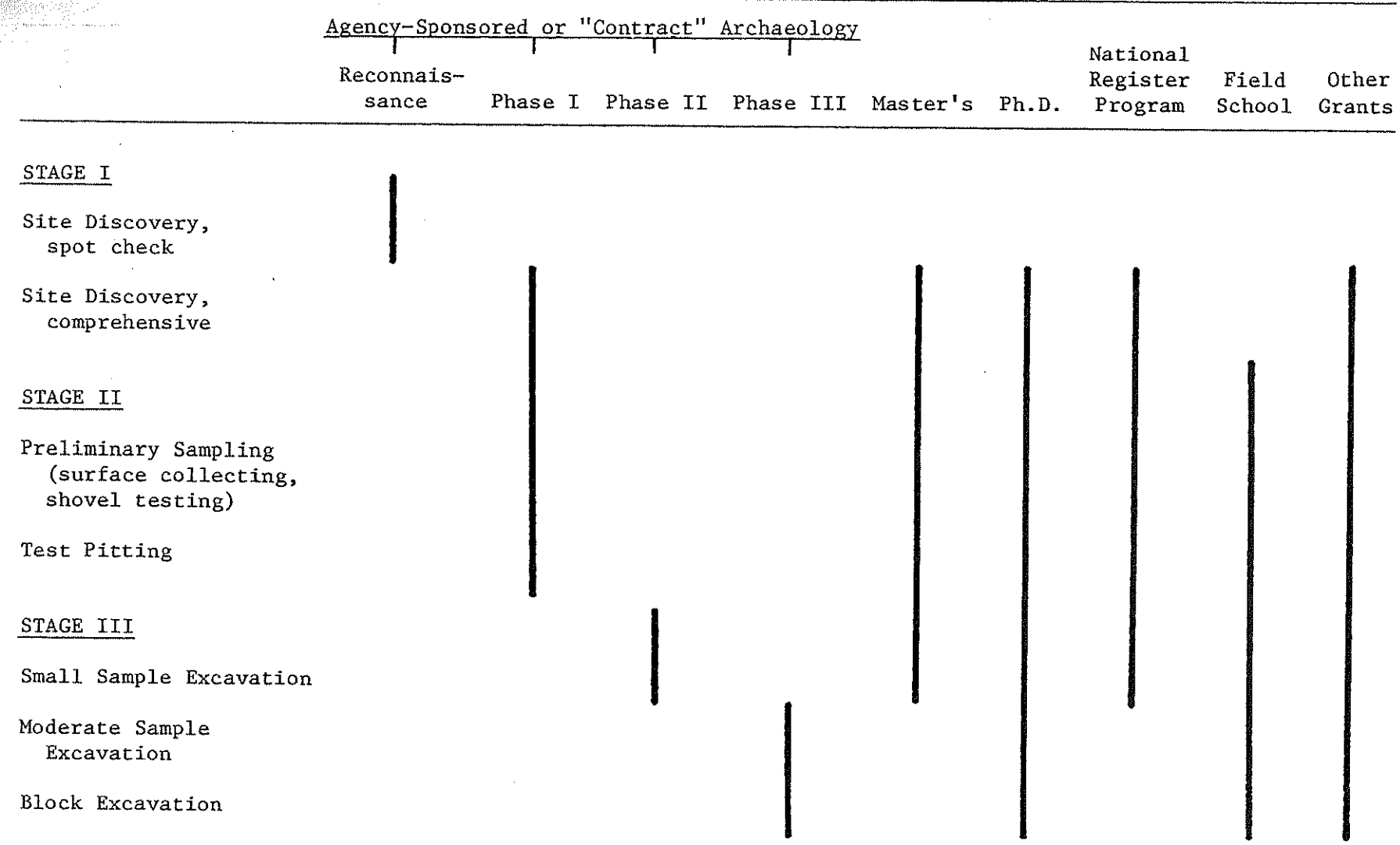
4. Field School in Archaeology--Excavations at the Milesburg (Webster et al. 1977), Houserville (Shindler et al. in prep.), and Fisher Farm sites between 1975 and 1978 were carried out under the Department of Anthropology's field school courses. These courses provide opportunitites to intensively investigate the settlement system aspects of key sites in the regional site matrix. The interest of many students goes beyond that of field work, as is apparent by the authorship of several chapters in this volume.

5. Non-contract Grants--Funding that comes from sources other than agencies required to contract services is viewed as the best way of filling gaps in the regional program left by the four resources described above. To date, such funding has been used for laboratory analyses of macrobotanical and radiocarbon samples. In the future, such funding will also be used for intensive excavations and paleoenvironmental research.

The relationship between the several levels of field work required by the Bald Eagle Archaeological Research Program and the five sources of funding and personnel is shown in Table 2.1. The integration of these resources in the program insures that those with variable applications are applied to the research level most in need of investigation at the moment, and that the results of each project articulate with those of prior or subsequent ones.

Just as the 3 stages of field work provide information for the phase and environmental setting dimensions of the settlement matrix, analyses of archaeological materials from these sites provide the basis for a site typology by reconstructing their demographic, seasonal, activity, and resource characteristics. The discipline has experienced a remarkable

Table 2.1: Relationship Between Program Resources and Fieldwork



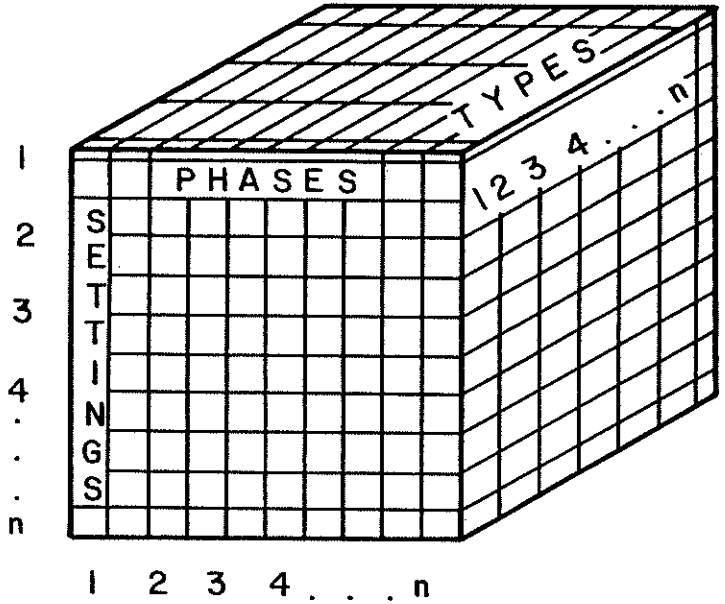
growth over the past 25 years in the variety of data types and research techniques amenable to demographic, seasonal, activity, and resource problems. A partial list of the techniques relevant to settlement system research in the Bald Eagle watershed is presented in Table 2.2. Most of these, of course, are only applied to key, excavated sites in the settlement matrix.

The Bald Eagle Archaeological Research Program is constantly evolving. The chapters of this and future volumes in the series will show its many research paths. To date, research has been carried out using many of the approaches listed in Table 2.2 and has been based on all 5 resource categories listed above. Efforts in paleoenvironmental modeling have met with good predictive success in those portions of the region where they have been applied. This volume presents the results of 2 projects, and several more are currently underway.

Table 2.2: Foci of Settlement System Studies in the Bald Eagle Archaeological Research Program

ARCHAEOLOGICAL PHASES

Radiocarbon Dating
Ceramic Studies
Lithic Tool Studies
Geomorphology, Pedology



SITE TYPES

(Defined by Demographic, Seasonal, Activity, and Resource Information)

Regional Movement of Materials
Experimental Knapping
Wear Analysis
Heat Treating, Fracture Tests
Paleofaunal, Paleofloral Studies
Feature Analyses
Site Size, Activity Area Analyses

ENVIRONMENTAL SETTINGS

Diachronic Climatology
Hydrology
Geology, Topography
Floral, Faunal Surveys (Diachronic)
Floral, Faunal Ethology
Floral, Faunal Energetics
Paleobotanical, Paleofaunal Studies
Palynology
Geomorphology, Pedology
Soil Fertility Analyses
Lithic Resource Surveys

CHAPTER 3

A PALEOENVIRONMENTAL RECONSTRUCTION OF DISTRICT 9

IRA C. BECKERMAN

I. INTRODUCTION

The purpose of a paleoenvironmental reconstruction should not simply be that of a backdrop for the culture history of an area. Using the paradigm of cultural ecology, archaeologists seek to rediscover the adaptations which prehistoric groups made to the world around them (Steward 1955). Standing in the way of our interpretation is an infinitely complex environment. With thousands of plant species, hundreds of bird species, a hundred soil types, topographic variation, climatic variation, and all of their interactions to deal with, environments can never be completely described. Instead, researchers must be able to isolate those environmental parameters relevant to the problems under investigation.

One recent ecological theory that has received some attention from anthropologists, especially those interested in hunter-gatherers, is optimal foraging theory (Schoener 1969; Pianka 1974; Smith 1979). This theory develops the postulate that organisms will attempt to maximize their rate of nutrient intake. Using linear programming, Keene (1979) has applied this theory toward an understanding of modern Eskimo adaptations, while Gage (n.d.) has applied derivatives of the theory in his research of agricultural choices in Samoa. Although the applicability of this theory with prehistoric groups has yet to be proven, it promises to be a framework on which to build.

The theory's strong emphasis on food (nutrient) and its spatial availability directs the focus of ecological reconstruction toward the important plant and animal resources which could be consumed by an area's prehistoric inhabitants. Given any locus within an area, it asks what net return per species and per unit time a particular food could provide to an individual or group. To solve this, we must know species densities and availability over time. Availability involves visibility and ease of capture, not simply that item's abundance. Measuring availability is a crucial and difficult problem, but it will be bypassed here.

It is not possible to measure the contemporary density of food items in District 9 and use these figures to generate a reconstruction, since the physical environment today is very different from that of two centuries ago. There are only a few acres of virgin forest left. Some species, such as mountain lion and elk, have been eradicated from the area, while deer and rabbit are in higher densities today than at any previous time. Even using the environment in 1800 A.D., as recorded by surveyors and naturalists, to extrapolate back to the distant past is risky.

The model used here tries to capture those important processes which determine the ecological system, especially for forest and animal life.

At this level of analysis, only broad qualitative statements can be made, although rigorous quantitative application of the model should provide closer approximations of the prehistoric system. Geology, physiography, and climate are treated as the controlling influences for soils, plants and animals (Figure 3.1). These influences are held constant for the time span under consideration here, from 8500 B.P. until the present. They are treated more or less in a deterministic fashion, with solid arrows showing the direction of effect and dashed arrows showing lesser effects. For example, soils and plants are mutually interactive, but soils exert a much greater influence.

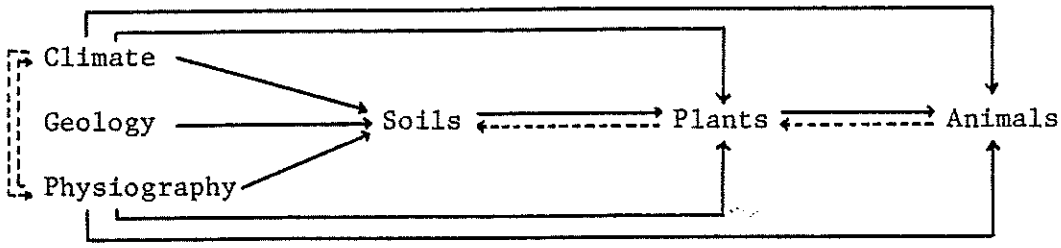


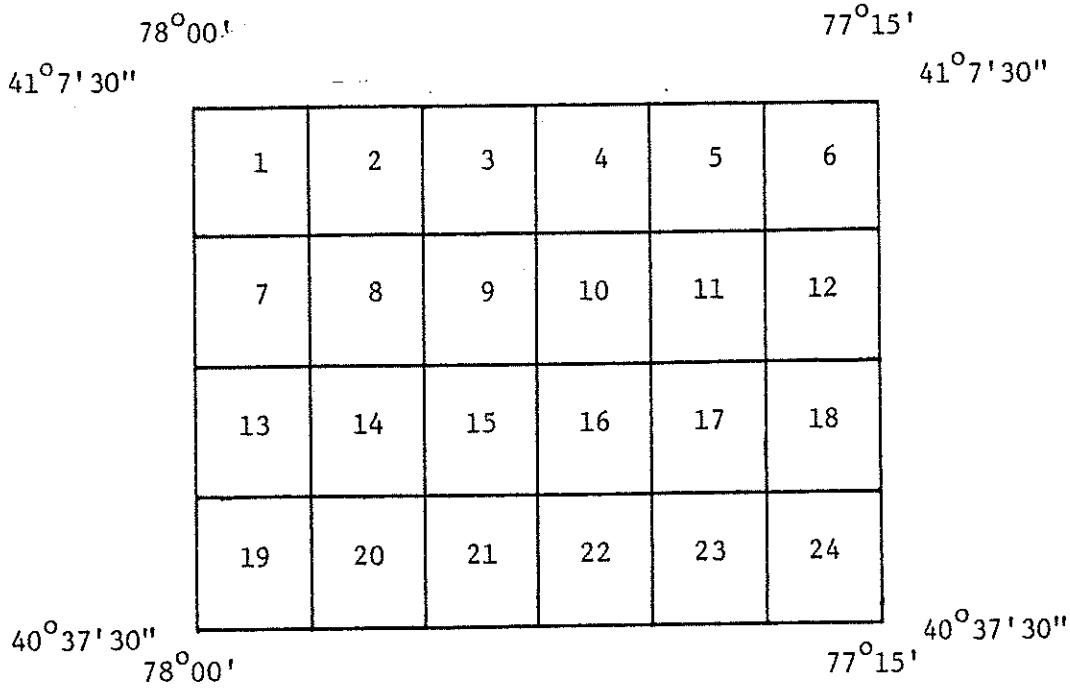
Figure 3.1: The Environmental Model

Emphasis will be placed on soils and topographic information. Using current soil survey information and factoring out the changes in the last two centuries, a reasonable reconstruction for pre-European conditions can be offered.

II. GEOLOGY AND TOPOGRAPHY OF DISTRICT 9

District 9 is composed of 24 seven and one-half minute USGS topographic quadrangles, located in central Pennsylvania. It is bordered on the north by 41°7'30" latitude, just south of Lock Haven and by 40°37'30", near Lewistown. East-west, District 9 is bordered by 78° and 77°15' longitude, comprising a total of 1379 mi^2 (3573 km^2). The district contains most of Centre County and portions of six other counties; Clinton, Huntingdon, Juniata, Mifflin, Snyder, and Union (Figures 3.2 and 3.3). The border between two distinct physiographic provinces runs SW-NE through the northwest corner of the area (Figure 3.4). To the northwest lies the Unglaciated Allegheny Plateau Section of the Appalachian Plateau Province (Fennemann 1938). This section consists of the eroded Allegheny Peneplain, dissected by deep angular valleys. The Allegheny Peneplain is older than the Harrisburg Peneplain, visible in the Ridge and Valley section, and may equate with the Schooley Peneplain, also visible in the Ridge and Valley Section. The geologic material underlying the Allegheny Plateau consists of more shale than sandstone, although it is the resistant sandstones which account for the fairly even ridge surface topography at an elevation of about 1800-2000'.

The majority of District 9 lies in the Middle Section of the Ridge and Valley Province. Here in the Susquehanna-Potomac Segment, the topography is distinguished by a series of nearly parallel mountain ridges separated by valleys. Most of these ridges are even-crested and continuous,



1. Snow Shoe
2. Snow Shoe SE
3. Howard
4. Beech Creek
5. Mill Hall
6. Loganton
7. Bear Knob
8. Bellefonte
9. Mingoville
10. Madisonburg
11. Millheim
12. Woodward
13. Julian
14. State College
15. Centre Hall
16. Spring Mills
17. Coburn
18. Weikert
19. Pine Grove Mills
20. McAlevys Fort
21. Barrville
22. Burnham
23. Alfarata
24. McClure

Figure 3.2: USGS 7-1/2 Minute Quadrangles in District 9

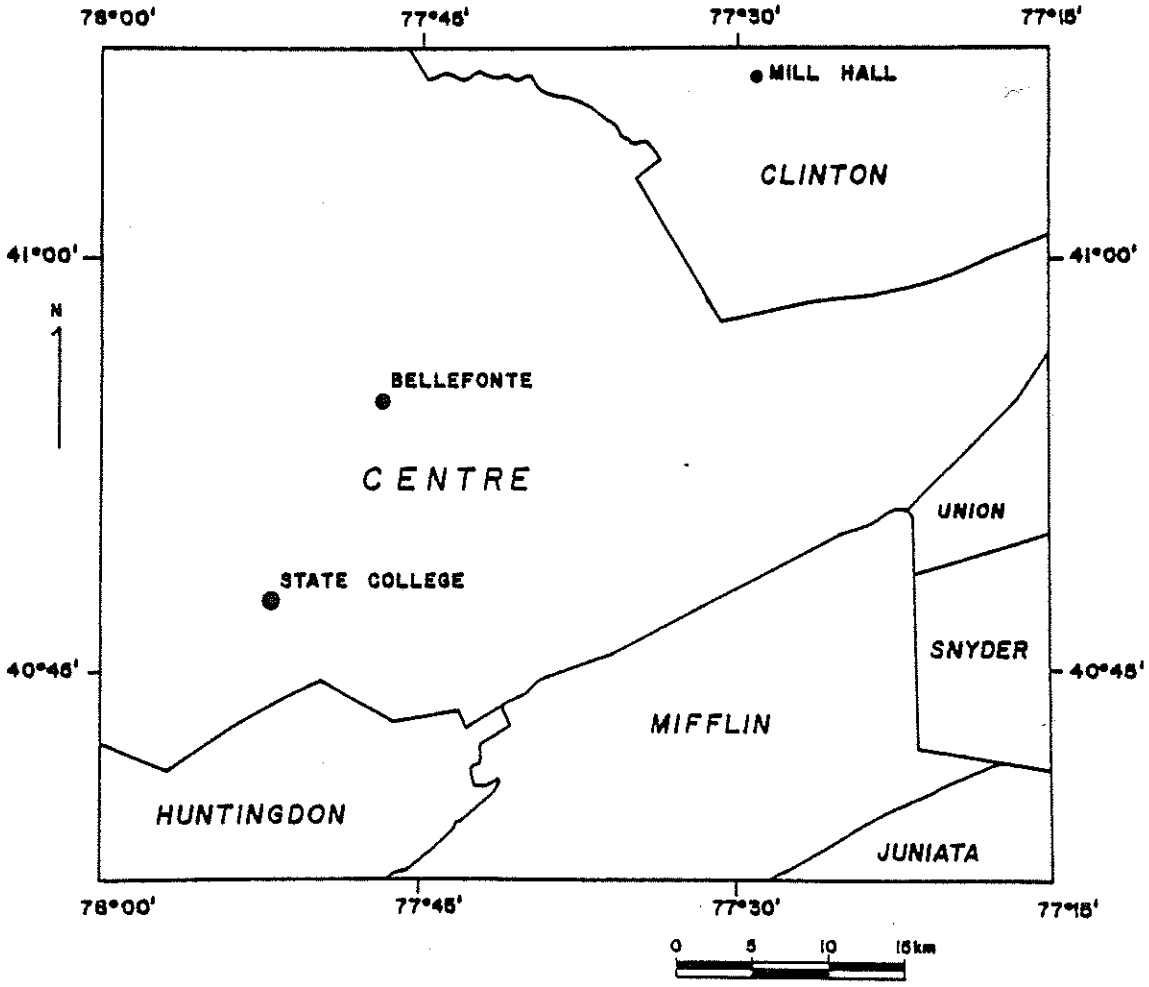


Figure 3.3: Counties within District 9

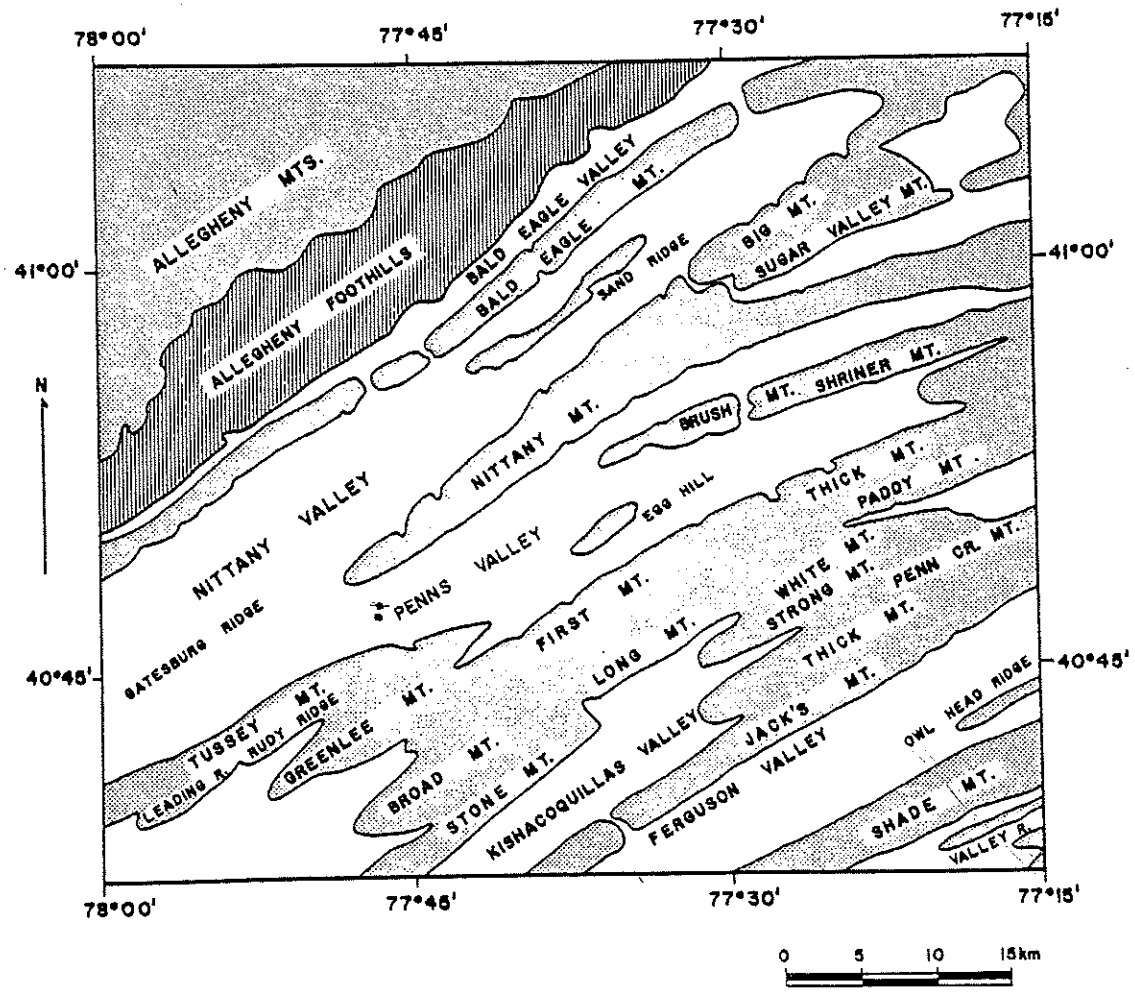


Figure 3.4: Principal Geographic Features in District 9

and were formed by the differential erosion of base-levelled folds. They may be anticlinal, synclinal, or monoclinal, although anticlines dominate in this area. At 1700-1800', Bald Eagle Mountain runs linearly and is separated from the Plateau by a straight, unbroken valley lowland. The larger valleys, such as Nittany and Kishacoquillas, stand out as patches of Ordovician limestone and are surrounded by mountain ridges composed of Silurian sandstones. Nittany Valley is the largest valley in the District, being 75 mi long and from 2 to 10 mi wide. The average elevation of the valley floor is 1100', with the ridges surrounding it standing at 1800-2100'. Kishacoquillas Valley to the south is similar to Nittany Valley although it is smaller and lower (800-900').

The hydrography of central Pennsylvania shows a distinct trellised drainage pattern (Butts and Moore 1936). Bald Eagle Creek drains the largest watershed in the District. Other major streams include Spring, Fishing, Kishacoquillas, and Beech Creeks (Figure 3.5). All northward flowing streams drain into the West Branch of the Susquehanna River, while those flowing east enter the Main Branch and those flowing south enter the Juniata River.

Since geologic activity in District 9 has strongly conditioned local topography, hydrology, and soils, a short summary of the area's geologic history and formations is in order.

The oldest Paleozoic strata found in the district is the Warrior Formation, of Cambrian age (Butts and Moore 1936). One remnant of this formation is located a few miles northwest of State College (Figures 3.6 and 3.7). During the Cambrian Period, Pennsylvania and much of the middle United States were submerged under a large sea. After the Warrior Epoch, Central Pennsylvania was still submerged, but was bordered by lowlands which formed a great quantity of quartz sand. This sedimentation produced the Gatesburg Formation. At the end of the Mines Epoch, the sea floor was uplifted to dry land, producing the Larke Formation in Huntingdon and Blair Counties. With the start of the Ordovician Period, the area was again submerged, resulting in a fairly pure calcium carbonate deposition that became the Beekmantown Group. After reemergence, another submergence marked the beginning of the Loysburg Epoch. With the coming of the Reedsville Epoch, there was a distinct change in deposition brought about by an uplifting of the sea floor, warping, and a shallowing of water. During the Reedsville, clastic materials dominate, a trend which continued to Tonoloway times. There was a trend toward the movement of the coastal shelf southeastward after the end of Reedsville, causing sandy and muddy sediment to be deposited in the area.

This trend culminated in the Tuscarora epoch, which was characterized by pure quartz sand at the start of the Silurian Period. During the Bald Eagle Epoch, the area was probably above ground, but it was submerged during the Clinton. Pure limestones were formed by calcium carbonate deposition during the McKenzie Epoch. The Devonian Period found the area under a narrow Helderberg Sea. The Oriskany Formation is characterized by sandstones formed by stream sediment transported to the sea. Marcellus, Hamilton, Portage, and Chemung Formations were all formed in a landlocked bay or gulf.

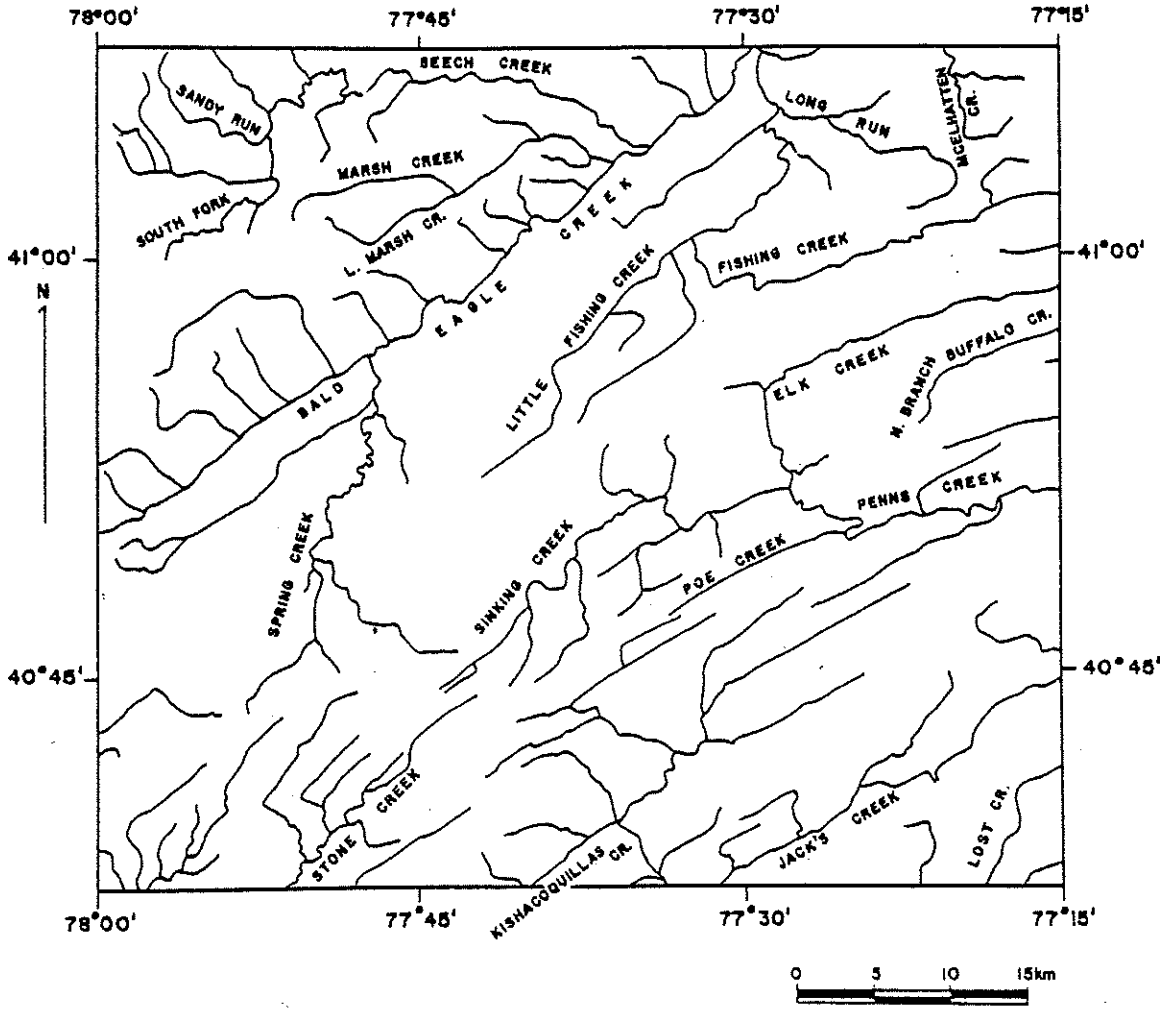


Figure 3.5: Major Streams in District 9

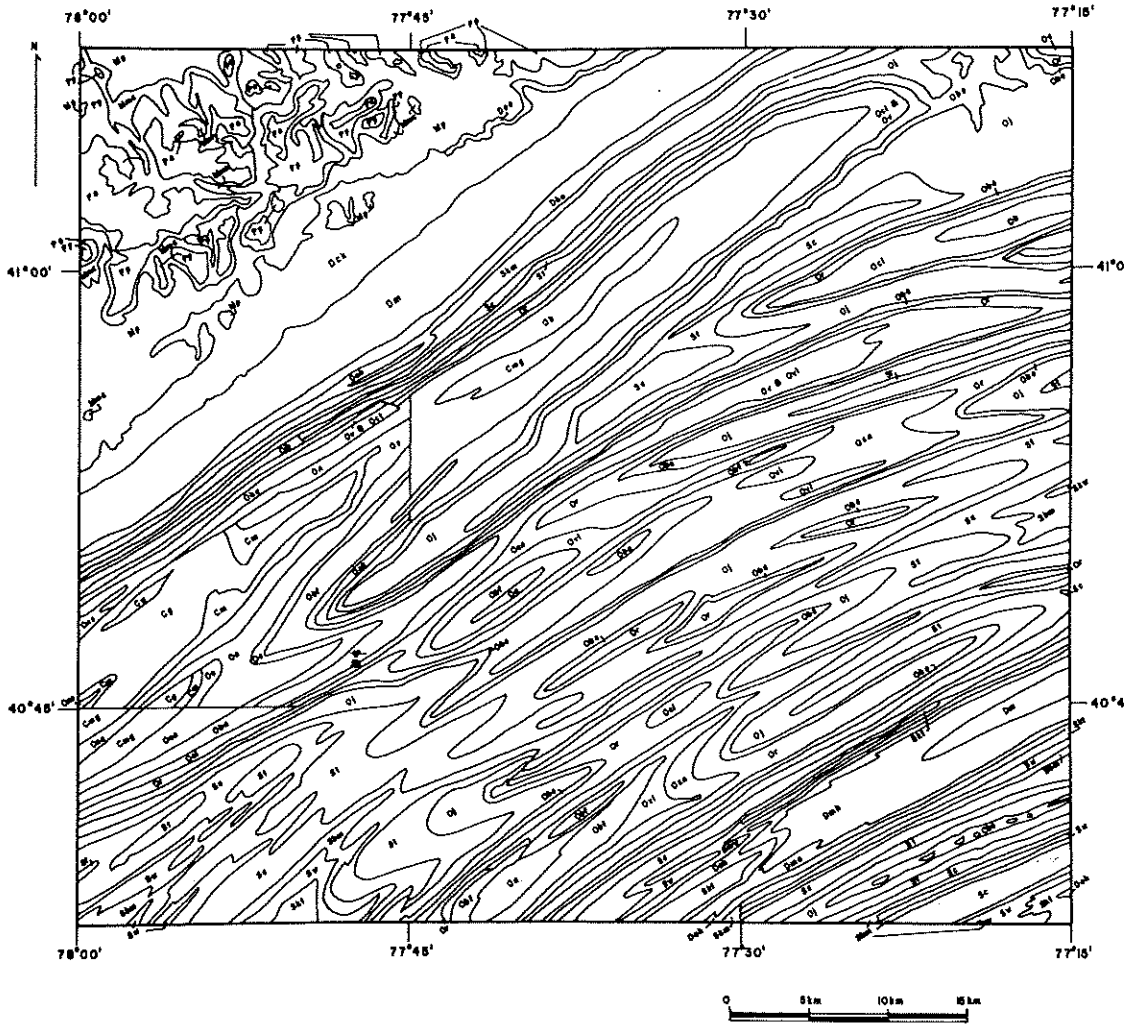


Figure 3.6: Geologic Formations in District 9

Key to Figure 3.6.

Formation		Composition
	Cambrian	
Warrior	Cw	Shales and Limestones
Cg and Cm	Cmg	Limestones and Sandstones
Gatesburg	Cg	Limestones and Sandstones
Mines	Cm	Limestones and Dolomites
	Ordovician	
Beekmantown Group (Ons and Oba)	Ob	Limestones and Dolomites
Os and On	Ons	Limestones and Dolomites
Stonehenge-Larke	Os	Limestones and Dolomites
Nittany	On	Limestones and Dolomites
Oa and Obf	Oba	Limestones and Dolomites
Axemann	Oa	Limestones and Dolomites
Bellefonte	Obf	Limestones and Dolomites
Ovl and Ocn	Ocl	Limestones and Dolomites
Loysburg, Hatter, Benner, and Curtin	Ovl	Limestones and Dolomites
Nealmont, Salona, and Coburn	Ocn	Limestones and Dolomites
Reedsville	Or	Shales
Obe and Oj	Ojb	Sandstones and Conglomerates
Bald Eagle	Obe	Sandstones and Conglomerates
Juniata	Oj	Sandstones and Conglomerates
	Silurian	
Tuscarora	St	Sandstones and Conglomerates
Clinton Group	Sc	Sandstones and Shales
Sbm, Sw, and Skt	Skm	Shales and Limestones
McKenzie and Bloomsburg	Sbm	Shales and Limestones
Wills Creek	Sw	Shales and Limestones
Sw and Skt	Skw	Shales and Limestones
Keyser and Tonoloway	Skt	Limestones and Dolomites
	Middle and Lower Devonian	
Dhb and Do	Doh	Shales and Limestones
Helderberg	Dhb	Shales and Limestones
Oriskany	Do	Sandstones and Limestones
Dmo and Dmh	Dho	Sandstones and Shales
Onondaga and Marcellus	Dmo	Limestones, Sandstones, and Shales
Mahantango	Dmh	Sandstones and Shales

Key (Continued)

Formation		Composition
	Upper Devonian	
Marine Beds	Dm	Sandstones and Shales
Catskill	Dck	Sandstones and Shales
Oswayo	Doo	Sandstones and Shales
	Mississippian	
Pocono	Mp	Sandstones and Conglomerates
Mauch Chunk	Mmc	Sandstones and Shales
	Pennsylvanian	
Pottsville Group	Pp	Sandstones and Conglomerates
Allegheny Group	Pa	Limestones, Sandstones, and Shales

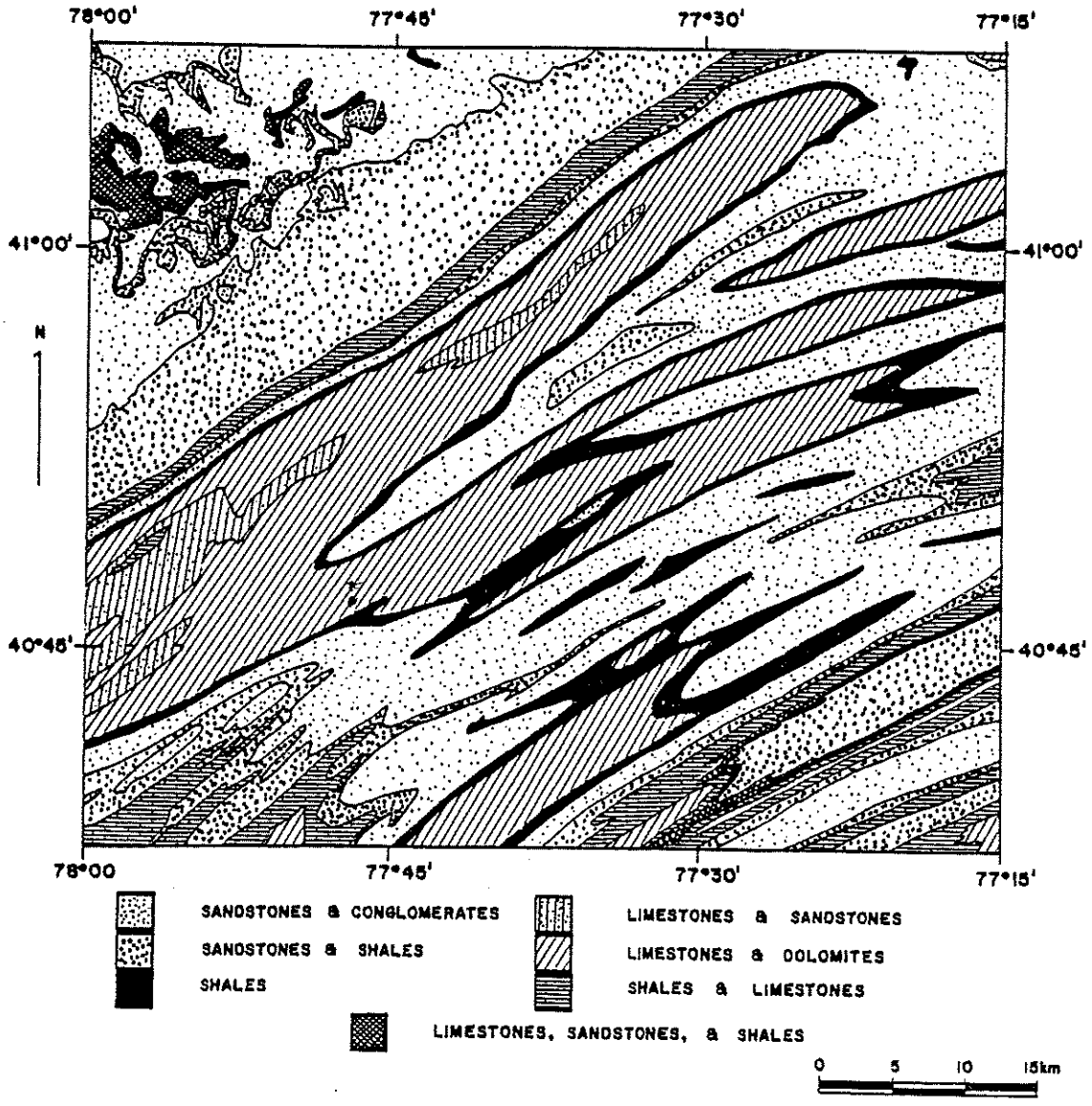


Figure 3.7: Composition of the Geologic Formations in District 9

Sedimentation continued during the Carboniferous Period, but in addition, abundant vegetal growth was deposited in extensive marshes. Beginning with the Pottsville Formation, a sining trough formed in the region. Rapid streams deposited a large quantity of coarse material, continuing into the Allegheny Epoch. Beds of shale, sandstone, limestone, and coal were the result.

The Mesozoic and Cenezoic Eras are characterized by a series of deformation and erosional cycles (Figure 3.8). The Mesozoic began with the emergence of dry land due to the uplifting of the sea bottom. Early Mesozoic folding of sedimentary beds produced high anticlines and deep synclines, warping which produced the present Appalachian Mountains. The first of three erosional cycles of this era formed the Kittatinny Peneplain during the Jurassic. Remnants of this peneplain are still visible as the crest of Tussey Mountain and the crest of the Allegheny Front. Uplift and subsequent erosion after the Kittatinny Peneplain but before Upper Cretaceous times produced the Schooley Peneplain, today visible at an elevation of from 1500-1800'. The last of the major peneplains, the Harrisburg Peneplain, formed after the Schooley. One result of these sequences of uplift and erosion is the presence of numerous gaps in the area, the most visible ones at Milesburg and Mill Hall through the Bald Eagle Mountain.

There is no evidence for Illinoian or Wisconsin Glaciation in the District, although the presence of fragipan soils in the area indicate either an earlier glaciation or glacial climate.

Although many geologic formations are found in District 9, only a few are common. The Gatesburg Formation (Cg) is composed of interbedded dolomite, dolomitic limestone, shaly dolomite, and sandstone (Figure 3.6). The dolomite is dark steely blue and coarsely crystalline. Gatesburg weathers to sand and some clay, producing a rolling topography covered with blocks of sandstone, limestone, and dolomite. The soils formed on this material are sandy and quite barren.

The Beekmantown Group (Ob) is a series of limestone formations of Ordovician age, namely Stonehenge (Os), Nittany (On), and Axemann (Oa). Stonehenge limestone is a comparatively pure limestone which weathers to leave isolated flat-topped mesa-like masses. Sink holes are common in contact points between Stonehenge and Mines Formations. Nittany dolomite produces a gently rolling landscape with good agricultural soil. Axemann limestone is pure, fossiliferous, and produces a similar topography to that of Nittany dolomite.

The Reedsville shales (Or) are brown, greenish, and black clayey to sandy shales which crop out at the base of mountains and along the slopes of anticlinal valleys. They yield a clayey soil which is too high in iron and low in pH to be agriculturally productive.

The Bald Eagle Formation (Oswego) (Obe) is a non-fossiliferous formation of arkosic sandstone and conglomerate. The color is brown to gray with reddish beds, and is well-cemented and resistant to weathering. Bald

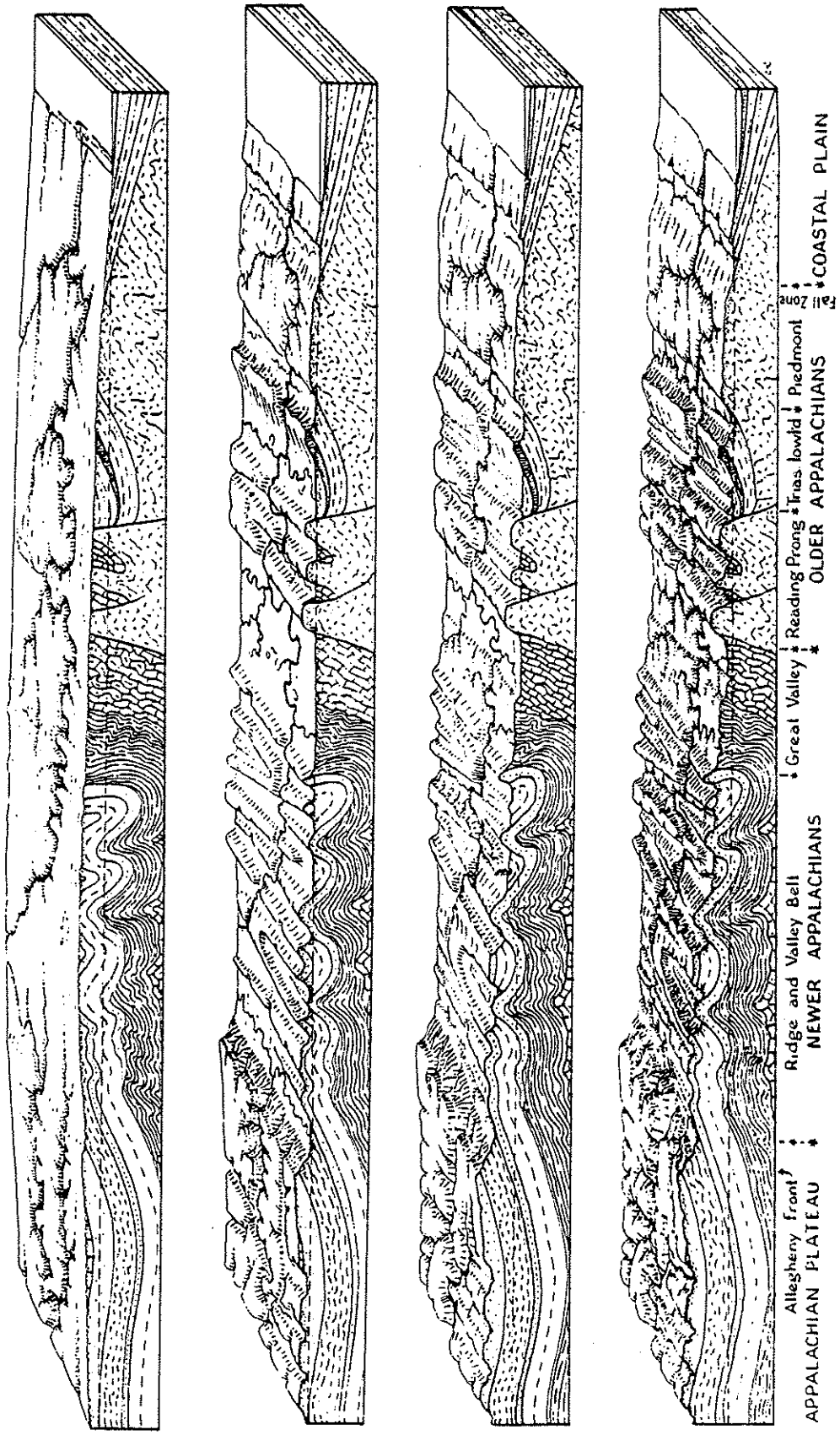


Figure 3.8: Geologic Evolution during the Mesozoic and Cenezoic Eras (after D.W. Johnson 1931 Stream Sculpture on the Atlantic Slope)

Eagle sandstones are distributed on the crest of several ridges, including Tussey, the south crest of Bald Eagle, Nittany, Brush, Shriner, and First Mountains.

The Juniata Formation (Oj) intergrades from the Bald Eagle Formation into a bright to dull red shale and sandstone formation. It is found in valleys between the double crests of Bald Eagle and Tussey Mountains, and it weathers to a rolling hill topography. Juniata soil parent material makes good farm land and supports a fine forest growth.

The Tuscarora Formation (St) is composed of white to gray quartzite sandstones which are very resistant to weathering. It forms the ridge crests of Greenlee, Broad, Stone, Paddy, Thick, and Strong Mountains as well as the northwest edge of Bald Eagle Mountain.

The Clinton Formation (Sc) is composed of a green, thin-bedded, soft shale, interlayered with thin layers of impure limestone and a few sandy streaks of shale. It is found in the upper slopes of Bald Eagle and Nittany Mountains, on the lower slopes of Strong and White Mountains, and in upper valleys in the southwestern corner of the District.

The Pocono Group (Mp) is composed of two parts. The lower part is thin-bedded gray, brown, red, or yellowish arkosic and shaly sandstones. The upper part, known as Burgoon sandstone, is composed of a thick-bedded, gray, quartz sandstone. The Pocono Formation forms the caps for the Allegheny Plateau.

The Pottsville Group (Pp) is a sandstone and quartz conglomerate that forms a thin cover on high knobs, and the Allegheny Group (Pa) is a cyclic sequence of sandstone, shale, limestone, and coal. Both are located in the Allegheny Plateau.

III. LITHIC RESOURCES

A number of these formations contain flint and chert bearing strata (Figure 3.9). While these lithic resources may not be at or near the surface everywhere in the formation, with few exceptions (such as the deposition and movement of cobble-sized chert fragments in stream beds) it is unlikely that these resources could be found outside the boundaries of the formation.

1. An oolitic chert is found in the Mines dolomite formation. The formation averages 150-200" thick, with the chert found in isolated 20" thick layers.

2. Cherty dolomite can be found in the lower 88' of the Nittany dolomite formation. Small amounts of a dense dolomite of siliceous appearance can be found in the Bellefonte dolomites.

3. Grey chert is located in the Helderberg Formation and a cherty limestone can be found in the Oriskany Formation.

4. Flint and chert can be found in Axemann limestones. The cherty dolomites of the Nittany and Bellefonte dolomites as well as the

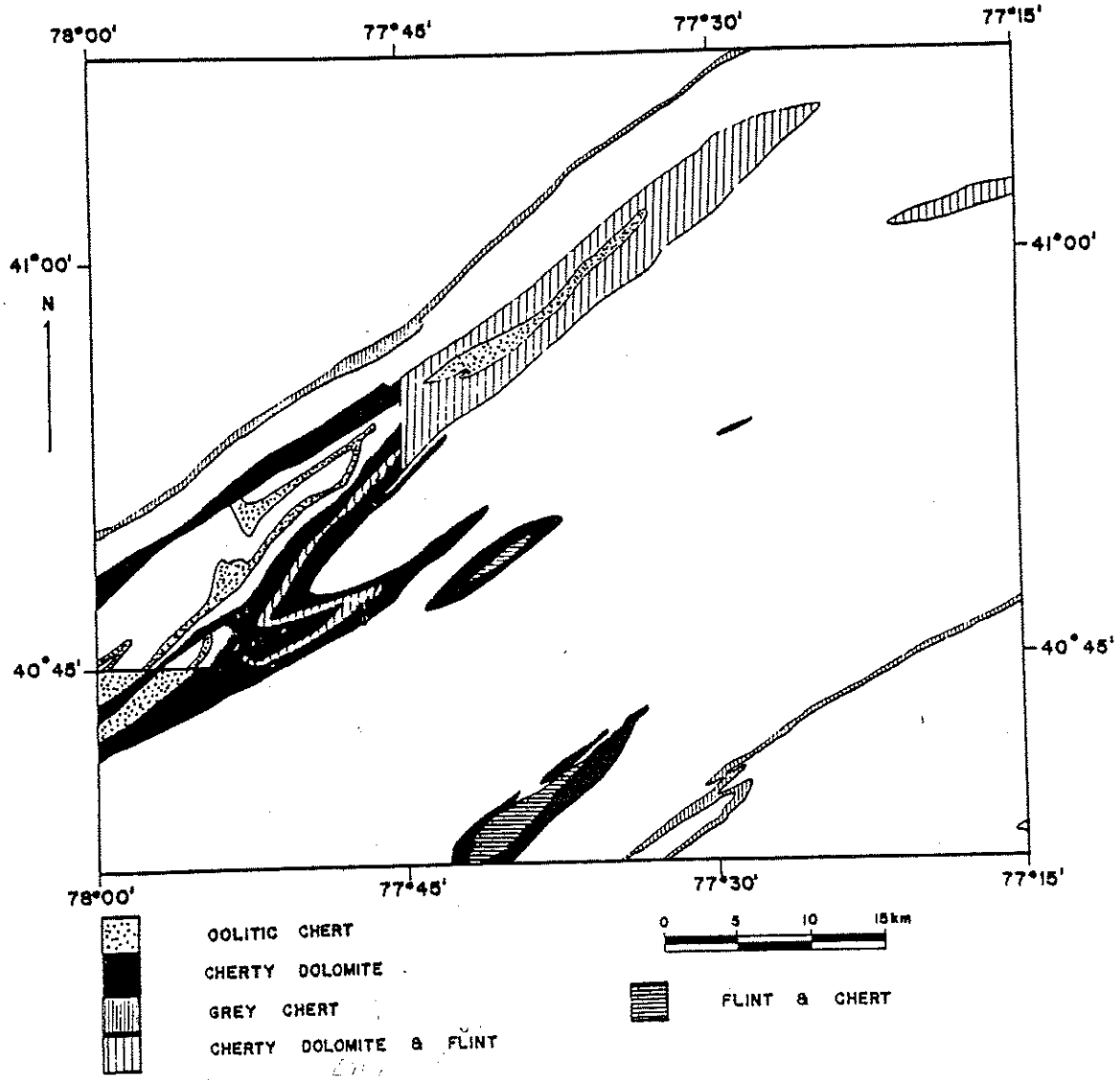


Figure 3.9: Major Lithic Resource Areas in District 9

cherts of the Axemann limestones are grouped together under the Beekmantown Group.

5. Jasper may be found in the Bald Eagle Formation.

IV. CLIMATE

The two components of climate which affect plant and animal life are temperature and precipitation. Both of these factors show considerable variation between the two major physiographic provinces. Generally speaking the Plateau is cooler and wetter than the Ridge and Valley Province, although altitudinal differences can supercede location.

The cooler conditions in the Plateau are exemplified by the shorter growing season, averaging 135-140 days, versus an average of 150-160 days in the Ridge and Valley Province. January and July average temperatures do not differ greatly; however, important differences in precipitation exist between the two provinces (Bliss 1941). Annual precipitation in the Plateau is 40-43", compared to 37-39" in the Ridge and Valley province. There is also a steady west to east gradient of decreasing precipitation through the western part of the District, with lows in the larger valleys of the Ridge and Valleys. The difference in precipitation is due to storms which travel perpendicular to the Allegheny Front; that is, from a direction of from 200-320° (Dutton 1962).

Most of the local differences in climate are due to topographic variation. Higher elevations generally receive more precipitation, up to 9" per year per 1000' increase in elevation (Reich 1966; Smallshaw 1953; Harsh 1962). Again this correlation holds only for storms perpendicular to the Allegheny Front. The contour of the landscape also affects temperature. Valleys, which have a concave topography, tend to have an increased daily and annual temperature range due to lower minimums. Mountain crests, with a convex topography, have decreased daily and annual temperature ranges. Slope locations are least exposed to temperature extremes (Landsberg 1958).

There is considerable daily circulation of mountain to valley winds. In the morning, air lying along inclined mountain slopes, especially southern slopes, is heated and rises, creating slope winds. During the day, the valley will become warmer than the mountain slopes, diminishing slope winds and increasing through-valley air movement. In the evening, air just above the mountain slopes is cooled rapidly and subsides along the slopes. This leads to a pattern of convergence and mean upward air motion over the valleys and subsidence over the hills. At night, the downslope motion diminishes and, as during the day, the wind blows down the valley. The cross-valley breezes created by this daily variation result in the wind being directed toward the slopes having higher temperatures (Myers 1963).

V. SOILS

The first dependent variable in our systematic model is soil. The factors that lead to distinctive soil formations include climate, geology (parent material), physiography (relief), biota, and time (Jenny 1941). To describe the variation in soil is to describe the variation in climate, geology, and physiography.

A soil association is a grouping of soils that occur together geographically and are formed from similar parent material. A brief description of the soil associations comprising District 9 is presented below. Figure 3.10 shows the location of these associations. These data were taken from the General Soils Map of Pennsylvania (USDA Soil Conservation Service). The characteristics of the most important soil series in each association are presented in Table 3.1.

Leck Kill-Calvin-Meckesville--This association consists of upland soils formed from a residuum (Leck Kill, Calvin) or colluvium of glacial till (Meckesville) from red shale, siltstone, and fine grained sandstones. It is found geologically on the Upper Devonian Catskill Formation.

Berks-Weikert-Bedington--This association consists of upland soils formed in a residuum of shale, siltstone, or fine-grained sandstones. It is found geologically on the Marine Beds, Onondaga, Marcellus, and Mahantango Formations.

Hazelton-Laidig-Buchanan--This association consists of upland soils formed in a residuum of acid gray and brown sandstone (Hazelton), colluvium from sandstones, shale, and siltstone (Buchanan), and acid gray sandstone and shales (Laidig). It is found geologically on the Juniata, Bald Eagle, and Tuscarora Formations and the Clinton Group.

Hazelton-Cookport--This association consists of upland soils formed in a residuum of acid gray and brown sandstones (Hazelton) and interbedded sandstones and siltstones (Cooksport). It is located geologically on the Juniata and Bald Eagle Formations.

Gilpin-Ernest-Wharton--This association consists of upland soils formed in a residuum of interbedded gray and brown acid siltstones, shales, and sandstones (Gilpin, Wharton) and on lower footslopes and fans formed in a colluvium of the same material. It is located geologically on the Mauch Chunk Formation, and the Pocono, Pottsville, and Allegheny Groups.

Hagerstown-Edom--This association consists of soils on the valley floors and adjacent uplands formed in a residuum of fairly pure limestone (Hagerstown) and on the gently sloping uplands formed from a residuum of interbedded shaly or platy limestone and calcareous shales (Edom). It is located geologically on the Ordovician Beekmantown Group, and the Loysburg, Hatter, Benner, and Curtin Formations.

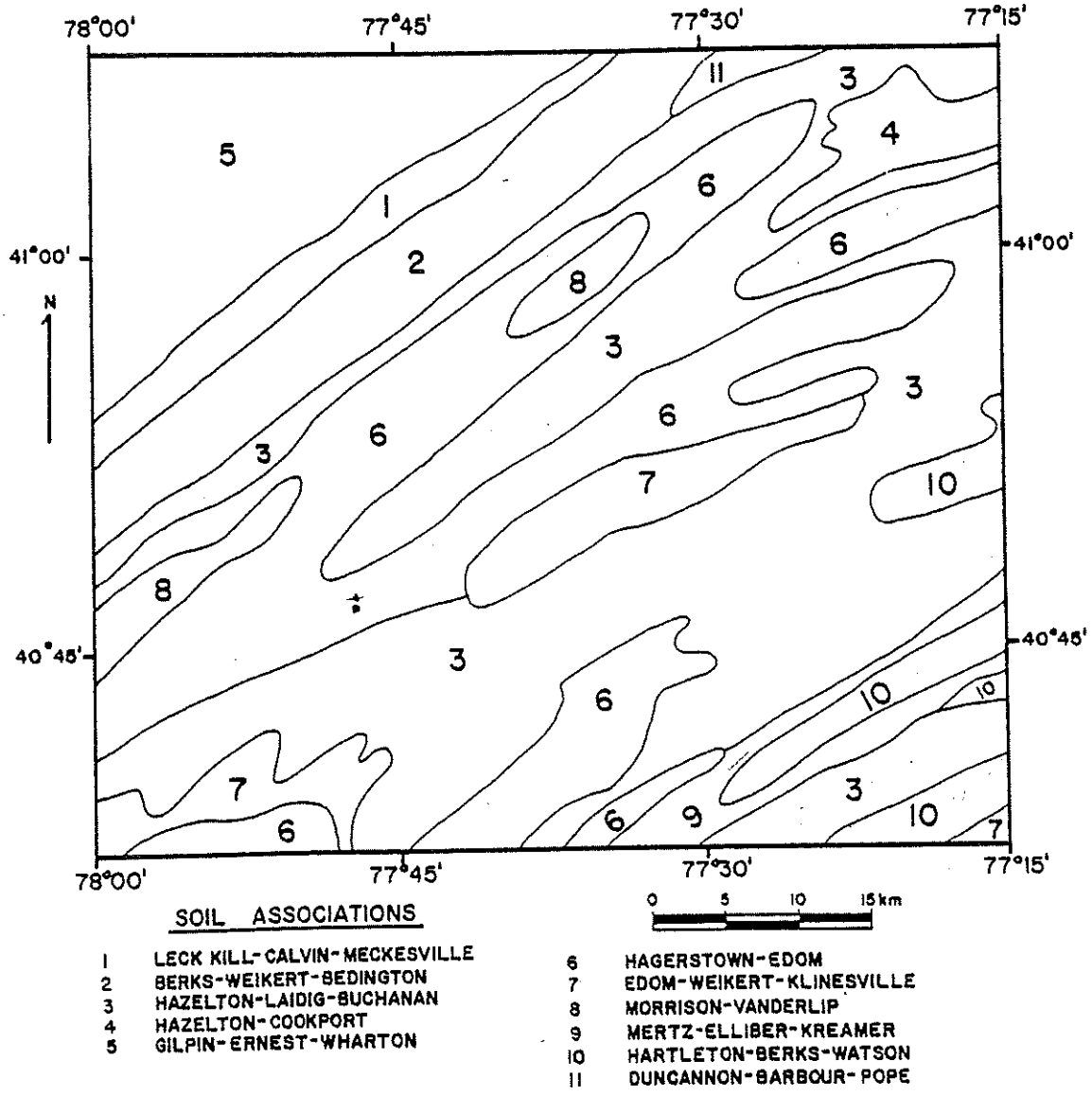


Figure 3.10: Soil Associations within District 9

Table 3.1: Soil Series Attributes

Soil Series	Taxonomic Subgroup[1]	De	Dr	CF	AWC	BS	pH	SQ	AP
Calvin	Typic Dystrochrept	MD	WD	M	VL	BL	4.8-5.0	G	P-F
Leck Kill	Typic Hapludult	D	WD	M	VL	VL	3.7-4.6	F-G	P-F
Meckesville	Typic Fragiudult*	D	WD	L	M	L	4.1-5.5	VG	P-G
Berks	Typic Dystrochrept	MD	WD	L	VL	L	4.5-5.5	F-G	P-F
Weikert	Lithic Dystrochrept	S	WD	H	VL	MH	4.5-5.5	F	-
Bedington	Typic Hapludult	D	WD	M	MH	ML	5.0-6.0	G-VG	F-VG
Dekalb	Typic Dystrochrept	MD	WD	M	VL	L	4.8-5.2	G	P
Laidig	Typic Fragiudult*	D	WD	M	ML	L	4.5-5.0	G	P-F
Buchanan	Aquic Fragiudult*	D	MWD	M	M	ML	5.0-6.0	G	P-F
Hazelton	Typic Dystrochrept	D	WD	M	ML	L	4.8-5.0	F-G	P
Cookport	Aquic Fragiudult*	D	MWD	L	MH	L	5.0-5.2	VG	P-F
Gilpin	Typic Hapludult	MD	WD	L	L	L	5.0-5.5	G	P-F
Ernest	Aquic Fragiudult*	D	MWD	L	M	L	4.5-5.5	VG	P-F
Wharton	Aquic Hapludult	D	MWD	L	MH	L	4.5-5.5	VG	F
Hagerstown	Typic Hapludalf	D	WD	L	MH	H	5.0-6.0	E	E
Edom	Typic Hapludalf	D	WD	M	M	H	6.5-7.0	G	F
Klinesville	Lithic Dystrochrept	S	WD	H	VL	H	6.0-7.0	F	-
Morrison	Ultic Hapludalf	D	WD	L	VL	L	2.5-3.9	G	G
Vanderlip	Typic Quartzipsamment	D	WD	L	M	VL	5.5-6.0	G	P-F
Mertz	Typic Hapludult	D	WD	M	M	L	5.0-5.5	VG	F-G
Elliber	Typic Hapludult	D	WD	MH	VL	ML	4.4-6.1	VG	G
Kreamer	Aquic Hapludult*	D	MWD	L	M	L	5.5-6.0	G	F-G
Hartleton	Typic Hapludult	D	WD	M	M	L	5.0-6.4	G	P-F
Watson	Typic Fragiudult*	D	MWD	M	MH	L	5.0-5.5	G	P-F
Duncannon	Ultic Hapludalf	D	WD	L	H	M	5.5-6.0	VG	E
Barbour	Fluventic Dystrochrept	D	WD	L	M	M	5.7-6.2	E	E
Pope	Fluventic Dystrochrept	D	WD	L	M	L	4.0-4.6	E	E

Table 3.1 (Continued)

De[2] - Depth to bedrock class
- D - deep, greater than 40" to bedrock
- MD - moderately deep, 20-40" to bedrock
- S - shallow, less than 20" to bedrock

Dr - Drainage class
- WD - well drained
- MWD - moderately well drained

CF - Coarse fragments in the B and C horizons
- L - low
- M - moderate
- MH - moderate to high
- H - high

AWC - Available water capacity
- VL - very low
- L - low
- ML - low to moderate
- M - moderate
- MH - moderate to high
- H - high

BS - Base saturation
- same as AWC

pH - Range in pH values for B and C horizons

SQ - Site quality for even-aged upland oaks
- E - excellent
- VG - very good
- G - good
- F - fair
- P - poor
- - - not classed

AP - Agricultural potential for unimproved corn
- same as SQ

*Soils in series contain fragipan.

[1]After Soil Taxonomy (USDA 1975).

[2]See (USDA 1978) for more detailed definitions.

Edom-Weikert-Klinesville--This association consists of upland soils formed in a residuum of impure limestones and calcareous shales (Edom), reddish shales, siltstones, and sandstones (Klinesville), or shale (Weikert). It is located geologically on the Nealmont, Salona, Coburn, McKenzie, Bloomsburg, Loysburg, Hatter, Benner, Curtin, Reedsville, and Wills Creek Formations, and the Clinton Group.

Morrison-Vanderlip--This association consists of upland soils formed in a residuum of non-acid sandstones. It is located geologically on the Gatesburg and Mines Formations and some of the Beekmantown Group.

Mertz-Elliber-Kreamer--This association consists of upland soils formed in a residuum (Elliber) and colluvium of cherty limestones (Mertz-Kreamer). It is located geologically on the Onondaga, Marcellus, Keyser, Tonoloway, Helderberg, and Oriskany Formations.

Hartleton-Berks-Watson--This association consists of upland soils formed in a residuum of fine-grained sandstones, shale, and siltstone (Berks) and glacial till derived from the same material (Hartleton, Watson). It is located geologically on the Mahantango Formations, Marine Beds, and the Clinton Group.

Duncannon-Barbour-Pope--This association consists of soils on floodplains and terraces formed on alluvium derived from sandstone, shale, and siltstone (Barbour, Pope) and on loess overlying alluvium (Duncannon). It is not located on any specific geologic formation.

VI. FOREST AND PLANT COMMUNITIES

The relationship between soils and plant and forest growth has been intensively studied (Veatch 1932; Maran 1944; Coile 1952). We are interested in two basic parameters of this interaction; the edaphic, climatic, and topographic effects upon the species composition of mature forests (Wilde 1958), and the edaphic effects upon the seed production of those forest species which were of probable economic importance to the area's prehistoric inhabitants.

Under mature forest conditions, tree species which are best suited to a particular site and are dominant in the canopy can be expected to out produce less suited dominants. Tolerant subdominant species best suited to the site would also out compete less light tolerant or more poorly suited species. The major attributes which favor some dominant species at a particular site and deter others are wetness, depth to bedrock, presence of a fragipan, low nutrient status, and a high percentage of coarse fragments. Generally speaking, the taller tree species with deep root systems are favored on ideal sites. The presence of the above limitations act to surpress the development of these large species and allow smaller, heartier species to flourish.

The height of a stand of trees at age 50 years is called the site index, the measure on which most interpretations of site quality are

based. The concept of site index emphasizes tree growth, or the effort each tree puts into manufacturing vegetation. Unfortunately, the linkage between vegetative growth and seed production is poorly understood and may not be as close as hoped (Baker 1950:194). In studies of immature species, it is generally found that the needs of growth and seed production are antagonistic (Assman 1970:201; Baker 1950:185). Due to the paucity of virgin forest and an industrial emphasis on timber production, the relationship of growth to seed production in fully mature stands is conjectural. One hypothesis states that fruitfulness is tied to reserves of food for the tree, namely carbohydrates (Baker 1950:184). Still it is generally felt that seed production is dependant on site quality, both directly and in the differentiation of crown classes and their effect on seed production (Baker 1950:194; Assman 1970:176).

Baker (1950:192) has grouped American species into five categories on the basis of seed production.

1. Annual seed crops with little variation. Included are all intolerant hardwoods such as cherries, maples (other than sugar maple), and pignut hickory.

2. Some annual seed, with good crops at 2-3 year intervals. Included are birches (except gray birch), chestnut, hickories (other than pignut), and red gum.

3. Some annual seed, with good crops every 3-5 years. Included are ashes and sugar maple.

4. Fail years frequent, with good crops every 2-3 years. Included are basswood, oaks, and walnuts.

5. Fail years frequent, with good crops every 3-5 years. Included are beech and black ash.

On the basis of original land warrantee survey data (such as Baldwin 1961) and studies of existing remnant virgin stands (Braun 1974), it is believed that a number of tree species were common to the District prehistorically. Each species' genetic attributes and site preferences are briefly discussed in Table 3.2 (Harlow and Harar 1937; Green 1933).

A. FOREST COMPOSITION

In the region, 6 major prehistoric forest types can be defined: stream bank, ravine, valley floor, lower slopes, upper slopes, and ridge top. The ridge and valley topography in the area assures the constant repetition of these types throughout. Hence they are not closely tied to the soil association categories presented earlier. In addition, the areal extent of these types is at a much smaller scale than that of soil associations.

Stream bank forests are found on the slopes of the indented peneplain of the last erosional cycle. The community is mixed-mesophytic, with either a hemlock-white pine association on smaller streams, or a deciduous association with beech, basswood, sugar maple, tuliptree, ash, red maple, and red oak (Braun 1974:233). Ravine communities are found in

Table 3.2: Tree Species Characteristics

Name	Species	Height (in feet)	Diameter (in feet)	Root System	Tolerance to Light	Associations	Site Preferences
White oak	Quercus alba L.	80-100	3-4	deep	somewhat intolerant	hickory, other oaks, basswood, white ash	grows best on deep, moist, well-drained soils in coves or on high bottoms; avoids dry, sandy, soils
Red oak	Q. borealis Michx.	60-70	2-3	deep, with or without taproot	most tolerant oak	basswood, black cherry, hickory, other oaks	best on rich sandy loams, but requires much atmospheric humidity
Black oak	Q. velutina Lam.	60-70	---	deep taproot	very intolerant	pignut hickory, scarlet and chestnut oaks; less often with white and red oaks	best on moist, rich, well-drained sites; more often on poor, dry, sandy or heavy glacial till hillside
Chestnut oak	Q. montana Willd.	60-80	2-3	deep, but adaptable to shallow soils	fairly tolerant	on poor sites in pure stands; on better sites with chestnut, pitch pine, black oak	best on deep, rich soil; more common on dry, sterile soil, rocky ridges
Scarlet oak	Q. coccinea Muench.	70-80	2-3	lateral root	intolerant	in pure stands or with other oaks and hickories	best on light, dry, sandy or gravelly soils; avoids very wet sites
Chestnut	Castanea dentata Borkh.	70-90	3-4	taproot	very tolerant	very common in forest; associated with many species	best on deep, well-drained loamy or sandy soil; will not grow well on thin or poorly drained soils
Black walnut	Juglans nigra L.	70-90	2-3	deep, widespreading taproot	very intolerant	white ash, black cherry, basswood, beech, hickory, numerous oaks	best on deep, rich, moist soils of alluvial origin; sensitive to soil conditions
Shagbark hickory	Carya ovata K. Koch.	70-80	1-2	strong taproot	moderately tolerant	other hickories and oaks	best on deep, rich bottomland soil; will tolerate wide range of soil
Mockernut hickory	C. tomentosa Nutt.	50-70	2-3	deep root	tolerant	upland oaks	best on moderately fresh and fertile soils, will tolerate wide range of soil and moisture conditions
Pignut hickory	C. glabra Sweet	50-80	2-3	deep root	tolerant	upland oaks, mockernut hickory; with mixed mesophytic species on bottomlands or in coves	best on moist, deep, moderately fresh, fertile soil
Beech	Fagus grandifolia Ehrh.	70-80	2-3	shallow and extensive	very tolerant	yellow birch, sugar maple	best on moist, sandy loams; avoids dry surface layers
Basswood	Tilia glabra Vent.	70-80	2-3	deep, widespreading	moderately tolerant	black cherry, yellow poplar, sugar maple, white ash	best on deep, rich soil, with considerable surface moisture
Red maple	Acer rubrum L.	50-70	1-2	shallow	very tolerant	bottomland oaks; on dryer sites with white pine, northern hardwoods	best on fertile, poorly drained soils; rarely found on dry sites
Sugar maple	A. saccharum Marsh.	60-80	2	shallow and widespreading	very tolerant	beech, yellow birch, white pine, hemlock, black cherry	best on moist, rich, well-drained soils
Black cherry	Prunus serotina Ehrh.	50-60	2-3	moderately deep and widespreading	moderately tolerant	hickories, basswood, yellow poplar, ash	only on rich, deep, moist soils
White ash	Fraxinus americana L.	70-80	2-3	deep, but adaptable to shallow and spreading on rocky site	moderately tolerant	basswood, yellow poplar, black cherry, beech	best on deep, moist, fertile soils
Pitch pine	Pinus rigida Mill.	50-60	1-2	early taproot, which disappears later	very intolerant	in pure stands; with scarlet, black, chestnut oaks, chestnut, red maple	best on sandy loamy soils with moderate amount moisture; will tolerate dry, sterile sites
White pine	P. strobus L.	80-100	2-3½	moderately deep	tolerant	pure stands on moist sites; with red or jack pine on drier sites	best on moist, sandy loamy soils
Hemlock	Tsuga canadensis Carr.	60-70	2-3	superficial, widespreading	very tolerant	white pine, red spruce, sugar maple, beech, yellow birch	best in cool, moist situations on many types of soil

higher valley floors and in narrow valleys with a northern aspect. This association is mesophytic, with hemlock and white pine dominating. There may also be some mixed oak and chestnut. Both stream bank and ravine communities are associated with soils that have imperfect drainage. Philo, Basher, and Lindside are all soil series on which these two types could be found. Because stream bank and ravine communities are extremely localized, generally speaking they are not situated in any one soil association. Still, it is unlikely that the stream bank type could be found on Morrison-Vanderlip, Calvin-Leck Kill-Meckesville, or most of the Dekalb-Laidig-Buchanan associations as these are too droughty. Ravine communities would be limited to the northern aspect of the Dekalb-Laidig-Buchanan association, and would not be found on the Morrison-Vanderlip, the Calvin-Leck Kill-Meckesville, or the Hagerstown-Edom associations, since ravines are not found there. Stream bank communities would be more commonly found in the Hagerstown-Edom, Edom-Weikert-Klinesville, Hartleton-Berks-Watson, and Duncannon-Barbour-Pope associations. Using land warrantee data from the original surveys of Centre County, Baldwin (1961) found two different stream bank communities in the area around Egg Hill (Table 3.3). Penn's Creek and Muddy Creek had a white oak consociation with some of the Hemlock-White Pine-Northern Hardwood species present. Along the banks of Sinking Creek was a mixed mesophytic association of 18 different species and 5 separate genera. White oak, sugar maple, and pine were the most important species.

Table 3.3. Stream Bank Forest Composition Near Egg Hill

	Sinking Creek	Penn's and Muddy Creek
Sugar maple	12%	12%
Birch	5%	4%
Hickory	3%	8%
Pine	14%	15%
White oak	19%	35%
Chestnut oak	3%	8%
Black oak	6%	4%
Hemlock	6%	4%
Other species	32%	10%

In the lower ravine flats of the Alan Seeger State Forest Monument, Braun (1974:236) found a Hemlock-Rhododendron community (Table 3.4). The major bottom land soil series was Atkins, a poorly drained, deep silt loam.

Table 3.4. Composition of the Alan Seeger-Ravine Flats Canopy

Hemlock	37%
White oak	16%
Red oak	6%
Red maple	15%
White pine	7%
Pignut hickory	6%
Sourgum	6%
Other species	7%

The valley floor type is found on the larger limestone and dolomite valleys in the region, such as Nittany Valley. On both flat and rolling topography, this type was predominantly oak, with white oak being the major constituent (Braun 1974). Chestnut was an important member of this and other forest types, composing up to 25% of a stand (Illick 1925). Near State College, the white oak community included white oak, black oak, red oak, scarlet oak, and occasionally white pine and hickory. The Hagerstown-Edom association can be thought to be coterminous with this valley floor type. In addition, the Edom-Weikert-Klinesville, Hartleton-Berks-Watson, and Mertz-Elliber-Kreamer associations would have a large proportion of the valley parts of the Duncannon-Barbour-Pope association. Two samples of the valley forest type were compiled for the area around Egg Hill (Baldwin 1961). On Hagerstown and Hublerburg soils, Penns Valley was predominately white oak, with some black oak, red oak, chestnut oak. White oak-pine segregates were also present and included white pine, pitch pine, hickory, and walnut. The narrower Georges Valley was a mixed oak-chestnut-white pine association with some sugar maple (Table 3.5).

Table 3.5. Valley Floor Forest Composition in Penns and Georges Valleys

	Penns Valley	Georges Valley
Sugar maple	7%	19%
Hickory	14%	4%
Chestnut	3%	12%
Walnut	23%	-
Pine	20%	15%
White oak	29%	12%
Chestnut oak	5%	8%
Red oak	1%	12%
Black oak	7%	4%
Elm	7%	8%
Other species	-	6%

The lower slopes type consists of two associational variants. On the lower slopes of ridges with a northern aspect, conditions are more mesic and one finds white oak and chestnut codominant with other oaks, sugar maple, ash, basswood, and red maple; or, in places, a mixed mesophytic association with hemlock and white pine dominant. On lower slopes with a southern aspect, probably a mixed oak association existed with white pine, chestnut, and hickories. The parent material on which the lower slope types would be found is largely colluvial and would crosscut all of the mentioned soil associations with the possible exceptions of Morrison-Vanderlip and the upper elevations of Dekalb-Laidig-Buchanan. There is probably a wider variability in species composition on lower slopes than on any other type, given that immediate topographic characteristics (such as slope and aspect) and edaphic conditions (such as stoniness, depth to bedrock, and presence of fragipans) vary widely. Baldwin (1961) found an association of mixed oak-chestnut-white pine for the southeast lower slopes of Egg Hill. The lower slopes of the Alan Seeger State Forest Monument

provide another example (Braun 1974:236). Located primarily on Buchanan extremely stony loams, Blairton silt loams, and some Philo and Basher silt loams, the dominant species are white oak, red oak, red maple, and white pine (Table 3.6).

Table 3.6. Composition of the Alan Seeger Lower Slope Forest

White oak	39%
Red oak	27%
Red maple	9%
White pine	15%
Other species	10%

The upper slopes type is located on the steep mountain sides and along the escarpment of the Allegheny Front. Trees in this type adapt to dry, shallow, and rocky soils. Chestnut oak is often dominant with chestnut second in abundance. Sweet birch, black and scarlet oaks, white and pitch pine are all found in varying percentages on these slopes. On northern aspects, red oak and ash may also be found. Soil associations on which this type is common are Gilpin-Ernest-Wharton, Calvin-Leck Kill-Meckesville, Morrison-Vanderlip, and Dekalb-Laidig-Buchanan. It would not be found on Hagerstown-Edom, Mertz-Elliber-Kreamer, or Duncannon-Barbour-Pope associations.

The ridge top forest type is found along the flat ridges of most of the mountains in the area. It is usually a white pine consociation, although pitch pine and chestnut oak are often associational segregates with white pine. In the Gilpin-Ernest-Wharton association along the Allegheny Front, there is a mixing of the Oak-Chestnut region, the Hemlock-White Pine-Northern Hardwoods region, and the Mixed Mesophytic forest (Braun 1974:226). The ridge top forest type would most likely be found only on the Dekalb-Laidig-Buchanan and Morrison-Vanderlip associations. The top of First Mountain was a white pine consociation, while the top of Nittany Mountain was pitch and white pine, with a pitch pine-chestnut oak segregate (Baldwin 1961) (Table 3.7).

Table 3.7. Ridge Top Forest Composition for Nittany and First Mountains

	Nittany	First
Birch	4%	2%
Chestnut	4%	20%
Pine	48%	51%
White oak	4%	5%
Chestnut oak	26%	10%
Red oak	9%	2%
Black oak	4%	2%
Hemlock	-	5%
Other species	1%	3%

B. FOOD POTENTIAL

Nuts were a principal food exploited from these forest types for most of the prehistoric era. While wild grasses became important at the end of the Archaic Period and continued to be used into historic times (Asch et al. 1972), their abundance in the region was limited (see Chapter 14).

Of all the potential human vegetable food items, acorns would easily be the most abundant. Ethnographically, the California Indians relied heavily on acorn crops (Heizer and Whipple 1962), while in the East, it is known that such groups as the Narragansett, Huron, and Iroquois all relied on acorns as a starvation food (Williams 1643; La Potherie 1722; Waugh 1916). With crop failures as frequent as 2 out of every 5 years for the Huron, the importance of acorns is clear (Heidenreich 1971).

Acorns can be divided into two major categories. Those produced from the white oak group (white oak and chestnut oak) tend to have a low tannin content (3-5%) and a low fat content (5-7%). Acorns from the black oak family (red oak, scarlet oak, and black oak) have a much higher tannin content (6-10%), but a much higher fat content (15-25%). Tannin in acorns is an impurity and must be removed before they can be eaten. White oak acorns can simply be roasted, but black oak family acorns must be leached. The Pomo, Tubatulabal, and Yokut Indians of California all processed black oak acorns, but considerable extra labor was involved (Powell 1877; Voegelin 1938; Gayton 1948). At least one justification can be made for utilizing high tannin acorns. Because fat has a much higher caloric value per gram than protein or carbohydrate, the black oak acorns provide 15-20% more energy than white oak acorns, or approximately 490 Kcal/100 g versus 420 Kcal/100 g dry weight. These figures are based on FAO values for protein, fat, and carbohydrate (1947).

In addition to food value, white and black oak groups differ greatly in production. White oak acorns mature in 3-4 months (Sharp 1958). They tend to produce a good to heavy crop one year, followed by several years of fair to poor crops. Although the data is poor, it appears that white oaks in a specific locality will synchronize their production pattern. This may also hold over a wide area. Liscinsky (n.d.) reports that in a good year and on a good site, a 55 year old stand produced 136 pounds of acorns with 35% of the stand being white oak. Were the entire stand mature white oak, this would represent about 400 pounds per acre. However, a 9 year study of the same stand showed that no more than 50 pounds were produced in any of the other years and that for 3 out of 4 years there was a complete failure to produce. Individual white oak trees on very good sites have been known to produce 16 pounds per tree in a good year, but average only 6.3 pounds per year over a 7 year period (Downs and McQuilkin 1944). Using Baker's (1950:57) formula for computing the number of mature white oak trees per acre in a pure white oak stand, we can estimate 80 trees per acre. For any given stand of white oaks, studies indicate that only 30% of the trees will bear fruit (Sharp 1958:19). It would thus appear that a pure white oak stand can produce around 400 pounds of acorns in a good year per acre. However, the average over time

would only be 150 pounds per acre (Downs 1944; Gysel 1957). On poorer sites, these yields would be smaller. Chestnut oak produces more reliably, with good crops every second or third year (USDA 1948), but the crops are smaller and overall would average fewer pounds than white oak (USDA 1948).

The black oak group fruits on a two year cycle, with the acorns taking 15 months to mature (Sharp 1958). Each tree contains two types of acorns; those that will mature in that year, and those that will mature in the next. Every year a single tree can bear some acorns. The variability between years is also less than in the white oak group, so that each location will produce some acorns each year. The triennial pattern calls for a fair crop to be followed by a medium and then a good-to-heavy crop. Thus, in a six year cycle, there will be two bumper crops, two medium, and two light crops (1958:19). Both black and scarlet oak comprised 57% of another 55 year old stand studied by Liscinsky (n.d.). It averaged 120 pounds per year, or 210 pounds per year per acre if the acre were pure black and scarlet oak. A medium quality site in Michigan composed of black and white oak averaged the equivalent of 420 pounds per acre of black oak acorns had the site been pure black oak (Gysel 1957), but only the equivalent of 175 pounds per year on a poor site. On a good site, red oak averaged the equivalent of 688 pounds per acre (Gysel 1957). Taking the average production per tree of 8.3 pounds for red oak (Downs 1944) and a value of 120 trees per stand (Baker 1950), of which 15% do not produce (Sharp 1958), approximately 850 pounds per acre would be produced in a pure red oak stand. In a bumper crop year, 1500-2000 pounds of red oak acorns would be produced in the hypothetical stand (Gysel 1957). Thus, it is clear that black oak family members not only produce more consistent yields than white oak family members, but they also produce more on a given site.

Chestnut could have been a major nut source in the region, given its former abundance and food value. Native American chestnuts (Castanea dentata) provide approximately 440 Kcal per 100 g of dried nut meat and 175 Kcal/100 g of fresh nut meat (Winton and Winton 1932; Tibbles 1912). Because of the chestnut blight in the early twentieth century, quantitative data on productivity is scarce. Under ideal conditions, a good tree in a good year would produce in the neighborhood of 100 pounds of uncleaned nuts (Emerson 1846). Hybrid trees, bred for nut production could yield 150-200 pounds per year (Morris 1924), so 100 pounds is not unreasonable for a tree under ideal conditions with maximum light access. Like red oaks, chestnuts produce some nuts annually, with good crops every 2-3 years. A hypothetical pure chestnut site could yield as much as red oak and probably more, yet would be lower in tannin than white oaks.

Shagbark hickory may have been a third major source of vegetable food. On a good site, a good tree can produce 40-60 pounds of sound nuts. Hickory nut meat is very high in fat and low in water, so that on a dry or fresh basis, 100 g of nut meat yields 600-630 Kcal. Pignut and mockernut hickories would produce comparable yields, but they are not found on good sites. The food value of hickory nuts is very high and on a good site in a good year a tree would yield twice the Kcal's of a red oak, the highest yielding oak.

Other less important vegetable foods would include black cherry, which is calorically unimportant, and wild grasses, which, although they compare favorably with other grain crops in food value (450 Kcal/100 g), would not be abundant until sections of the forest were cleared.

VII. ANIMAL COMMUNITIES

A wide variety of animal species was supported by this rather productive eastern deciduous forest. Of primary importance were white-tailed deer, black bear, wild turkey, Eastern and New England cottontails, beaver, raccoon, elk, southern woodchuck, gray squirrel, ruffed grouse, and migratory water fowl (Doutt et al. 1973). The most important economically for prehistoric inhabitants were probably white-tailed deer (Odocoileus virginianus), black bear (Ursus americanus), and wild turkey (Meleagris gallopavo sylvestris).

White-tailed deer may certainly have been the region's single most important meat source in prehistoric times. Live weights vary by season and individual, but in general bucks average 170 pounds and does 120 pounds. This converts to 100 and 70 pounds dressed weight, respectively (Taylor 1956). Density values are highly variable in that they are dependent on the seasonal availability of food and the overall quality of the range. Broadly speaking, deer densities in the contemporary landscape are on the order of 20-30 per mi^2. Given the fact that much of their food currently is a by-product of agricultural fields, prehistoric estimates would more likely be 10-15 individuals per mi^2. If we treat deer productivity through time as an equilibrium problem, 33% of the herd can be taken in the winter without diminishing it. Thus a square mile could annually produce 3-5 deer or about 400 pounds of meat. Deer are browsing ruminants and will eat a wide variety of plants. On the average, though, an adult male deer consumes 4-6 pounds of browse daily to maintain weight, while females need 3-4 pounds (French et al. 1955). Prized foods are young grasses, acorns, and young twigs, but these are only available seasonally (Atwood 1941; Martin et al. 1951; Swift 1948). Important winter foods are flowering dogwood, white pine, red maple, black cherry, blueberry, and birch twigs (Schoenfelt 1975; Clark 1977; Watts 1964).

In the fall, deer congregate at sites which are heavy in mast production. However, acorns can only be a small part of their total food picture. Even with no competition from squirrels or turkeys, 5 deer can clean out the best acre of the best acorn site in 2-3 weeks. In general, acorns are usually depleted from most areas in a month. After the rutting season, deer will winter in areas that protect them from harsh weather (Taylor 1956:140). If the winters are moderate, they will stay evenly distributed over the bottoms, hills, and tops of ridges. Severe cold or snow will force deer into sheltered coves and valleys. Maximum snow will create yarding conditions.

In the spring, the food situation is critical and they will congregate wherever early buds and shoots grow. During late spring and summer, deer are distributed over the entire area and will only reaggregate at mast areas when the fruiting season begins in September.

Wild turkey average 17 pounds for adult males and 11 pounds for adult females, producing 10 and 7 pounds of meat per bird respectively (Schorger 1966). In Pennsylvania statewide, there is an average of 7 birds per mi^2 (Schorger 1966). For a mixed oak and oak-hickory forest in central Pennsylvania, densities ranged from 8-13 per mi^2 (Scheirer 1969). If these figures are valid and a 60% rate of culling is used (Scheirer 1969:Table 8), than a square mile could annually produce 50 pounds of turkey meat. Since range is dependent on the availability of open areas, these figures are probably high. The ideal turkey habitat contains mature oak forest composition with white oak in the largest proportion. Bases of ridges and flat areas with open understories are the best spots (Kozicky 1948). This setting conforms to the valley floor and lower slope forest types defined earlier.

Seasonal variations in dietary preferences and social organization determines the spatial distribution of turkeys through the year. Turkeys are gregarious, but the extent of the flock depends on the season. In spring the flock disbands for mating purposes (Kozicky 1948). Acorns are the most important food, followed by grasses, some insects and snails. In the late spring and summer, gobblers have one or more hens plus the brood, and the diet consists of insects, grasses, and berries. In the late summer and fall, the birds begin flocking. This activity increases until the winter. Diet in the late summer is berries, grasses, and insects. This switches to acorns and grapes in the fall and then to acorns in the winter.

Black bears average 240-520 pounds for adult males and 140-340 for females, with an average of 190 and 170 pounds dressed weights respectively (Eveland 1971; Wakefield 1969). Densities are much lower than for deer or turkey, with an average of one non-cub bear for 2.77 mi^2 (Kordek 1973) or one bear suitable for hunting in each 28 forested mi^2 (Eveland 1973). Annual mortality is roughly 25%. If we presume that 20% can be culled annually, then 1 mi^2 would yield roughly 20 pounds of meat per year, or one bear per 10 mi^2. Beech, sugar maple, and birch are the principal species for food, with red oak acorns, black cherry, and blueberry also being consumed (Wakefield 1969; Eveland 1973). In the summer wild cherry and acorns are most important, while in the fall and winter, acorns, beechnuts, and apples are sought (Bennett et al. 1943). In the spring, on the basis of limited data, it would appear that acorns, vegetable matter, and deer are eaten. Principal bear range encompasses a steep, hilly, terrain with ample understory vegetation. Thus, most of the bear population would be expected on the higher elevations in the area and along the Appalachian Plateau.

CHAPTER 4

THE METHODOLOGICAL BASIS FOR THE 1978 SITE SURVEY PROGRAM IN DISTRICT 9

JAMES W. HATCH

I. RESEARCH CONSIDERATIONS

The 1978 National Register Survey in District 9 provided an important opportunity to increase both the scope and detail of our knowledge of the settlement patterns and occupational history in the Bald Eagle watershed. Prior to this time, our understanding of the area was based on a few small scale, reconnaissance level surveys in a limited number of environmental settings. The National Register Survey, however, called for operations associated with intensive survey efforts. It was hoped that these operations would result in large numbers of carefully collected sites and that initial attempts to relate phase-specific settlement patterns to environmental parameters could be made. In terms of the overall research strategy discussed in Chapter 2, the 1978 survey was designed to bridge the gap between the patchy regional familiarity afforded by reconnaissance level survey efforts and a first generation matrix of site categories which could be sampled for intensive surface collection and excavation at a later date.

With this in mind, the 1978 survey of District 9 was designed to best satisfy the demands of three sets of factors: the goals of the National Register Site Survey Program, the guidelines set forth by the Pennsylvania Historical and Museum Commission for such a program in Pennsylvania, and the realities for such work under the environmental conditions characterizing District 9.

The goals of the survey were twofold: first, a thorough inspection of areas traditionally bypassed by professional archaeological surveys (both generally, on a district-wide level and specifically, in terms of environmental and topographic settings within the districtct) and second, the discovery of candidate sites for the National Register of Historic Places. It was thus felt that a program of settlement pattern survey was in order. Clearly, given the first goal, geographically extensive operations carried out in an environmentally sensitive sampling scheme were necessary. For the second goal, procedures were needed to test the spatial, chronological, and functional dimensions of each site. The outline presented below represents the operationalization of these goals.

The major organizational backdrop for the District 9 survey program was the guidelines prepared by the Pennsylvania Historical and Museum Commission. Briefly stated, the guidelines called for the inspection of selected portions of 3 of 24 U.S.G.S. 7.5' quadrangles comprising the district. Within each quadrangle 15 one-square-mile units would be selected for intensive inspection, employing contemporary field discovery and testing techniques, in order to assess the number and diversity of sites in the area. Since only a fraction of each quadrangle was proposed

for inspection, the selection was to be made in a manner that would maximize the representativeness of the sites in the entire quadrangle. In the event that the suggested 15 one-square-mile areas could not be adequately inspected in the time allotted, the selection of fewer units would become even more crucial.

Certain aspects of the program for site survey in District 9 catered to the realities of environmental diversity and heavy ground cover that characterize the area. The principal effort was to balance the need for land-extensive procedures against manpower and time limitations as well as local conditions that would slow the pace of archaeological inspection. These conditions included some areas of rugged terrain, extensive portions of the landscape with site-obscuring ground cover, and scheduling problems with respect to gaining access to active farmlands. Certain aspects of the following outline should therefore be thought of as necessary only in similar environmental and social circumstances.

II. SAMPLE SELECTION

In choosing three 7.5' quadrangles for the 1978 survey season, several factors were kept in mind. In their approximate order of priority, preference was given to:

1. Quads that collectively would cross-section a large portion of the region's ecological variability.
2. Quads that contained comparatively large amounts of agriculturally cleared land.
3. Quads associated with a single major drainage system.
4. If 2 quads incorporated roughly comparable features, the selection process favored the one farthest from others previously selected.

The concept of a single large drainage system mentioned in #3 above was used here for two reasons. First, it was felt that settlement patterning, as reflected in gross comparisons between major environmental zones within the region, could be more accurately assessed within an area presumed to have a single trajectory of settlement history. Secondly, the Bald Eagle drainage had been a focus of study for several years. The supporting archaeological, geomorphological, and botanical data collected to date could be brought to bear on the survey project, thereby maximizing information return.

Of the 24 quadrangles comprising Region 9, 3 were selected for consideration: Beech Creek, Bellefonte, and State College (Figure 3.2). Five of the 6 major topographic zones in the Bald Eagle watershed were included in this selection (only the Allegheny Plateau was seriously underrepresented) as were differences in M.S.L. elevation within the valley floors.

Within each quadrangle, 15 one-square-mile survey areas were chosen as a maximum target population for intensive investigation by the survey crew. Not only were these selected to insure a large sampling fraction of each major zone, but also within each zone squares were positioned to

cross-section the variety of drainage and slope characteristics contained in each (Figures 4.1-4.3).

Table 4.1 illustrates 1) the major and minor environmental characteristics used in selecting each original survey unit, 2) the relative distribution of survey units so characterized within and between quadrangles, and 3) the resulting coverage of each major environmental zone by survey operations. In reading this table, "-" should be read as "characteristic not present in this zone", while Class 1, 2, and 3 streams refer to the standard hydrologic nomenclature for dendritic drainage patterns (Figure 4.4). Those portions of Bald Eagle and Nittany Mountains that appeared on the 3 selected quadrangles were collapsed into a single major category, "Appalachian Ridges." On both environmental and assumed behavioral grounds, this merger reflected the author's a priori opinion of a single dimension of resource potential and prehistoric utilization between them.

III. FIELDWORK DESIGN

Prior to the start of actual fieldwork on June 1, 1978, aerial photographs were prepared for each of the 45 proposed survey squares. These photos were a necessary field aid given the small scale of the available map series for the area. Also, the aerial photographs clearly showed property boundaries, either in the form of fences, agricultural fields, or tree lines. As these were the dominant features on the landscape during field survey, the photographs provided much needed orientation.

The photos themselves were made by photographically copying the existing positive prints of the survey squares in the Soil Conservation Office, Bellefonte, Pennsylvania, with a tripod mounted 35 mm camera using Plus-X film and a close-up lens. By enlarging these to 9" x 9", durable black and white prints of each square were available at a 1:7000 scale. Both the originals and a xerox copy were carried into the field on all occasions, the original to be read for reference, the xerox for mapping site locations and survey unit boundaries.

Also prior to the fieldwork's initiation, the survey team was selected and four orientation meetings were held. The 9 member survey team was chosen from a large pool of second and third year archaeology graduate students at The Pennsylvania State University. Several criteria were used in their selection; among them, their prior experience in archaeological survey and their commitment to American archaeology. Orientation meetings were devoted to the adoption of terminology, the use of equipment, forms and procedures, and on one occasion, a tour of the entire region.

An early and important distinction was made between "survey square" and "survey unit." The term "square" referred to any of the 45 one-mile squares selected as the target population. Within each square, however, were a variable number of "units." Units most often corresponded to agricultural fields or particular pieces of property, but were occasionally used to differentiate segments of a single field with different crops. The unit concept was a very useful means of keeping track of what fractions of each square the survey team was permitted to enter by landowners and, as the survey of the square progressed, which segments remained to be done.

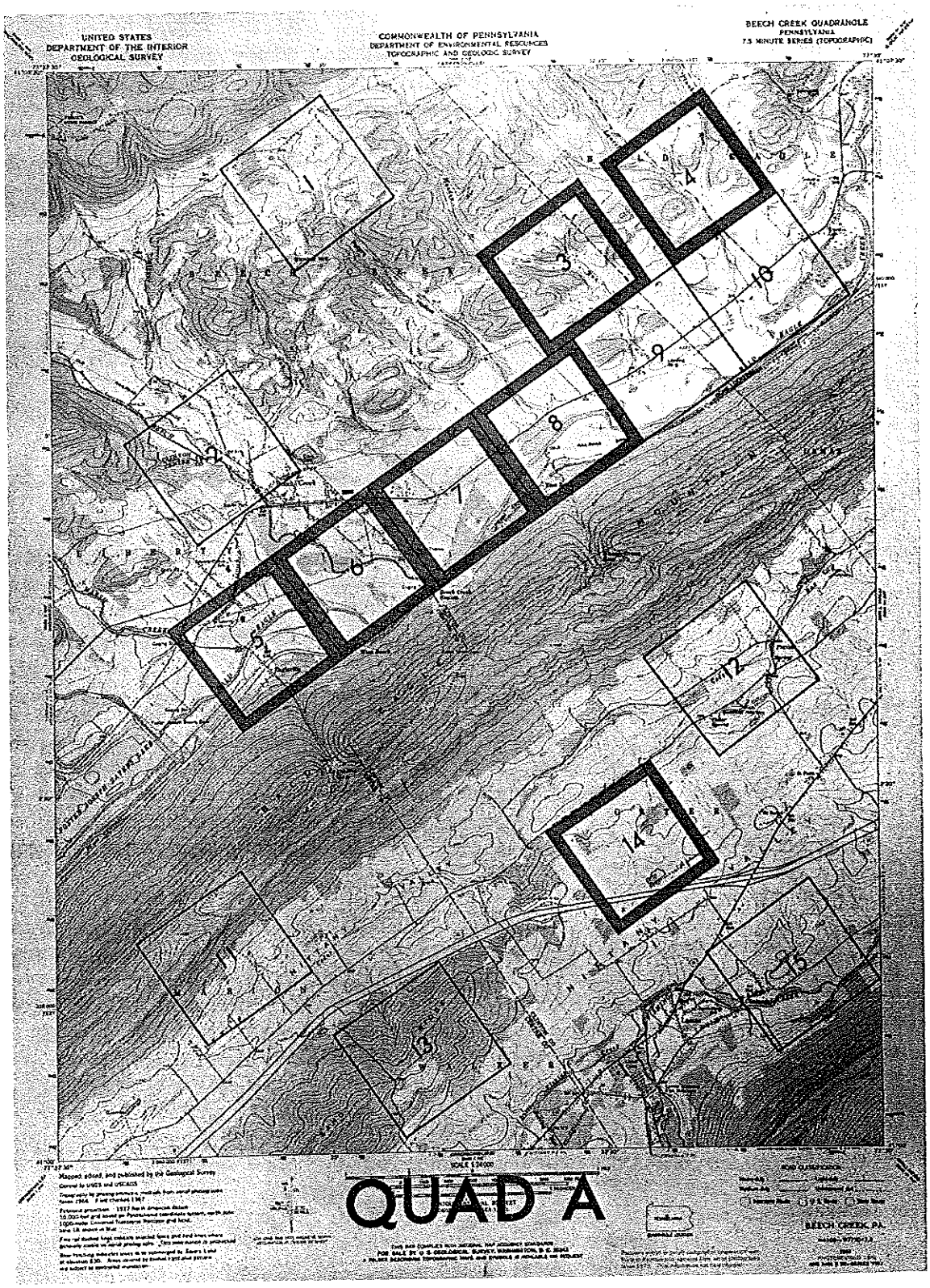


Figure 4.1: Survey Squares in Quad A--The Beech Creek Quadrangle*

Boardered squares deleted during survey.

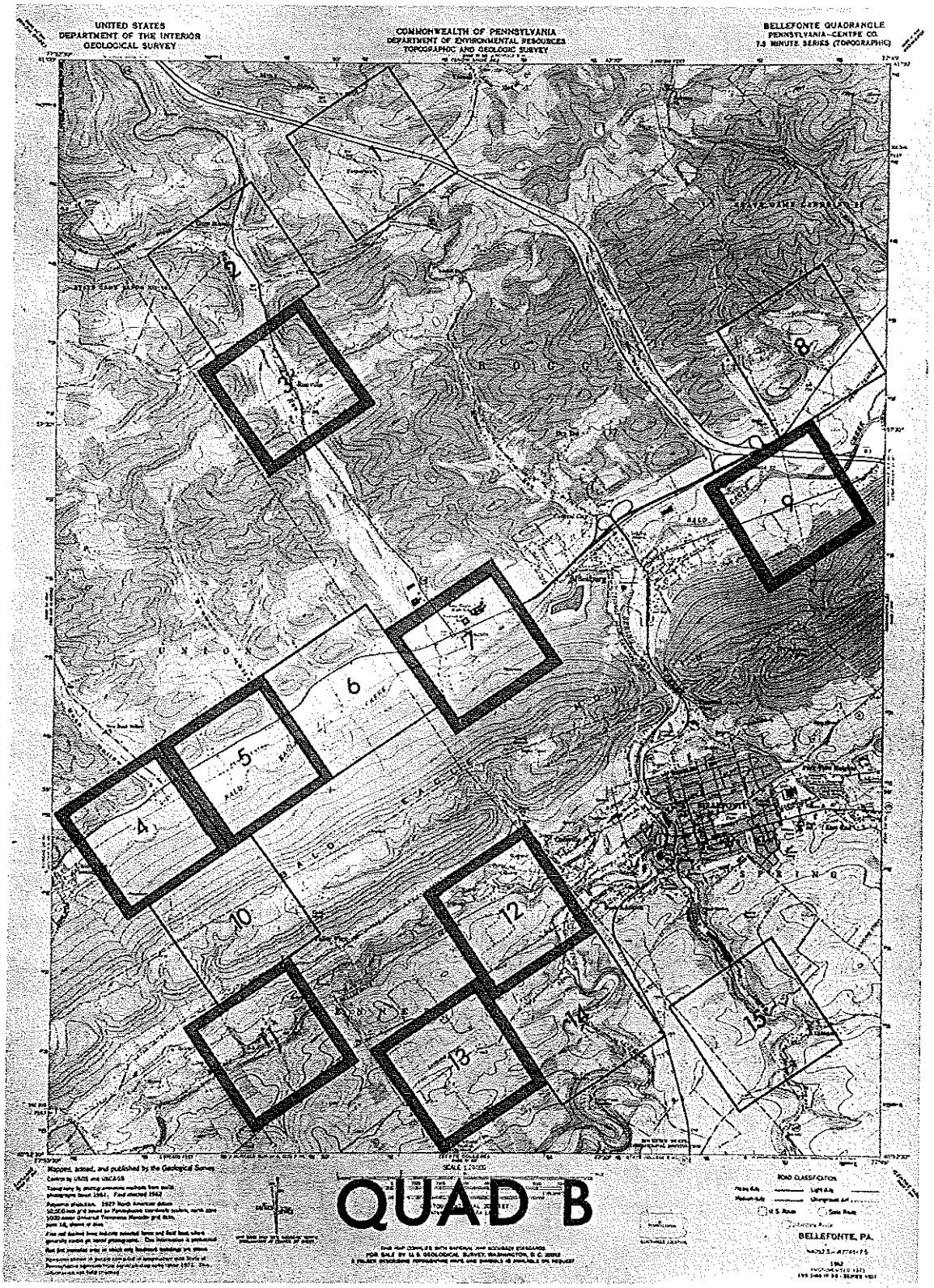


Figure 4.2: Survey Squares in Quad B--The Bellefonte Quadrangle

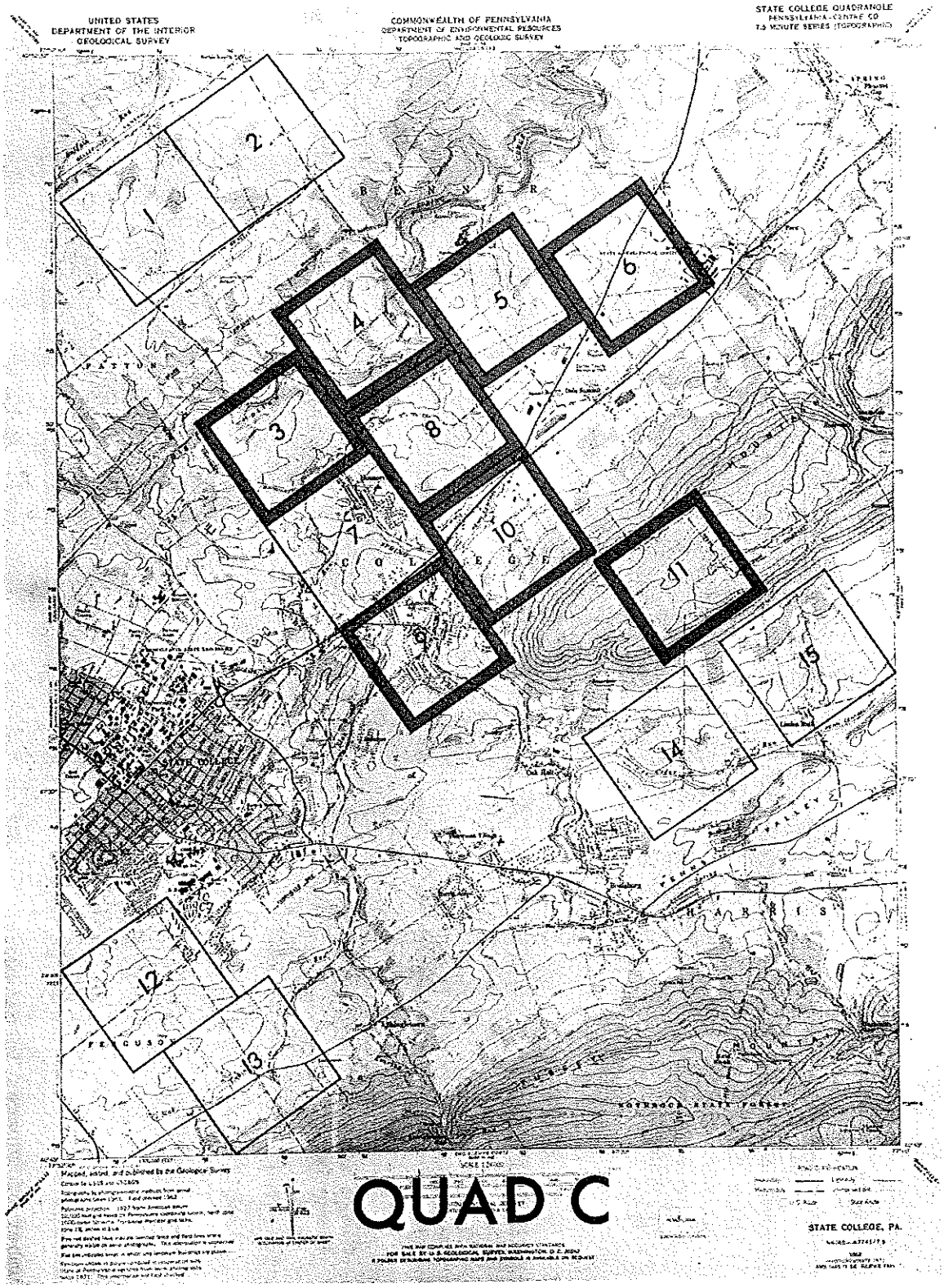


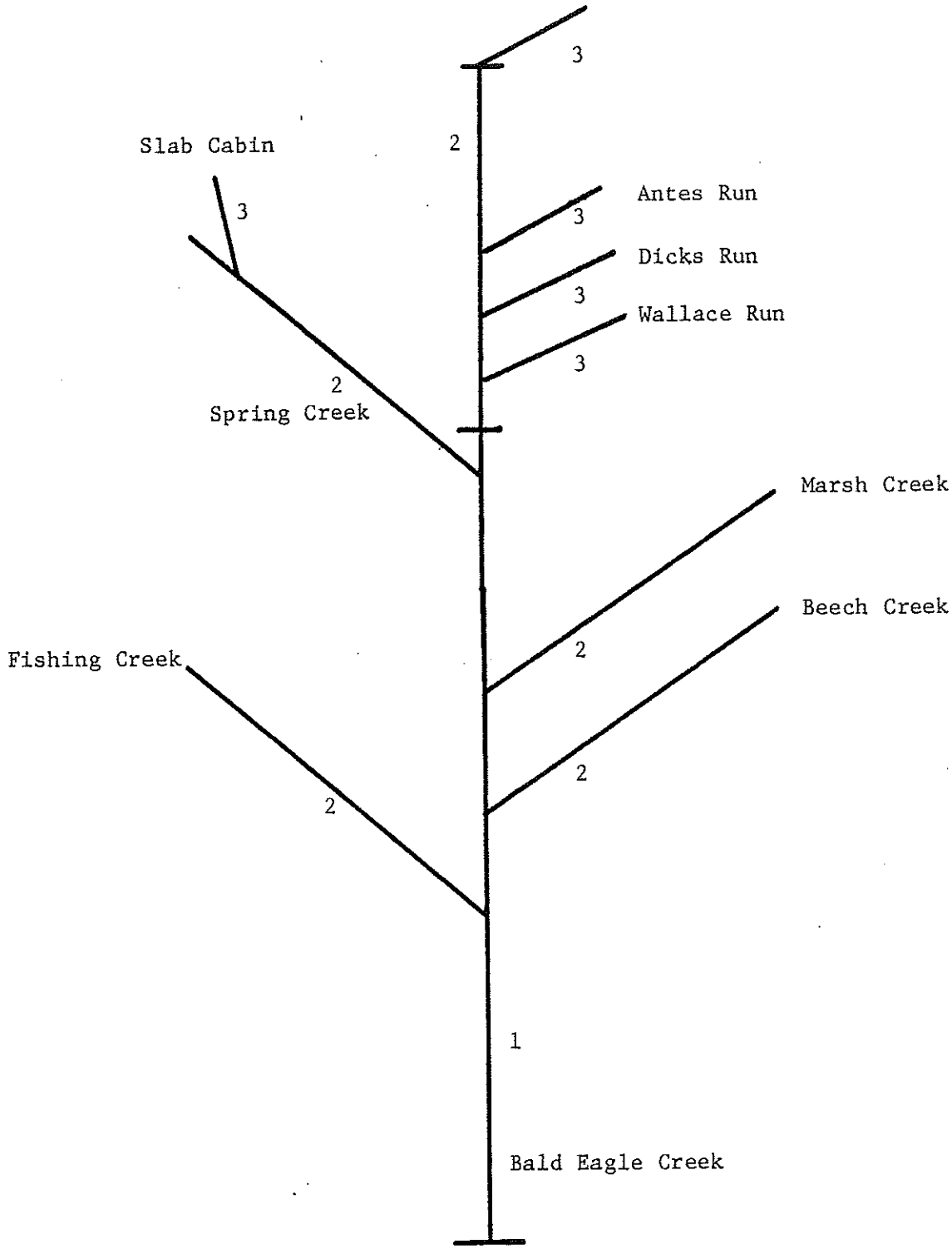
Figure 4.3: Survey Squares in Quad C--The State College Quadrangle

Table 4.1: Target Population of Survey Squares for 1978

	Quad A (Beech Creek)	Quad B (Bellefonte)	Quad C (State College)			
Allegheny Foothills						
1. Class 2 Stream Environments	1[a](2)[b]	---	---	1		
2. Class 3 Stream Environments	---	2(2,3)	---	2		
3. Margins	2(3,4)	1(8)	---	3		
4. Interior	1(1)	1(1)	---	2	Total = 8	Percent of Available[c] 20%
Bald Eagle Valley						
1. Class 1 Stream Environments	6(5,6,7,8,9,10)	---	---	6		
2. Class 2 Stream Environments	---	5(4,5,6,7,9)	---	5	Total = 11	Percent of Available 69%
Appalachian Ridges						
1. Ridge Tops	0	1(10)	1(11)	2		
2. Ridge Margins	1(11)	---	2(10,15)	3	Total = 5	Percent of Available 16%
Nittany Valley						
1. Class 2 Stream Environments	1(15)	1(14)	4(4,7,8,9)	6		
2. Class 3 Stream Environments	1(12)	3(11,12,15)	2(13,14)	6		
3. Uplands	1(14)	1(13)	6(1,2,3,5,6,12)	8		
4. Interior Ridge	1(13)	---	---	1	Total = 21	Percent of Available 22%

[a] Number of squares in category.
[b] Square identification number(s).
[c] Percent of total area on Quads of this category planned for inspection.

Figure 4.4: Schematic Hydrologic Diagram of the Bald Eagle Drainage



During most of the survey effort, the 9-member crew was divided into 3 teams of 3 members each. On occasion, teams of 2 and 4 were tried. However, a 3-member team proved to be the most efficient for field operations. Membership in each team was frequently changed after completing a square to avoid boredom, and the position of team leader (who assumed the duties of recorder and quality control) was held by all crew members at least once during the survey.

The initial entry into each square was made by the team leader and (preferably) one other member of his/her crew in order to contact landowners and record certain information. As an aid in locating landowners, plat books for Centre and Clinton counties were first consulted. On making contact, landowners were asked a series of questions regarding property boundaries, traditional and current land-use, survey team access and stipulations, and their knowledge of archaeological materials from their property. Collector Identification Cards were filled out when appropriate as well as Land Use and Ownership Forms (Figures 4.5 and 4.6), all in advance of the actual survey effort.

Two comments should be made here. First, the success the survey experienced gaining access to lands surprised us all. Something greater than 99% of all landowners contacted allowed the survey to enter. Many of these, however, did so with certain stipulations. Most frequently, permission was granted for areas that were planted in corn during 1978 or that were fallow. Fields in oats, hay (alfalfa), or wheat were routinely denied us; the owners fearing that walking through or shovel testing in the crop would damage it. Because District 9 encompasses an area with a large number of cattle farms, a corn, oats, wheat, and fallow one-year crop rotation system is frequently used. This suggests that on the average, a farm will raise all three crops, in roughly equal proportions, and that 50% of the farm land will be available for survey in any one year. While this is generally true, we found that many farmers raise feed corn in preference to other crops and that as long as The Pennsylvania State University provides financial incentives to farmers trying "no till" methods, the 1978 and future surveys will benefit from more available land.

Once the initial contacts were made, the full survey team was ready to enter. The work week lasted from 8:00 A.M. to 5:00 P.M., Monday through Friday, for a 10-week period. The first and last 30 minutes of each day were spent discussing the day's strategy or the day's finds with the author at the Archaeology Laboratory on The Pennsylvania State University campus. Each team was equipped with the supplies necessary for that day's effort (Table 4.2).

Arriving in the square, the team proceeded to the first survey unit for the day. Each unit, like each square on each quadrangle, was assigned a unique number. Thus A-15-32 would refer to quadrangle A (Beech Creek), square 15, unit 32. Entering the unit, the team leader decided on the most efficient and informative site discovery strategy and supervised its execution. Since units were by definition homogeneous in terms of ground cover characteristics, a single site discovery strategy was employed throughout the unit.

COLLECTOR IDENTIFICATION CARD

NAME _____ DATE _____

ADDRESS _____

PHONE _____ AREA _____

SIZE OF COLLECTION _____

SITE NUMBERS (PHOTO #)

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Figure 4.5: Collector Identification Card

LAND USE AND OWNERSHIP FORM

Unit Number _____

Owner: Name
Address
Phone

Tenant: Name
Address
Phone

Land Use, 1978: _____

_____

_____

Land Use, Traditional: _____

_____

_____

Figure 4.6: Land Use and Ownership Form

Table 4.2: Equipment and Supplies for Survey Teams

Item	Quantity and User
Camera, 35 mm SLR	1 per team
Vehicle	1 per team
Tape, 30+ meters	1 per team
Aerial Photograph	1 per team per square
Aerial Photograph, Xerox	1 per team per square
Shaker Screen, two-man	1 per team
Brunton Compass	1 per team
Abney Level	1 per team
Personal Notebook	1 per person
Trowel	1 per person
Shovel	1 per person
Shaker Screen, one-man	1 per person
Cloth Bags	as needed
Bag Tags	as needed
Zip-Loc Storage Bags	as needed
Clipboard	as needed
Forms	as needed
Graph Paper	as needed
Pencils, Pens, Magic Markers	as needed
String	as needed

Because comparability of results between units was a necessary concern of the survey, only 8 predetermined strategies were permissable. Again, once selected by the team leader, the entire unit would be so examined. The choice of strategy involved 2 primary considerations; the severity of the slope angle and the amount of ground cover.

If the slope was greater than 20° and significant ground cover was present, crews searched for only 3 types of features; rock outcrops, springs, and denuded spots caused by erosion, cuts, etc. Test pits were concentrated in such areas, and surface inspection was carried out when possible.

If the slope was less than 20°, 1 of 7 strategies was chosen, depending on the size of the unit and the amount of ground cover. Freshly plowed fields or fields planted in corn were considered clear enough for surface inspection only. Either 10, 20, or 30 m spacing intervals would be used. Each team member would walk a straight path the length of the unit, turn, and cross again, always maintaining the agreed upon interval, until the entire unit had been covered. With a ground cover that decreased visibility by more than 40% in a unit, the survey strategy would rely on a shovel testing or "mole holing" scheme, maintaining either 25, 50, 75, or 100 m between crew members and between shovel tests. Shovel tests consisted of an approximately 30 cm cube, with all soil from such tests screened through one-man shakers lined with ¼"-mesh hardware cloth. Again, straight line passes were made by each crew member, with the number of passes dependent on the width of the unit.

A Survey Procedure Form was filled out as each unit was completed (Figure 4.7), recording the nature of the ground cover and the survey methods used in the inspection of that unit. The next unit would then be examined.

When a site was discovered in a unit, the survey crew would temporarily stop its search and begin collecting data on the site itself. Minimally, observations made in the field were those necessary for the Pennsylvania Archaeological Site Survey site forms provided by the Museum Commission. These were recorded in a first draft format on the field forms provided each team (Figure 4.8). Slope angles were measured with the Abney Level provided each team. Abney Levels are scopes that allow for the simultaneous sighting of both the horizon (top or bottom of the slope) and a bubble level fixed to a protractor. The bubble is positioned horizontally, and the difference between the actual and horizontal angles is read from the protractor. Slope orientation, or the "facing angle" of the slope on which the site was located, was measured with a Brunton Compass.

Like the discovery procedures, the procedures for collecting artifactual and stratigraphic information from sites was predetermined and limited to insure comparability.

General Surface Collection--On small, sparce sites all material was removed from the surface and bagged collectively. On larger sites, a preliminary collection was taken from the surface that emphasized the

SURVEY PROCEDURE FORM

Unit Number_____

Ground Cover _____

_____

Survey Methods _____

_____

_____

_____

_____

Days since rain_____ Survey Team_____

Figure 4.7: Survey Procedure Form

SITE FORM - FIELD COPY

1. Site Number _____ 2. Team Leader _____

3. Slope Angle _____ 4. Slope Orientation _____

5. Immediate Vegetation _____

6. Distance to Water _____

7. Data Collecting Strategy _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

8. Stratigraphic Descriptions and Profiles _____

_____

_____

_____

_____

Profile Drawing

_____

_____

_____

(Reverse)

9. Field sketch of site boundaries, key topographic and mapping features (roads, buildings, streams, trees, etc.), and location of all collecting strategy units. Include north arrow and scale.

Figure 4.8: Site Form - Field Copy

removal of tools and temporally diagnostic items, again with no more specific provenience than the site itself. Both types of collections were referred to as "general surface collections" and one such collection was taken on all sites from which a surface collection could be taken. The horizontal dimensions of all surface-visible sites was marked and then measured with a 30 m tape.

Dog Leash--Assuming that some of the sites would contain differentially dense loci of material within their boundaries, "dog leashes" were used to provide quantitative control over the variation. A dog leash is a circular surface collecting unit of a fixed radius within which all archaeological material is collected. A 3-m radius was consistantly used by the survey, with the number of dog leashes dependent on the apparent internal complexity of the site itself. Generally speaking, both high and low density areas within each site were so collected.

Test Pits--Test pits varying in size from 50 cm x 50 cm to 1 m x 1 m were excavated to control for stratigraphy, the vertical distribution of components, and to increase the sample of archaeological material from each site. All soil was screened through a 2-man shaker screen with ¼" mesh. Typically, these would reach to sterile horizons, encountered anywhere from 25 cm to nearly 1.5 m below the surface. Profile composition and stratigraphic measurements were drawn and recorded on the field forms. Test pits were excavated on most sites discovered during the survey. However, given the time investment necessary, adjacent sites in similar topographic settings were often tested with a single test pit.

Shovel Tests--Shovel tests or "mole holes" were used for both site discovery and site collection purposes. Each hole was approximately 30 cm^3 with all contents going through ¼" mesh in a 1-man screen. For site collection purposes, holes radiated out from the original discovery hole. The absence of material in two consecutive holes was used as the boundary definition. Internally holes were concentrated on terraces, rises, alluvial banks, and other areas within the site expected to be the principle areas of material deposition. Given the volumetrically small size of each shovel test, the total absence of material is to be expected in some holes even in the most densely occupied sites. On the other hand, in some of the sites discovered by the survey, several objects per hole were routinely encountered. Some site discovery implications of this technique will be discussed further in the next section.

Postholes--A posthole digger was used on some occasions to augment test pit information. Once the test pit was excavated and a clear impression of basic stratigraphy was had, a series of postholes were used to trace strata of particular interest over the site. In this fashion, boundaries of buried geomorphic features (buried flood banks, sandbars, stream channels, etc.) were delimited and associated with the distribution of archaeological remains. Soil contents were generally not screened. The intent of its use was simply to maximize stratigraphic information in a brief period of time.

These 5 operations constituted the basic procedures for artifact collecting at each site. Once again, the team leader was responsible

for choosing the best combination of procedures and their exact placement on the site. All operations were discussed at the end of each day with the author, however, and were subject to modification.

One final operation was carried out in each survey unit by the crew. Since one of the working hypotheses of this survey dealt with the spatial proximity of sites with particular raw material assemblages to possible quarry locations, samples of non-archaeological raw material were collected in each unit regardless of whether or not a site was present. These were washed, identified against a type collection, counted, and mapped in the laboratory. Comparative results from these data will be presented in Chapter 6.

The decision of when a crew should leave one square and move to the next was always made by the author. Obviously, the main concern was to stay in each square until a large and representative sample of the units had been surveyed. However, the time factor strongly influenced the final sampling fraction of units. The pressure of time, and our overall goal of surveying, if not 45, then a large number of squares, forced us to leave a square even when permission had been granted on as yet unsurveyed units. When that happened, every attempt was made to guarantee a reasonable sampling of all portions of the square and all topographic zones. No less than 9% and no more than 63% of any square was actually inspected by our survey teams.

A file was maintained on each square in the laboratory, and all forms and information were collected in it. When a square was finished, the completed folder was examined by the author, returned to the team leader of the square for revisions, and checked again. If all details were satisfactory, a Survey Square Checklist (Figure 4.9) was filled out by the author and the folder permanently filed.

A complete square file consisted of the following:

1. The square's aerial photograph;
2. The xerox photograph showing all units, their numbers and boundaries, and all site locations and their numbers;
3. Site Form-Field Copy--one each site, both old (if previously recorded and revisited) and new;
4. Land Use and Ownership Form--one each unit;
5. Survey Procedure Form--one each unit;
6. Collector Identification Cards and content cards (if appropriate);
7. All photographs of sites and collections;
8. Survey Square Checklist;

and a 1-2 page written summary of each square's

9. Geologic Patterns--based on geologic field samples;
10. Site function--impressionistically for each site; and
11. Settlement patterns--impressionistic spatial, temporal and functional ties.

SURVEY SQUARE CHECKSHEET

Square Number _____

Survey Team _____

Team Leader _____

Date Begun _____ Completed _____

Previous Sites _____ # New Sites _____

Site No.	Unit No.	Land Use	Site Location	Survey Procedure	Collect I.D.	Field Form	P.A.S.S.	Artifact Bags

Figure 4.9: Survey Square Checksheet

Even with sampling fractions of only 9-63% per square, it was suspected before the survey began and became apparent after about 3 weeks into the survey that the target of 45 squares was an unrealistic goal. The reconsideration of each square therefore had to be based on the same criteria as those used in selecting the original 45. It was obvious that those squares surveyed up to that moment would be kept in the final total. However, it was decided that simply by eliminating some of the multiple squares of the same category in the original survey taxonomy a more modest sample of 22 could still achieve a representation of that environmental diversity originally proposed (Table 4.3 and Figures 4.1-4.3). While the confidence in such a reduction would be less, arguments will be presented in Chapter 6 that suggest that even this sample has some legitimacy as an accurate representation of site patterning in these 3 quadrangles specifically and in the Bald Eagle watershed generally.

III. AN APPRAISAL OF FIELD TECHNIQUES

The recognition of patterning in the spatial distribution of sites plays such a key role in contemporary archaeology that any effort to improve methodologies along these lines warrants thorough testing and evaluation. The field techniques for site discovery described in the previous section have largely been developed in the context of American "contract" archaeology. In spite of their routine use in this area, few rigorous evaluative tests exist regarding their statistical accuracy. Mueller's (1974) work remains one of the most thorough evaluations of site discovery strategies. However, many of the techniques selected by him for testing are not particularly applicable under the highly variable, "patchy" ground cover conditions so common in the eastern United States.

While the solutions are not easy, the problems are relatively clear. Of immediate concern are the following:

1. What effect does the selection of a mole-holing technique over a walk-over technique have on the representativeness of the sample of sites discovered?

2. To what extent does the density of artifacts within a site and the size of the site horizontally have on its detection using different techniques and spacing intervals?

3. What is the most efficient scenario of site detection for different spatial configurations of sites, and how does one choose from alternate strategies a priori?

Several of the authors of this volume are engaged in research that addresses these problems, although results are forthcoming. Both mathematical and simulation (game board and computer) models are being used. Until these results are in, the obvious limitations of evaluating methods against a population of unknown parameters will force us to make only conditional and "order of magnitude" statements of accuracy. However, with this in mind, two interesting points can be made regarding our survey results from 1978.

Table 4.3: Survey Squares Actually Inspected in 1978

	Quad A (Beech Creek)	Quad B (Bellefonte)	Quad C (State College)	Totals		
Allegheny Foothills						
1. Class 2 Stream Environments	1[a](2)[b]	---	---	1		
2. Class 3 Stream Environments	---	1(2)	---	1		
3. Margins	0	1(8)	---	1		
4. Interior	1(1)	1(1)	---	2	Total = 5	10%[c]
Bald Eagle Valley						
1. Class 1 Stream Environments	2(9,10)	---	---	2		
2. Class 2 Stream Environments	---	1(6)	---	1	Total = 3	19%
Appalachian Ridges						
1. Ridge Tops	0	1(10)	0	1		
2. Ridge Margins	1(11)	---	1(15)	2	Total = 3	10%
Nittany Valley						
1. Class 2 Stream Environments	1(15)	1(14)	1(7)	3		
2. Class 3 Stream Environments	1(12)	1(15)	2(13,14)	4		
3. Uplands	0	0	3(1,2,12)	3		
4. Interior Ridge	1(13)	---	---	1	Total = 11	12%

[a] Number of squares in category.

[b] Square identification number(s).

[c] Percent of total area on Quads actually inspected.

Of the 148 sites collected during the survey, 128 were newly discovered by the survey team. Table 4.4 provides, for each square and technique, information on the areas surveyed (in acres) and the number of sites found. Table 4.5 combines the total acres and sites for each technique and, as a rough relative measure of their success, shows the average number of acres inspected per site discovery event.

It is clear from the latter table that our pre-survey impressions regarding the success of walk-over survey techniques were justified. The high visibility and greater area of inspected surface associated with walking techniques in exposed fields no doubt accounts for this success. Table 4.6 summarizes these data further, demonstrating that 82.4% of all newly discovered sites were found using one of the walk-over techniques even though these were applied to only 56.3% of the area actually surveyed.

The 26 sites (17.6%) discovered by mole holing must be considered a successful return for the investment as well. In a qualitative sense, it is clear that these sites would not have been discovered otherwise, given their pasture or forest settings. More importantly, many of these sites were discovered in topographic settings that have never before received systematic archaeological attention. Our awareness of them now allows important additions to the area's settlement system reconstructions. Quantitatively, it is interesting to note that our overall relative success rate of site discovery per acres examined (1 per 21 acres for walk over versus 1 per 63 acres for mole holing) is apparently biased against mole holing. As Chapter 6 will discuss in detail, we can successfully retrodict relative site density in each square mile surveyed using rather crude estimates of prehistoric resource potential. If we rank order our 22 squares and divide the list in two, calling the half with the fewest sites "low" and the half with the most sites "high," we find that on the average somewhat more area in the "low" squares was examined by mole holing than in the "high" squares (43% versus 37%). Mole holing was differentially applied in these areas out of necessity, since the areas of lesser resource potential prehistorically tend to be the most overgrown today. However, by differentially applying the mole-holing techniques in areas that are independently believed to have few sites, we have biased the relative success statistics discussed earlier. Our impressionistic satisfaction with mole-holing techniques is therefore even greater, and as a result, the comparative values presented in Tables 4.5 and 4.6 should be interpreted very cautiously.

Table 4.4: Statistical Summary of Survey Squares

Square		Walk				Shovel Test					>20°
		10	20	30	TOT	25	50	75	100	TOT	
A-1	102.5[a]	35.2[d]	32.4	0	67.6	15.6	19.3	0	0	34.9	0
	18.0%[b]	34.3%[e]	31.6%	0	65.9%	15.2%	18.8%	0	0	34.0%	0
	4[c]	3[f]	0	0	3	0	1	0	0	1	0
A-2	60.3	.9	8.1	17.0	26.0	0	13.3	21.0	0	34.3	0
	9.0%	1.5%	13.4%	28.2%	43.1%	0	22.1%	34.8%	0	56.9%	0
	2	1	1	0	2	0	0	0	0	0	0
A-9	123.3	5.0	39.1	79.2	123.3	0	0	0	0	0	0
	19.0%	4.1%	31.7%	64.2%	100.0%	0	0	0	0	0	0
	20	0	3	17	20	0	0	0	0	0	0
A-10	181.8	1.4	43.6	136.8	181.8	0	0	0	0	0	0
	28.0%	.8%	24.0%	75.2%	100.0%	0	0	0	0	0	0
	9	0	3	6	9	0	0	0	0	0	0
A-11	161.8	0	44.0	91.4	135.4	0	0	26.4	0	26.4	0
	25.0%	0	27.2%	56.5%	83.7%	0	0	16.3%	0	16.3%	0
	8	0	0	8	8	0	0	0	0	0	0
A-12	256.4	12.9	6.5	147.1	166.5	0	89.9	0	0	89.9	0
	40.0%	5.0%	2.5%	57.4%	64.9%	0	35.1%	0	0	35.1%	0
	4	1	0	0	1	0	3	0	0	3	0
A-13	112.6	0	0	0	0	0	15.8	94.6	2.2	112.6	0
	17.0%	0	0	0	0	0	14.0%	84.0%	2.0%	100.0%	0
	0	0	0	0	0	0	0	0	0	0	0
A-15	188.4	21.1	93.6	49.9	164.6	6.9	16.9	0	0	23.8	0
	29.0%	11.2%	49.7%	26.5%	87.4%	3.7%	9.0%	0	0	12.7%	0
	14	8	3	1	12	0	2	0	0	2	0
B-1	112.8	11.6	59.8	31.7	103.1	0	9.7	0	0	9.7	0
	17.0%	10.3%	53.0%	28.1%	91.4%	0	8.6%	0	0	8.6%	0
	0	0	0	0	0	0	0	0	0	0	0
B-2	92.2	6.3	31.9	0	38.2	6.4	32.8	0	0	39.2	14.8
	14.0%	6.8%	34.6%	0	41.4%	6.9%	35.6%	0	0	42.5%	16.1%
	5	1	0	0	1	1	3	0	0	4	0
B-6	111.8	17.8	6.9	12.0	36.7	.5	9.2	33.5	31.9	75.1	0
	17.0%	15.9%	6.2%	10.7%	32.8%	.4%	8.2%	30.0%	28.5%	67.1%	0
	4	2	0	1	3	0	0	1	0	1	0
B-8	159.4	7.9	23.5	115.1	146.5	0	0	0	12.9	12.9	0
	24.0%	5.0%	14.7%	72.2%	91.9%	0	0	0	8.1%	8.1%	0
	4	1	0	3	4	0	0	0	0	0	0

Table 4.4 (Continued)

Square		Walk				Shovel Test					>20°
		10	20	30	TOT	25	50	75	100	TOT	
B-10	72.4	1.8	0	0	1.8	2.3	20.0	0	48.3	70.6	0
	11.0%	2.5%	0	0	2.5%	3.2%	27.6%	0	66.7%	97.5%	0
	1	0	0	0	0	1	0	0	0	1	0
B-14	199.9	7.6	0	13.8	21.4	2.9	34.3	75.9	45.9	159.0	19.5
	31.0%	3.8%	0	6.9%	10.7%	1.5%	17.2%	38.0%	23.0%	79.7%	9.7%
	1	0	0	1	1	0	0	0	0	0	0
B-15	324.1	7.0	0	102.8	109.8	0	94.3	0	120.0	214.3	0
	50.0%	2.2%	0	31.7%	33.9%	0	29.1%	0	37.0%	66.1%	0
	0	0	0	0	0	0	0	0	0	0	0
C-1	404.8	10.0	58.7	6.1	74.8	0	5.6	0	324.4	330.0	0
	63.0%	2.5%	14.5%	1.5%	18.5%	0	1.4%	0	80.1%	81.5%	0
	0	0	0	0	0	0	0	0	0	0	0
C-2	165.6	0	54.5	111.1	165.6	0	0	0	0	0	0
	25.0%	0	32.9%	67.1%	100.0%	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
C-7	255.6	0	41.7	88.9	130.6	0	54.2	0	70.8	125.0	0
	39.0%	0	16.3%	34.8%	51.1%	0	21.2%	0	27.7%	48.9%	0
	22	0	5	7	12	0	2	0	8	10	0
C-12	278.5	5.4	59.8	172.0	82.4	0	0	41.3	0	41.3	0
	43.0%	1.9%	21.5%	61.8%	85.2%	0	0	14.8%	0	14.8%	0
	1	0	0	1	1	0	0	0	0	0	0
C-13	310.0	102.8	45.2	83.1	151.1	8.7	46.5	0	23.7	78.9	0
	48.0%	33.2%	14.6%	26.8%	74.6%	2.8%	15.0%	0	7.6%	25.4%	0
	15	11	0	1	12	1	2	0	0	3	0
C-14	243.6	23.2	107.0	0	130.2	8.1	8.6	0	96.7	113.4	0
	38.0%	9.5%	43.9%	0	53.4%	3.3%	3.5%	0	39.7%	46.5%	0
	6	2	3	0	5	0	0	0	1	1	0
C-15	147.9	3.3	91.0	5.0	99.3	0	0	0	48.6	48.6	0
	23.0%	2.2%	61.5%	3.4%	67.1%	0	0	0	32.9%	32.9%	0
	8	0	7	1	8	0	0	0	0	0	0

[a] Acres surveyed in square.
[b] Percent of square surveyed.
[c] Total sites discovered.
[d] Acres surveyed by technique.
[e] Percent of surveyed area examined by technique.
[f] Sites discovered by technique.

Table 4.5: Interval Comparisons of Site Discovery Techniques

	Shovel Testing			
	25 m	50 m	75 m	100 m
Total Acres Examined	51.4	470.4	292.7	825.4
Number of Sites Discovered	3	13	1	9
Acres Surveyed per Site	17.1	36.2	292.7	91.7

	Walking		
	10 m	20 m	30 m
Total Acres Examined	281.2	847.3	1263.0
Number of Sites Discovered	30	25	47
Acres Surveyed per Site	9.4	33.9	26.9

Table 4.6: Comparative Summary of Site Discovery Techniques

	Shovel Testing	Walking	>20°
Total Acres Examined	1639.9	2156.7	34.3
Number of Sites Discovered	26	102	0
Acres Surveyed per Site	63.1	21.1	-
% of Total Sites	17.6%	82.4%	0.0%
% of Total Acres Surveyed by this Technique	42.8%	56.3%	.9%

CHAPTER 5

AN ANALYSIS OF THE CHIPPED STONE ASSEMBLAGES FROM THE NATIONAL REGISTER SURVEY--1978

CONRAN A. HAY

I. INTRODUCTION

Of the 148 sites discovered during the course of the National Register Survey the vast majority produced samples of chipped stone artifactual materials. Furthermore, such material was by far the most common variety of artifact recovered. Only one site produced prehistoric pottery, and only a few produced isolated ground stone items. Interpretations of the results of this survey have therefore been based largely on lithic analysis. The specific approach employed was designed to reflect three dimensions of prehistoric behavior: 1) tool manufacture, 2) tool use, and 3) raw material procurement and transport. Since these dimensions of behavior reflect more general aspects of extinct socioeconomic systems, they provide a basis for a preliminary reconstruction of the settlement systems and land-use practices of the prehistoric inhabitants of the survey area.

II. METHODS OF ANALYSIS

A. TOOL MANUFACTURE AND TOOL USE

From Archaic to Woodland times, the Indians of central Pennsylvania employed a bifacial thinning and shaping core reduction strategy to produce lithic implements. There is no evidence that any prepared core techniques were used, or that flake or blade tools were numerically important components of prehistoric tool kits. Instead, finished bifaces were produced from primary cores. Three steps in this process can be distinguished. Using percussion flake removal techniques, primary cores were first shaped into crude bifacial preforms. Second, these preforms were further thinned and shaped until the approximate shape of the finished tool had been produced. Third, the fine bifacial preforms produced by stage two were finished through the use of carefully controlled percussion or pressure flaking. Since projectile points are the most common variety of finished tools recovered during the National Register Survey, it can be inferred that the primary objective of this manufacturing sequence was to produce projectile points.

In addition to finished bifacial tools, a few unifacial tools were produced by the prehistoric inhabitants of the survey area. The manufacturing techniques employed for this purpose involved selecting a suitable flake blank, and then shaping that blank through the use of unifacial percussion flaking. Throughout this process, the bulbar face of the flake blank was used as the striking platform.

To document the relative importance of these tool manufacturing activities at the various sites discovered during the survey, all chipped stone artifacts were classified using the following typological scheme.

Primary Core--Any angular chunk or nodule from which one or several flakes have been removed using percussion techniques, but which shows no evidence of bifacial shaping.

Crude Bifacial Preform--Any thick, unfinished biface showing evidence of percussion flaking only.

Fine Bifacial Preform--Any finished biface which has been successfully thined and/or shows evidence of pressure flaking.

Unifacial Preform--Any flake that has been partially shaped using unifacial flaking.

Finished Bifacial Tool--Projectile points, drills, etc.

Finished Unifacial Tool--Side scrapers, end scrapers, etc.

Flake--

Biface thinning flake--Any flake showing a combination of attributes indicating removal from a biface preform. Long, narrow platforms, thin cross-sections, high angles between platform surfaces and bulbar faces, and complex scar patterns on external flake surfaces and on platforms are common attributes.

Other flake--Any flake with an intact bulb and platform that does not show evidence of having been removed from a biface.

Shatter--Any flake fragment which lacks a bulb of percussion and a platform.

In-depth functional interpretations based on wear pattern analysis were beyond the scope of the present investigation. Generalized functional inferences have been made, however, and provide preliminary insights into the tool-using behavior of the prehistoric inhabitants of the survey area. These inferences are based on a classification of lithic material by traditional functional categories, including such types as projectile points, drills, bifacial knives, side scrapers, end scrapers, and utilized flakes. These type categories do not require formal definitions since their defining characteristics are generally known.

In order to reveal site to site variability in tool-manufacturing and tool-using behavior, all lithic materials, including finished tools unfinished tools, and debitage, were classified using this scheme. The results indicate that all sites include approximately equivalent amounts of the various types distinguished. The full range of preforms in the biface reduction sequence (including primary cores, crude preforms, fine preforms, and finished bifaces) is represented at virtually all sites with total lithic samples in excess of 200 specimens. These sites also show roughly equivalent frequencies of finished tools (projectile points, drills, knives, scrapers, utilized flakes, etc.). Since cores, preforms, and finished bifaces are relatively rare in all assemblages, the absence of various of these types at some sites with samples of less than 200

pieces is probably due to sampling variability rather than to true behavioral differences in artifactual content.

Several exceptions to the overall similarity in lithic content exhibited by these sites should be noted. First, three sites show an artifact complex that differs from the common pattern. At these sites, no fine bifacial preforms or finished bifacial tools were present, despite the fact that samples well in excess of 200 items were recovered from each. In addition, flake cores and crude biface preforms were somewhat more numerous and biface thinning flakes were somewhat fewer than at other sites. These characteristics suggest that the tools produced were transported to other localities at an early stage in the manufacturing process. Since two of these sites are in the immediate vicinity of black flint outcrops, it seems probable that this distinctive behavior is associated primarily with quarrying activities rather than with hunting and more generalized tool manufacture. Thus, these sites probably should be interpreted as raw material procurement stations rather than as hunting camps.

A second exception to the overall similarity of the sites discovered during the survey is overall site size and density, which is highly variable. Two alternative hypotheses concerning the significance of this variability are possible. First, variability in size and density may be primarily a function of differences in the frequency, and perhaps the duration, of site occupation. Sites near major streams and other desirable resources may have been occupied more often than sites in more remote areas, leading to larger and denser artifact concentrations at the former localities. An alternative hypothesis, however, is that the larger and denser sites are functionally distinct from small ones. A settlement system consisting of seasonally occupied macroband and microband camps might be expected to produce such a pattern, since distinct activity regimes would probably have characterized each camp type. Archaeologically, such a settlement system would produce both large and small sites. Furthermore, one might expect the larger sites to contain a distinctly different artifactual complex as compared to the small ones.

In order to test these two alternative hypotheses, sites were first classified by overall size and density. Artifact type frequencies were then tabulated for each size category. If the larger and denser sites were functionally distinct from smaller ones, the differences should be reflected in the different relative frequencies of tool types exhibited by each size class. Alternatively, if differences in site size are primarily a function of differences in the frequency and duration of occupation, small sites and large sites should exhibit similar overall artifact type frequencies.

Since similar data collecting procedures were employed at most sites, the size of the total artifactual sample recovered from a site was taken as a crude relative estimator of the overall site size and density. Figure 5.1 presents the distribution of this variable, and suggests that three gross categories of site size and density exist within the sample. Small, light lithic scatters generally produced samples of from 1 to 70 pieces, moderate scatters produced from 70 to about 220 pieces, and large

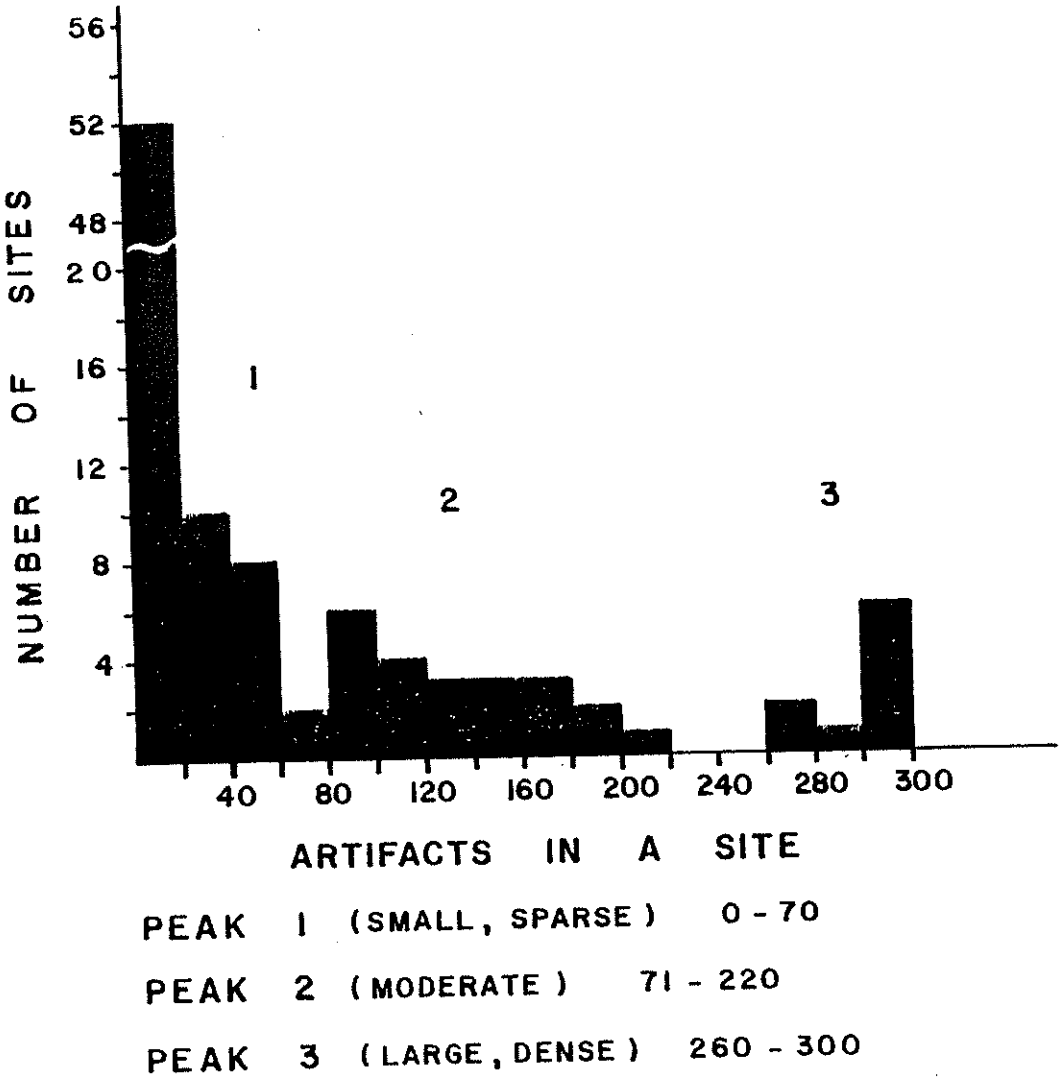


Figure 5.1: Site Categories by Artifact Count

dense scatters produced samples in excess of 250 specimens. To determine whether these size categories represent functionally distinct site types, percentages of lithic artifact types were tabulated for the sites in each size category. Although the three black flint quarry localities are all large, dense scatters, they are clearly distinctive behaviorally from the other sites in their size category. For this reason, artifact frequencies were tabulated for these three sites separately. The results of this procedure (Figure 5.2) emphasize the uniqueness of the three black flint quarries and confirm the overall similarity of all the other sites discovered during the survey, since flake cores, preforms, projectile points, other finished tools, and the various types of flakes are present in approximately equivalent amounts at sites of all three general size categories. It therefore seems likely that the lithic samples recovered from the larger sites discovered during this survey are not functionally distinct from those of the smaller ones. Preferred localities appear to have been occupied more frequently and for somewhat longer periods of time leading to larger and denser scatters at such locations.

An exception to the similarity exhibited by all three categories of site size should be noted, however. A somewhat lower frequency of preforms and finished tools in larger and denser sites is discernible, suggesting that the raw material procurement and initial core reduction activities were somewhat more important at these larger sites than at the smaller ones. This difference may reflect somewhat longer periods of stay at the larger sites. Short excursions for the purpose of collecting suitable lithic materials may have been made more frequently from sites occupied for several weeks than from those that were occupied for only a few days. This conclusion is reinforced by the presence of Late Woodland pottery at one of the largest black flint sites. One might expect such material at sites occupied for longer times by mixed groups of men, women, and children, while camps temporarily occupied by small hunting parties consisting of males only probably would not contain such material.

In summary, surprisingly little variation was observed in the lithic assemblages collected during the National Register Survey. Assuming a high degree of reliability in these data, one would conclude that little functional variation exists within the lithic samples recovered. Two alternative explanations concerning this lack of variability seem reasonable. First, all the sites in the sample (with the exception of the quarry sites) may have been occupied for the same basic economic purposes. The wide range of variability in size and density would thus be due primarily to differences in the frequency and duration of occupation. A second explanation, however, is that the lithic assemblages in question are not sensitive indicators of site function. If stone tools were used in a restricted range of tasks (e.g., hunting), then differences in non-hunting economic activities might not be reflected in lithic variability. In the following chapter, site distributional data will be used to further investigate the issue of site function.

B. PROJECTILE POINT TYPOLOGY

A key problem in the interpretation of settlement pattern data is the correct chronological phasing of archaeological sites. This problem is

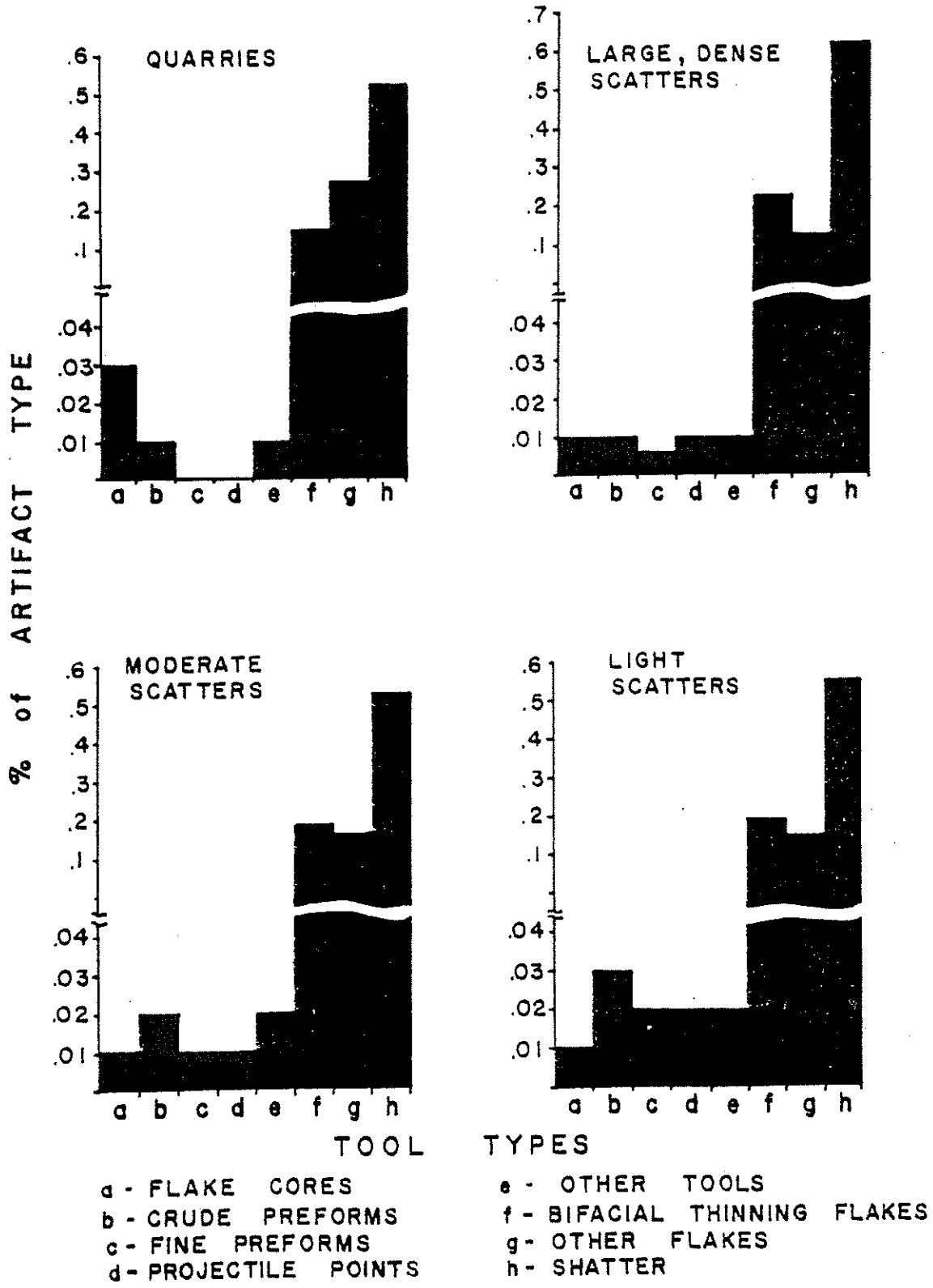


Figure 5.2: Tool Types by Site Categories

commonly solved through the identification of temporally diagnostic artifact types. The only chronologically sensitive artifacts recovered in significant numbers during the National Register Survey were projectile points. The correct temporal assignment of the sites recovered during this project thus relies primarily on projectile point typology.

Projectile point identifications were based primarily on recent discoveries by Funk (1976) of many previously defined point styles in well dated contexts. Coe (1964), Bebrich (1971), Broyles (1971), Ritchie (1971), Ritchie and Funk (1973), Calkin and Miller (1977), Turnbaugh (1977), and Brennan (1977) were also consulted. In one important aspect, the chronological assignments made here depart from those of Funk (1976); the well-recognized Brewerton point styles have been assigned to the Middle Archaic Period rather than to the Late Archaic Period. This revision was effected for two reasons: 1) recent excavations in New York state (e.g., Calkin and Miller 1977; Brennan 1977) have produced Brewerton and Brewerton-like points in association with radiocarbon dates in excess of 3000 B.C.; 2) Brewerton points are stylistically and technologically similar to point styles that are clearly of Early and Middle Archaic provenience, such as Otter Creek in New York and Kirk in the Southeast. In contrast, they show less affinity with known Late Archaic point styles, such as Sylvan Stemmed and Sylvan Side-notched, Normanskill, and Snook Kill in New York, or Savannah River in the Southeast. Since the division between the Middle and the Late Archaic is an arbitrary one, and since Brewerton points are assigned to the earliest phase of the Late Archaic in any case (Funk 1976), this revision does not contradict current data concerning projectile point style changes through time.

The results of these projectile point identifications are presented in Table 5.1. If numbers of projectile points per phase is taken as a crude reflector of general demographic trends, the results of this phase of the analysis suggest that the Bald Eagle watershed saw gradually increasing population densities throughout the Archaic Period. However, distinctly smaller populations seem to have characterized the Early and Middle Woodland Periods. Greatest population densities clearly occurred during the Late Woodland Period, which exhibits fully twice the number of points as any previous phase. These trends are in general agreement with those proposed by Michels (1968) and Webster et al. (1977) for the Bald Eagle and nearby areas.

C. RAW MATERIAL

In central Pennsylvania, many lithic materials were used in the manufacture of chipped stone tools. For some of these, specific sources are known. One-to-one identification of artifactual material and procurement localities are possible in these cases. For others, however, no source has yet been identified (see Chapter 3). The following types of raw material are commonly encountered on archaeological sites in the survey area.

Black Flint--This material is encountered on the majority of sites in the survey area. It is fine textured, high quality flint, which

Table 5.1: Projectile Point Type Chronological Assignments and Frequencies of Occurrence

Period	Type	Number
Late Woodland	Shenks Ferry, Susquehannock, Other Triangular Points	37
Middle Woodland	Snyders, Jack's Reef	4
Early Woodland	Meadowood	1
Transitional	Susquehanna Broadspear	3
Late Archaic	Genesse, Snook Kill, Sylvan Side-Notched, Sylvan Stemmed, Rossville	14
Middle Archaic	Otter Creek, Brewerton	12
Early Archaic	Palmer, Kirk, MacCorkle	10
----	Non-diagnostic	18
Total		99

varies in color from black to a nearly colorless white. Thin edges are generally translucent. Outcrops with associated quarry debitage have been discovered on the flanks of Nittany Mountain, near Oak Hall, and elsewhere in the Nittany Valley.

Bald Eagle Jasper--This material is very common on certain sites in central Pennsylvania. It is coarse to fine textured, opaque, and red and/or yellow in color. Present data (Schindler et al. 1980) indicates that it occurs naturally as a yellow jasper, but becomes red with heat treatment. It occurs as a field stone near Houserville, Pennsylvania in association with debitage indicative of raw material procurement and initial core reduction. It therefore seems likely that this area was a primary source of Bald Eagle Jasper.

Gray Cherts--Many varieties of chert, varying in color from grayish-white to dull black, are encountered on archaeological sites in central Pennsylvania. They are usually fine textured and opaque, and some may have been heat-treated. No local sources for these materials have yet been identified, and they may in fact be of exotic origin. The lack of type specimens from known sources and the wide range of variability exhibited by these materials prevents clear categorization by raw material type. For the purposes of this analysis, they have been treated as a single group.

Rhyolite--A slightly metamorphosed, banded or speckled, gray rhyolite was a preferred lithic material throughout much of Pennsylvania during Transitional times. Source localities for this material have been discovered in south-central Pennsylvania, near Chambersburg, Pennsylvania. Rhyolite occurs on archaeological sites in the Bald Eagle region, but no sources in this area are known. At present, it seems likely that all the actual rhyolite encountered in the region covered by this survey derives from the Chambersburg rhyolite quarries.

Oolitic Chert--This is a coarse to fine textured, speckled chert. The speckled appearance is the result of the presence of either dark oolites in an homogenous, light gray matrix or of light oolites in a dark gray matrix. This chert outcrops at numerous localities in the State College area.

Other Materials--Quartz, quartzite, sandstone, various non-local jaspers, banded cherts, etc are encountered in low frequencies on archaeological sites in the survey area. The sources of these materials are unknown, and they occur in such low frequencies that quantitative, distributional analyses are presently impossible. They have therefore been treated as a single group for the purposes of this analysis.

All of the chipped stone artifacts recovered during the National Register Survey were classified using these raw material types. All sites with statistically reliable samples were then plotted on a three coordinate graph, using percentages of the three most common lithic raw material types as variables. As Figure 5.3 indicates, three clear clusters were produced by this procedure. One cluster includes those sites almost exclusively of Bald Eagle jasper, one includes those that are predominantly

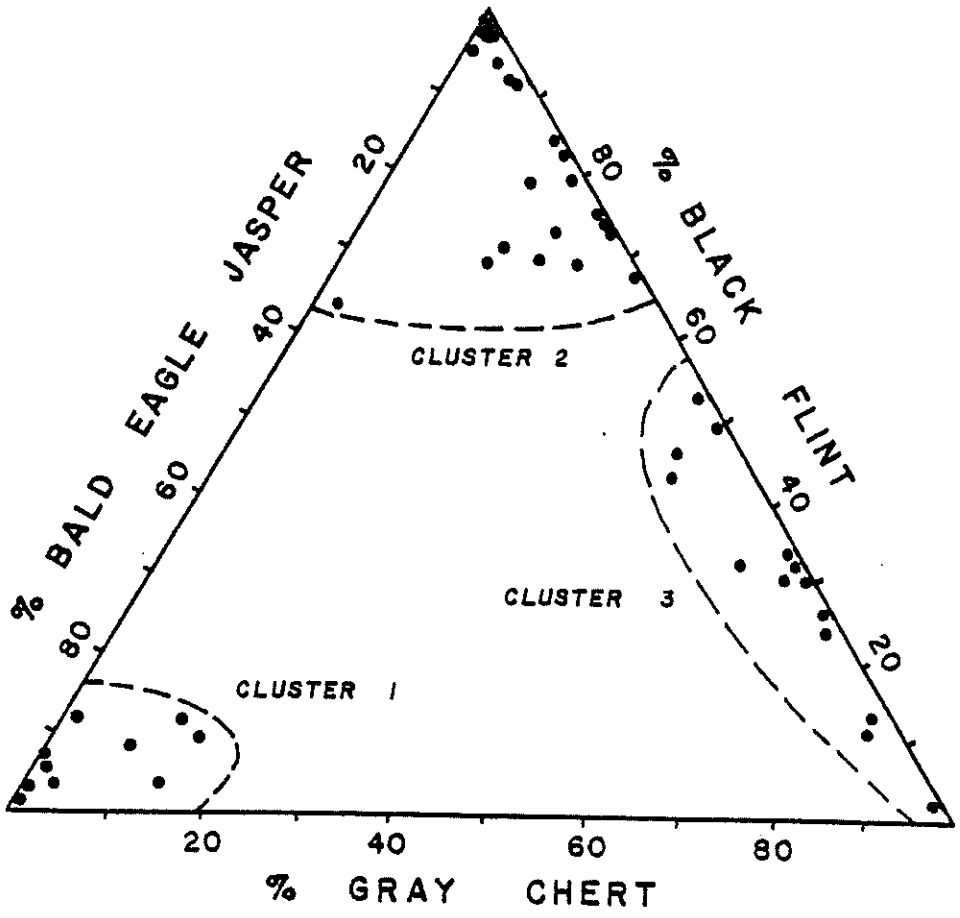


Figure 5.3: Raw Material Preference Clusters

black flint, and one includes sites with high percentages of gray cherts. The remaining lithic types are present in small quantities at many sites, but do not exhibit numerical dominance in any. This pattern indicated that a tripartate classification of sites was feasible, and suggested that raw material distributions might provide insights into prehistoric patterns of resource exploitation and land-use strategy.

To further investigate prehistoric patterns of lithic resource utilization within the survey area, two different hypotheses concerning the distribution of lithic raw materials were tested. First, proximity to sources of raw material may have acted as a primary determinant of procurement strategy. Thus, one would expect sites near black flint outcrops to show a predominance of black flint debitage, and sites near Bald Eagle Jasper collecting localities to have high percentages of Bald Eagle Jasper. In an area with several distinct sources of raw material, a pattern such as this is perhaps to be expected.

A second hypothesis, however, is that raw material procurement strategies changed through time. Thus certain sources may have been preferred during some period(s), and others during other period(s). Sites occupied primarily during one phase would thus exhibit a predominance of one lithic material.

Three procedures were employed to evaluate these hypotheses. First, in order to reveal chronological changes in raw material preference, the lithic materials of all temporally diagnostic projectile points were identified. Second, the associations of diagnostic projectile points with the sites of each major cluster were analysed. Third, the spatial distribution of the sites of each cluster vis-a-vis known raw material sources was examined.

By examining the lithic materials from which projectile points were manufactured, changes in lithic procurement practices were identified. The results (Table 5.2) indicate a clear preference for black flint during Late Woodland times, and only during Late Woodland times. This suggests that the distribution of black flint debitage within the survey zone may relate primarily to a Late Woodland settlement pattern. If so, one can tentatively conclude that the sites in Cluster 2 of Figure 5.3 represent such a settlement pattern. In contrast, Early and Middle Woodland raw material preferences are less obvious. Many different lithic materials were used in the manufacture of projectile points, and no clear emphasis on a single raw material can be discerned. A similar pattern is exhibited by Transitional and Early through Late Archaic projectile points. Of significance for the present analysis, however, is an apparent clustering of Bald Eagle Jasper points in the Early and Middle Archaic Periods. Although sample sizes are low, this clustering suggests that Bald Eagle Jasper utilization was primarily an Early and Middle Archaic phenomenon.

Late Woodland preferences for black flint and Early-Middle Archaic preferences for Bald Eagle Jasper are confirmed by a second test, which involved analyzing the associations of diagnostic projectile points with the sites included in each cluster. Regardless of the material from which they are made, 65% of all diagnostic points found on Bald Eagle Jasper sites are

Table 5.2: Raw Material of Diagnostic Projectile Points and Frequencies of Occurrence

Period	B.E. Jasper	Black Flint	Grey Chert	Other
Late Woodland	0	27	5	5
Middle Woodland	1	0	0	3
Early Woodland	0	0	1	0
Transitional	1	1	1	0
Late Archaic	0	2	3	9
Middle Archaic	4	1	5	2
Early Archaic	1	0	3	6
Totals	7	30	22	22

of Early and Middle Archaic styles. One can therefore conclude that this material was utilized primarily during the Early and Middle Archaic times and that the distribution of Bald Eagle Jasper debitage within the survey area is primarily a function of Early and Middle Archaic settlement patterns. Similarly, 68% of all diagnostic points found on black flint sites are of Late Woodland styles, confirming the hypothesis that the distribution of black flint debitage relates primarily to Late Woodland raw material procurement and transport activities. The sites showing a predominance of gray cherts show a more ambiguous pattern. As Table 5.2 indicates, these materials were utilized for point manufacture during both the Late Woodland and the Archaic periods. Similarly, sites which exhibit a predominance of these materials contain approximately 50% Late Woodland points and 50% Archaic points. Thus the distribution of these materials cannot be clearly related to the settlement patterns of a single phase or phases. Since many different raw material types with different sources are subsumed in the gray chert lithic material category, this result is perhaps to be expected.

In the final test, the distribution of the sites in each cluster was compared to known raw material source localities. The results of this comparison indicate that sites which show a predominance of black flint are widely scattered, and are found in the vicinity of both black flint and Bald Eagle Jasper outcrops. They are most often situated adjacent to high quality agricultural soils, indicative of the well-known Late Woodland orientation toward a maize, bean, wild grass seed, nut, and deer based economy. The only black flint sites discovered during the survey that were not situated on agriculturally rich soils were the aforementioned quarry and workshop sites. About 60% of all black flint sites were situated outside the mi^2 survey units incorporating these outcrop localities. This pattern suggests that the distribution of black flint within the survey zone is not primarily a function of proximity to sources, but is instead a result of Late Woodland raw material preferences. In contrast, the jasper dominant sites showed a tight clustering around the Houserville outcrop. About 80% of these sites were located within the same mi^2 survey unit as the Houserville outcrop, and those that fell beyond reflect little more than single resharpening events at hunting camps and blinds. This latter pattern suggests that proximity to a lithic source was an important determinant of procurement strategy during Early and Middle Archaic times. In conjunction with the wider range of materials used for projectile point manufacture, it also suggests that a more eclectic use of raw materials was characteristic of the Early and Middle Archaic Periods.

In summary, neither hypothesis (proximity to lithic source or period of exploitation) provides a full explanation of the distribution of lithic raw materials within the survey zone. During Late Woodland times, a clear preference for black flint resulted in a widespread distribution of this material. Thus, proximity to sources was a less important variable during that phase. During Early and Middle Archaic times, a more eclectic use of raw materials charcterized the prehistoric inhabitants of the survey area, and proximity to sources seems to have played a major role in determining lithic material distributions. As a result of these differences in

procurement strategy, those sites with high percentages of black flint can be interpreted as reflecting a predominantly Late Woodland lithic procurement and settlement pattern system. Sites which consist primarily of Bald Eagle Jasper, on the other hand, reflect a highly localized segment of a more widely dispersed Early and Middle Archaic procurement and settlement system. This patterning allows a rough age assessment for many sites despite their lack of temporally diagnostic artifacts. As a result, a more complete analysis of the settlement patterns of the prehistoric inhabitants of the survey area is possible.

III. RESULTS

Taken together, the results of the analyses of artifact type frequencies, of projectile point typology, and of raw material distributions provide a chronologically and behaviorally sensitive typology of the sites discovered during the National Register Survey. This typology is presented below.

Type 1: Black flint quarries (3 sites)--Raw material procurement and initial core reduction are the only activities represented in the lithic assemblages from these sites. Primary cores are numerous and crude bifacial preforms are present in lower numbers. Since no other shaped artifacts are present, it can be assumed that after initial raw material procurement and minimal reduction, the resulting preforms were transported to other localities where they were finished and used. Other distinguishing characteristics of these sites include relatively low frequencies of biface thinning flakes, high percentages of decortication flakes (approximately 50%), and virtual absence of debitage of materials other than black flint.

Type 2: Large, dense, black flint scatters (2 sites)-- Flake cores, preforms, and finished tools are all present in the assemblages recovered at these sites. One can therefore conclude that tool manufacture was an important activity. With 44% of all finished tools being projectile points, one can further conclude that both tool manufacture and tool use at these sites were related primarily to hunting activities. Since 67% of all diagnostic projectile points are Late Woodland, and since Late Woodland pottery was discovered at one of these sites, it is clear that maximum utilization occurred during this phase. However, these sites were also occupied to a lesser degree during the Middle and Late Archaic, as evidenced by the presence of two Brewerton points and one Sylvan Stemmed point in their assemblages. A single Jack's Reef point indicates minor Middle Woodland utilization at one site. All of the Late Woodland points and most of the debitage of these sites are of black flint, indicating that the Late Woodland inhabitants of these sites probably exploited the black flint quarries described above. In contrast, the Archaic points are of varied raw materials, including black flint, oolitic chert, and Bald Eagle Jasper. This pattern is consistent with the more eclectic exploitation of raw materials that has been inferred for these earlier periods.

Other diagnostic attributes of these sites include higher than average percentages of decortication flakes (about 35%), which are nevertheless lower than are those of the black flint quarry sites. The relatively greater importance of raw material procurement and initial core reduction at these sites as compared to smaller ones is reflected in this statistic. In contrast with the quarries, however, these sites have higher percentages of biface thinning flakes, and do contain fine preforms and finished bifaces. One can therefore conclude that the later core reduction stages occurred at these sites, and not at the quarry sites.

Type 3: Moderate black flint scatters (14 sites)--These sites are equivalent in all respects to the large, dense scatters except that they are smaller, they exhibit lower percentages of decortication flakes (about 25%), and they have slightly higher percentages of preforms and finished tools. Shorter and less frequent periods of occupation, and a somewhat lesser emphasis on lithic raw material procurement can thus be inferred. Fifty percent of the diagnostic projectile points recovered from these sites are of Late Woodland styles, and again, they are made primarily of black flint. Several Brewertons', a Broadspear, and a Meadowood indicate that some of these sites were also occasionally used during Archaic, Transitional, and Early Woodland times.

Type 4: Small, sparse black flint scatters (25 sites)--Small size and low artifact density are the primary distinguishing characteristics of these sites. In addition, they have the highest overall frequencies of preforms and finished tools, and lowest percentages of decortication flakes (average is 6%). Only three diagnostic projectile points were discovered on these sites; one is a Late Woodland point and two are Archaic points. However, this sample is clearly inadequate to provide an accurate chronological assessment. Since the predominant lithic material on all of these sites is black flint, peak utilization during the Late Woodland period seems most probable. Thus, very occasional visits by small, Late Woodland hunting parties are probably represented by these sites.

Type 5: Large, dense, Bald Eagle Jasper scatters (7 sites)--These localities represent the preferred camping places of Early and Middle Archaic people in the survey area. Although 64% of all diagnostic points are Early and Middle Archaic, several Late Woodland points, and a Susquehanna broadspear attest to later periods of utilization. Like the largest black flint scatters, these sites show relatively low frequencies of finished tools and high percentages of decortication flakes, indicating that raw material procurement was an important activity at these sites. Furthermore, the proximity of these (and all other Bald Eagle Jasper scatters) to a known Bald Eagle Jasper source indicates that a localized pattern of raw material procurement was characteristic of Early and Middle Archaic groups in the area. This conclusion is confirmed by a further consideration of the lithic material that one encounters at these sites. Virtually all of the debitage and most of the preforms recovered from these sites are of Bald Eagle Jasper. In contrast, most of the finished tools are made of other materials. This suggests that the people who camped at these localities brought a lithic tool kit composed of various materials with them, and lost or replaced a portion of

these tools while in residence. In order to replace these lost or broken items, the nearest available lithic source was visited, which in this case was a Bald Eagle Jasper collecting station. As a result of this pattern, the by-products of tool manufacture (preforms and debitage) that one recovers at these sites are of Bald Eagle Jasper, while the by-products of tool use (finished tools that were discarded or lost) are of varied raw materials. As indicated above, this pattern of lithic resource exploitation contrasts markedly with that inferred for the Late Woodland phase, during which one lithic resource was primarily exploited. As a result, the majority of finished tools on Late Woodland sites are made of the same material as the debitage, i.e., black flint. The possible significance of this contrast will be further discussed below.

Type 6: Light, sparse, Bald Eagle Jasper scatters (9 sites)--None of the Bald Eagle Jasper scatters discovered during the survey fall into the intermediate size category. All are either large and dense, or light and sparse. The latter are equivalent to the former in all respects except for their smaller size and somewhat higher percentages of preforms and cores. As with black flint sites, these differences are probably a function of shorter and less frequent occupations. Only one diagnostic projectile point (a Brewerton) was discovered on these sites. In light of this and the predominantly Early and Middle Archaic utilization of Bald Eagle Jasper, it is reasonable to attribute an Early and Middle Archaic date to all of these sites.

Type 7: Moderate gray chert scatters (5 sites)--These sites are equivalent in all respects to the black flint scatters of intermediate size and density, except that for these, no reliable age assessment is possible. Most are probably multi-component sites utilized as temporary hunting camps during both the Archaic and the Late Woodland Periods. Of the ten diagnostic points recovered at these sites, 4 are Late Woodland and 6 are Archaic.

Type 8: Light, sparse gray chert scatters (25 sites)--These sites are distinguished from those included in Type 7 primarily by their smaller size. They probably represent camps that were used infrequently during Archaic and/or Late Woodland times. Five of the 8 diagnostic points from these sites are Late Woodland and 3 are Archaic.

IV. DISCUSSION

The patterns that emerge from these analyses have important implications concerning prehistoric social and economic organization in the Bald Eagle Creek watershed. During Early and Middle Archaic times, utilization of the area clearly included the Houserville jasper outcrop. Several sites in the immediate vicinity of the outcrop saw repeated visits by the inhabitants of the area. The presence of Early and Middle Archaic projectile points and end scrapers in these assemblages suggests that the groups that visited them engaged in such economic pursuits as hunting and the processing of hides.

Since the finished tools that were lost or discarded at these sites exhibit a wide variety of lithic raw materials, it can be assumed that the Early and Middle Archaic inhabitants of the area did not rely exclusively on the Bald Eagle Jasper for the manufacture of stone tools. Access to numerous alternative sources of lithic materials is thus implied.

These behavioral characteristics suggest that the Early and Middle Archaic groups that inhabited the study area were characterized by high mobility and had access to a large and ecologically diverse environment. They may have controlled large territories directly, or they may have gained access to widely dispersed resources through an extended network of kin ties.

Present data provide little insight into the lithic procurement systems of the succeeding, Late Archaic Period. In several notable respects however, Late Archaic lithic technology differs from Early and Middle Archaic technology. First, the high quality, fine-grained jaspers and cherts used for point manufacture during earlier times are replaced by poorer quality, coarse-grained cherts and rhyolites. The Bald Eagle Jasper outcrop at Houserville was rarely exploited. In like manner, the black flint localities preferred by Late Woodland peoples were only occasionally visited. Second, the technology of point manufacture exhibits a marked change. Late Archaic styles are noticeably more irregular than earlier styles, exhibit poorly controlled bifacial thinning, and rarely if ever were finished through carefully controlled pressure flaking.

The significance of these changes is at present unclear. Since the source localities of the preferred Late Archaic lithic materials are as yet unknown, distributional analyses of debitage and technological analyses of manufacturing processes are not yet possible. However, similar changes have been noted in the Early-Middle to Late Archaic sequences of the North Carolina Piedmont (Bass 1977; Snavely personal communication). They can also be inferred from illustrations and descriptions of projectile points found in other areas in the eastern United States (e.g., Funk 1976). An hypothesis concerning this pattern is that increasing population densities and concomitant increases in social circumscription resulted in a shift from societies composed of small groups of highly mobile hunters and gatherers to more sedentary societies with intensified hunter-gatherer economies. Increasingly restricted access to lithic raw materials, an associated decline in the quality of available materials, and changes in lithic technology may all have resulted from this evolutionary trend (Snavely personal communication).

Data for the Transitional, the Early Woodland, and the Middle Woodland Periods are even scantier than for the Late Archaic Period. All that can be inferred at present concerning lithic procurement strategies is that projectile points were made from varied raw materials, and that most were made on flakes, rather than through the biface reduction strategies utilized during the Early and Middle Archaic times. Projectile point raw materials indicate that both the Houserville outcrop and the black flint quarries were occasionally visited during the Transitional, Early Woodland, and Middle Woodland Periods.

The Late Woodland Period represents a further change in the technology of stone tool manufacture in the Bald Eagle Creek watershed. For the first time, a single raw material was clearly preferred. Since source localities for this material are known, the procurement and core reduction strategies used in its exploitation can be inferred. A comparison of these latter systems of lithic tool manufacture with those of Early and Middle Archaic peoples provides further insight into the general trends of sociocultural evolution in the Bald Eagle watershed.

The lithic assemblage from the black flint quarry sites differ from the Houserville lithic assemblages in four important respects. First, failed bifacial preforms are relatively rare, while primary flake cores are common; second, primary trimming flakes are more common than biface thinning flakes; third, finished tools are not represented despite the collection of samples in excess of 1000 specimens. Finally, there is no evidence that heat treatment was used during the manufacuring process. These differences reflect a radically different approach to lithic raw material exploitation. Since no finished tools are present in the assemblages from black flint quarry sites, it can be assumed that these localities were visited solely for the purpose of procuring lithic materials, and were not utilized as habitation sites. Furthermore, the core reduction activities represented by these assemblages seem directed primarily towards the production of flakes and/or flake cores, rather than bifaces. Coupled with the probable absence of heat treatment, a more expedient approach to tool manufacture is suggested.

The manufacturing activities represented by the black flint quarry sites provided the bulk of the material from which the Late Woodland projectile points in the Bald Eagle Creek watershed were made. Furthermore, the wide areal distribution of sites that exhibit a predominance of black flint debitage indicates that systems of production and distribution incorporated relatively large areas. Two alternative scenarios concerning the nature of these networks seem reasonable. First, specialists in the manufacture of lithic products may have visited the black flint quarry site periodically to procure raw material. The flake blanks or finished projectile points produced by these craftsmen may then have been provided to the general population through exchange networks. Alternatively, the black flint quarries may have been visited by individuals residing throughout the Bald Eagle Creek watershed. Thus, special trips to the quarry localities may have been conducted to procure lithic materials, which were then transported to habitation sites throughout the region. In either case, procurement and distribution patterns differed radically from those of the earlier, Early and Middle Archaic peoples. It seems probable that these changes are related to the development of larger and more complex agricultural societies. Exchange networks and more extensive systems of social and political integration may have included larger populations, thus providing more generalized access to raw materials with restricted distributions.

CHAPTER 6

PREDICTIVE MODELS OF SITE DISTRIBUTION WITHIN THE BALD EAGLE CREEK WATERSHED

CONRAN A. HAY AND JAMES W. HATCH

I. INTRODUCTION

A major objective of the 1978 National Register Survey was the development of predictive models concerning the distribution of archaeological sites within the study area. Using generalizations derived from extant site location data as a guide, such models seek to identify other, unsurveyed areas likely to contain additional sites. The results of the survey were therefore used to test 2 low-level hypotheses concerning the distribution of archaeological resources within the study area. The first of these was concerned with the distribution of all sites regardless of their chronological associations, since the existing data did not allow phase-specific assignments for the majority of the sites discovered during the survey. A second hypothesis was developed for the Late Woodland settlement pattern alone, since lithic analyses (see Chapter 5) had provided a basis for isolating sites relating to this period. Both of these hypotheses were formulated to express expected patterns of site density within the study area. These expected patterns were then statistically compared to the actual site location data recovered during the 1978 survey. The results of these procedures, as described below, provide a basis for formulating predictive models concerning site distributions within unsurveyed portions of the Bald Eagle Creek watershed.

II. HYPOTHESIS 1

The prehistoric availability of key natural resources, such as water, wild plant foods, lithic raw materials, etc., determined the location of sites in the Bald Eagle Creek watershed. Areas providing maximum access to such resources should thus exhibit especially high site densities.

A brief consideration of the culture history of the study area indicates the probable importance of key natural resources as determinants of settlement location. From the Paleo-Indian Period until the beginning of the Woodland Period, the prehistoric inhabitants of Pennsylvania were probably organized into small mobile bands of people who subsisted by hunting and gathering wild food resources. During the succeeding Early and Middle Woodland Periods, agricultural crops in the form of beans, squash, gourds, and maize were added to the available food resources. By Late Woodland times, dependence on these cultivated crops is believed to have been substantial, with maize probably constituting the single most important food resource. The shift from full dependence on wild foods to a heavy reliance on cultivated crops was undoubtedly a gradual one, however, and it seems likely that cultivated foods supplemented a predominatly

hunting and gathering economy during much of the Early and Middle Woodland Periods. Thus, the primary factor constraining settlement location choices throughout most of the prehistory of the study area appears to have been the distribution of the natural resources upon which hunters and gatherers depend for their survival.

As indicated in Chapter 3, a detailed reconstruction of the prehistoric environment that characterized the study area is not yet available. As a result, predictive generalizations concerning the distributions of sites vis-a-vis specific wild food resources are not feasible. However, previous research in the area (Webster et al. 1977; Aldenderfer n.d.) and initial attempts at environmental reconstruction (Chapter 3) provide preliminary criteria for evaluating habitat desirability. These data indicate that, in general, access to water for drinking and navigational purposes, the presence of level ground for camping, proximity to sources of lithic raw material, and easy access to the food resources of different ecozones were all important factors influencing settlement locations. Hypothesis 1 thus proposed that site densities would increase with habitat desirability, as defined on the basis of these 4 variables.

To test this hypothesis, the 22 survey squares completed during the 1978 survey were rank ordered on the basis of habitat desirability. This ordering was then compared to actual site densities within survey squares. The rank ordering was accomplished by assigning a score of from 1 to 4 to each environmental characteristic specified in the hypothesis based on its assumed desirability (Table 6.1). These scores were then totaled for each survey unit (Table 6.2). Finally, the rank order of actual site densities per survey square, after being corrected for differential survey coverage, was compared to the rank order of squares defined by habitat desirability (Table 6.3).

The results indicate a distinct increase in site density with increased habitat desirability (ρ=0.66, significant when α=0.001), thus confirming the hypothesis that archaeological sites tend to be located with respect to the specified natural resources. They also reveal interesting site distributional patterns. A distinct jump in site density occurs as resource desirability increases from a score of 8 to a score of 9 and 10 (Table 6.3). This pattern suggests that habitats within the Bald Eagle Creek watershed can be divided into 3 general categories: undesirable habitats (desirability score $\leq$ 8), moderately desirable habitats (desirability score = 9), and highly desirable habitats (desirability score $\geq$ 10).

Squares in the first of these categories share certain general environmental characteristics. They are drained by tertiary or intermittent streams only, they are primarily located in the foothills of the Allegheny Plateau or in mid-valley upland settings within the Ridge and Valley Province, and they provide minimal access to lithic raw materials or to varied ecozones. In general, habitats within the moderately desirable category are similar to those in the first category. However, survey squares within this second category all possess one of three distinguishing characteristics: outcrops of lithic raw materials, a floodplain terrace, or a navigable stream. Habitats within the third (highly desirable) category are generally unlike

Table 6.1: Environmental Variables and Habitat Desirability Point Score Assignments

Variable	Point Score
A. Access to Water	
1. None or Intermittent Streams Only	1
2. Tertiary Drainage Streams	2
3. Secondary or Primary Drainage Streams (Navigable)	3
4. Secondary-Secondary or Secondary-Primary Drainage Stream Confluence	4
B. Topography	
1. Steep Mountain Side Slopes	1
2. Mountain and Ridge Tops	2
3. Foothills and Mid-valley Uplands	3
4. Floodplains	4
C. Availability of Lithic Resources	
1. None	1
2. Scattered Field Stone	2
3. Outcrop	3
D. Access to 2 or More Ecozones	
1. Difficult	1
2. Easy	2

Table 6.2: Survey Squares and Habitat Desirability Scores

Square	Desirability Scores[a]				
	Access to Water	Topography	Lithic Resources	Access to Ecozones	Total
A-13	1	1	2	1	5
B-10	1	1	2	1	5
C-1	1	3	1	1	6
C-2	1	3	1	1	6
A-1	1	3	1	1	6
C-12	1	3	1	1	6
B-1	1	3	1	2	7
A-12	2	3	1	1	7
C-13	2	3	1	1	7
B-15	2	3	2	1	8
B-8	1	4	1	2	8
B-2	2	4	1	2	9
A-11	1	3	3	2	9
C-15	2	3	3	1	9
C-14	2	3	3	1	9
A-15	3	4	1	1	9
B-14	3	3	2	1	9
A-2	3	4	1	2	10
B-6	3	4	1	2	10
A-9	3	4	1	2	10
A-10	3	4	1	2	10
C-7	3	4	3	1	11

[a]See Table 6.1.

Table 6.3: Survey Square Rank Order and Site Densities

Square	Habitat Desirability Score	No. Sites Found	% Square Surveyed	Estimate Sites/Mi^2	Estimate Average Sites/Mi^2
A-13	5	0	17.6	0	4.4
B-10	5	1	11.3	8.8	
C-1	6	0	63.3	0	7.8
C-2	6	0	25.9	0	
A-1	6	4	18.8	21.3	
C-12	6	4	43.5	10.0	
B-1	7	0	17.6	0	14.4
A-12	7	4	40.1	10.0	
C-13	7	16	48.4	33.1	
B-15	8	0	50.6	0	8.1
B-8	8	4	24.9	16.1	
B-2	9	5	14.4	34.7	28.9
A-11	9	8	25.3	31.6	
C-15	9	8	23.1	34.6	
C-14	9	7	38.1	18.4	
A-15	9	15	29.4	51.0	
B-14	9	1	31.2	3.2	
A-2	10	2	9.4	21.3	62.9
B-6	10	13	17.5	74.3	
A-9	10	24	19.3	124.4	
A-10	10	9	28.4	31.7	
C-7	11	25	39.9	62.7	62.7

those in the first two categories and exhibit a number of characteristics in common. All contain both floodplain terrain and secondary or primary streams, and all but one provide easy access to varied ecozones. Interestingly, the presence of lithic outcrops is not a general characteristic of these latter habitats.

These generalizations provide a valuable tool for predicting site distributions within unsurveyed portions of the Bald Eagle Creek watershed. If, for example, an unsurveyed locality is assigned a score based on assumed habitat desirability using the procedures described above, a preliminary estimate of site densities within that locality can be estimated. Such predictions will allow the identification of areas likely to witness severe impacts to archaeological sites, and avoidance or mitigative procedures can thus be instituted. Through such procedures, the preservation of archaeological sites can be maximized.

III. HYPOTHESIS 2

Access to high quality agricultural soils played a significant role in determining Late Woodland settlement locations. Late Woodland sites should therefore exhibit a strong association with such soils.

As indicated above, Late Woodland populations in eastern North America relied heavily on cultivated crops, especially maize, for their subsistence needs. As a result, access to high yield soils probably played a predominant role in the selection of Late Woodland habitation sites. The evaluation of this hypothesis involved 3 procedures. First, soil types (U.S.D.A. 1966, 1968, in preparation) were identified for all sites discovered during the 1978 survey. Second, the productivity of these soils were identified using contemporary maize potential figures for "common" rather than "improved" management and for "grain" rather than "silage" corn. Finally, the association between site location and soil productivity for the Late Woodland sites in the sample was compared to that for the remaining sites in the sample.

The results of these procedures (Table 6.4) indicate that Late Woodland sites exhibit a significantly greater tendency to be located on high quality maize-producing soils than do other sites ($\chi^2=7.52$, df=1, significant when $\alpha=0.01$). Thirty-one (70%) of the 44 Late Woodland sites in the sample are located on soils with productivity ratings of 85 or above out of a possible 100. This pattern contrasts markedly with that exhibited by non-Late Woodland sites, of which only 44% are on soils rated 85 or above. The hypothesis that Late Woodland settlements tend to be located on highly productive soils is thus confirmed.

However, 13 (30%) Late Woodland sites are located on soils with productivity ratings that range from 40-80, thus implying some degree of divergence from the expected pattern. Further insights into the factors that may underlie this divergence of settlement choices is provided by a detailed examination of site distributions within individual survey squares.

Table 6.4: Chi-square evaluation of the Late Woodland site association with productive soils.

	Late Woodland Sites	Other Sites	Totals
Soil Productivity Rating ≥ 85	31	27	58
Soil Productivity Rating < 85	13	35	48
Totals	44	62	106

$\chi^2=7.52$, df=1, significant when $\alpha=0.01$

Two squares, A-9 and A-10, represent primary stream floodplain settings. Eleven of the 44 Late Woodland sites in the sample occur in these 2 squares alone. Two of these 11 sites are located on soil types with productivity ratings of 100. Seven of the remaining 9 sites are on 90-rated flood plain soils, while 2 are in sloping valley edge locations with soil ratings of 80. In primary stream settings, a clear tendency for Late Woodland materials to be located on high ranked soils can thus be observed.

Secondary streams are represented in 3 squares: A-15, B-6, and C-7. Square A-15 contains the largest of these streams, Fishing Creek. This stream is paralleled by a broad band of soils with productivity ratings of 90. Eight of the 9 Late Woodland sites within Square A-15 are located on this band of highly productive soil. Squares B-6 and C-7 are located further up the drainage pattern; as a result, pockets of highly rated soils are more dispersed. Square C-7 contains 3 Late Woodland sites, and all are located on soils with ratings of either 100 or 90. Square B-6 contains 2 sites located on soils rated 100 and 90, respectively. As with primary stream drainages, a clear association between high quality soils and Late Woodland sites is apparent in secondary stream drainages.

Tertiary streams occur in 3 squares containing Late Woodland sites: A-12, C-13, and C-14. Squares A-12 and C-13 each contain 1 small Late Woodland site. In both cases, these sites are located at confluences of tertiary streams on small patches of soil with productivity ratings of 95. In Square C-14 3 Late Woodland sites are found at a major tertiary stream confluence, on soils with ratings of 100, 100, and 90, respectively. Three additional sites are located further upstream, however, on soils rated 85, 70, and 40. Although on less productive soils, these latter sites are located near a black flint outcrop. Since this flint was preferred by Late Woodland populations in the area, the location of these latter sites probably relates to lithic procurement and production rather than to agricultural activities. When these sites are disregarded, tertiary drainages exhibit the same clear association between Late Woodland occupational loci and productive soils as do secondary and primary drainages.

Squares A-11 and C-15 contain 11 of the 12 remaining Late Woodland sites in the sample. In contrast with the units discussed previously,

the sites in Squares A-11 and C-15 do not exhibit a clear association with productive soils. Of the 11 Late Woodland sites in these squares, only 2 are located on 90-rated soils. The average rating is 61. However, both A-11 and C-15 contain black flint outcrops. Again, the presence of Late Woodland sites within these squares probably relates primarily to lithic procurement and production.

A single Late Woodland site in Square C-12, characterized by a proportionately large number of biface thinning flakes, is probably the location of a single core reduction sequence and represents either a hunting camp or a kill site.

Two factors, either singly or in combination, can thus be used to predict Late Woodland site locations: the presence of black flint outcrops and/or the distribution of highly productive soils. In primary stream valleys, such soils are extensive and Late Woodland sites are numerous. In secondary and tertiary drainages, patches of high quality soil become increasingly small and scattered, and Late Woodland sites become less abundant. However, the clear association between these scattered patches of productive soil and the presence of Late Woodland sites remains. Only in the vicinity of black flint outcrops do Late Woodland sites occur in significant numbers on poorer quality soils. In these latter situations it seems highly probable that lithic procurement and production were the prime factors responsible for settlement location.

These generalizations provide a second model which should prove to be a valuable predictive tool. Although it relates to Late Woodland sites only, this model reveals a highly consistent and potentially reliable site distributional pattern. It should thus provide an important complementary procedure for predicting site distributions within the Bald Eagle Creek watershed.

IV. DISCUSSION

The generalizations derived from the hypothesis testing procedures discussed above provide two predictive models of prehistoric site location within the Bald Eagle Creek watershed--one dealing with sites of all periods and another with Late Woodland Period sites only. The predictive capacity of these models for areas yet to be surveyed is an important adjunct to the research goals of the Bald Eagle Archaeological Research Program. In addition, these models should contribute to the preservation of the archaeological resources of the Bald Eagle Creek. Planners and resource administrators can use their predictions to anticipate which areas are likely to witness severe impacts to archaeological resources during ongoing economic development. These areas can then be avoided. Alternatively, mitigative procedures can be incorporated in the earlier planning phases.

It should be noted that these predictive models represent a preliminary attempt at site distribution prediction. Neither the survey squares

themselves nor the units examined within these squares were selected using probabilistic sampling techniques. As a result, statistically based predictive modeling procedures such as regression analysis were not appropriate for the problem at hand. Instead, the procedures used to develop these models consisted of site location data summaries. Recent research concerning the reliability of various types of archaeological predictive models (Hay et al. 1980) indicates that models consisting of summaries of non-probabilistic data are subject to certain weaknesses, the most important being the possible incorporation of unrecognized biases and the lack of statistically based error estimates. The models presented here share these weaknesses, and any predictions based on these models should thus be viewed with caution. They represent a preliminary attempt at site distribution prediction--one that the Bald Eagle Archaeological Research Program will subject to future testing, revision, and refinement.

CHAPTER 7

INTRODUCTION TO THE FISHER FARM EXCAVATIONS

JAMES W. HATCH

I. BACKGROUND

The Fisher Farm site is located on the large tract of alluvial farmland owned by the Fisher family of Unionville and Milesburg, Pennsylvania. The several fields comprising the tract have been used by them for over 100 years, primarily for raising feed corn for dairy cattle. Recently, however, the Fishers have leased the tract to other dairy farmers in Bald Eagle Valley. The cumulative impact of 100 years of plowing on the site has been great. The shift from horse-drawn plowing to tractor plowing and recently to chisel plowing has increased the depth and destructiveness of plow disturbance to the site's subsurface features.

The site proper is situated on a terrace which rises approximately 1 m above the gently undulating floodplain of Bald Eagle Creek, about 4 km upstream from Milesburg. A railroad line, now primarily used for the transport of coal through the region, cuts across the northern perimeter of the site. The railroad bed and adjacent borrow pit have no doubt obscurred a portion of the site but careful surface inspection and test pitting in Field F just beyond the disturbance shows very slight evidence of prehistoric occupation in this area (Figure 7.1). To the west, Field B contains a more substantial portion of the site, but again it is a small fraction of the total.

Dense concentrations of Late Woodland surface material occur in small clusters in the vicinity. The nearest to the Fisher Farm Site is located at the extreme eastern edge of Field D. These concentrations probably represent single households positioned in or adjacent to Woodland Period agricultural fields. Such households seem to occur sporatically between Fisher Farm-like hamlets in Bald Eagle and adjacent valleys. Hamlets are strategically positioned with respect to creek, floodplain, foothill, and mountain resources, and, especially, large expanses of quality agricultural soil (Figures 7.2 and 7.3). The nearest hamlet to Fisher Farm is 36 Ce 69, about 3 km further up Bald Eagle Creek. It too is located on a floodplain terrace.

The site was selected for excavation for a number of very different reasons.

1. As discussed in Chapters 1 and 2, the goals of the research program dealing with the Bald Eagle watershed called for the excavation of sites that exemplify a group of sites of the same phase and of similar adaptive characteristics in the settlement system. At the time of its excavation, Fisher Farm was one of at least 6 localities in the upper Bald Eagle watershed suspected of being Late Woodland farming hamlets.

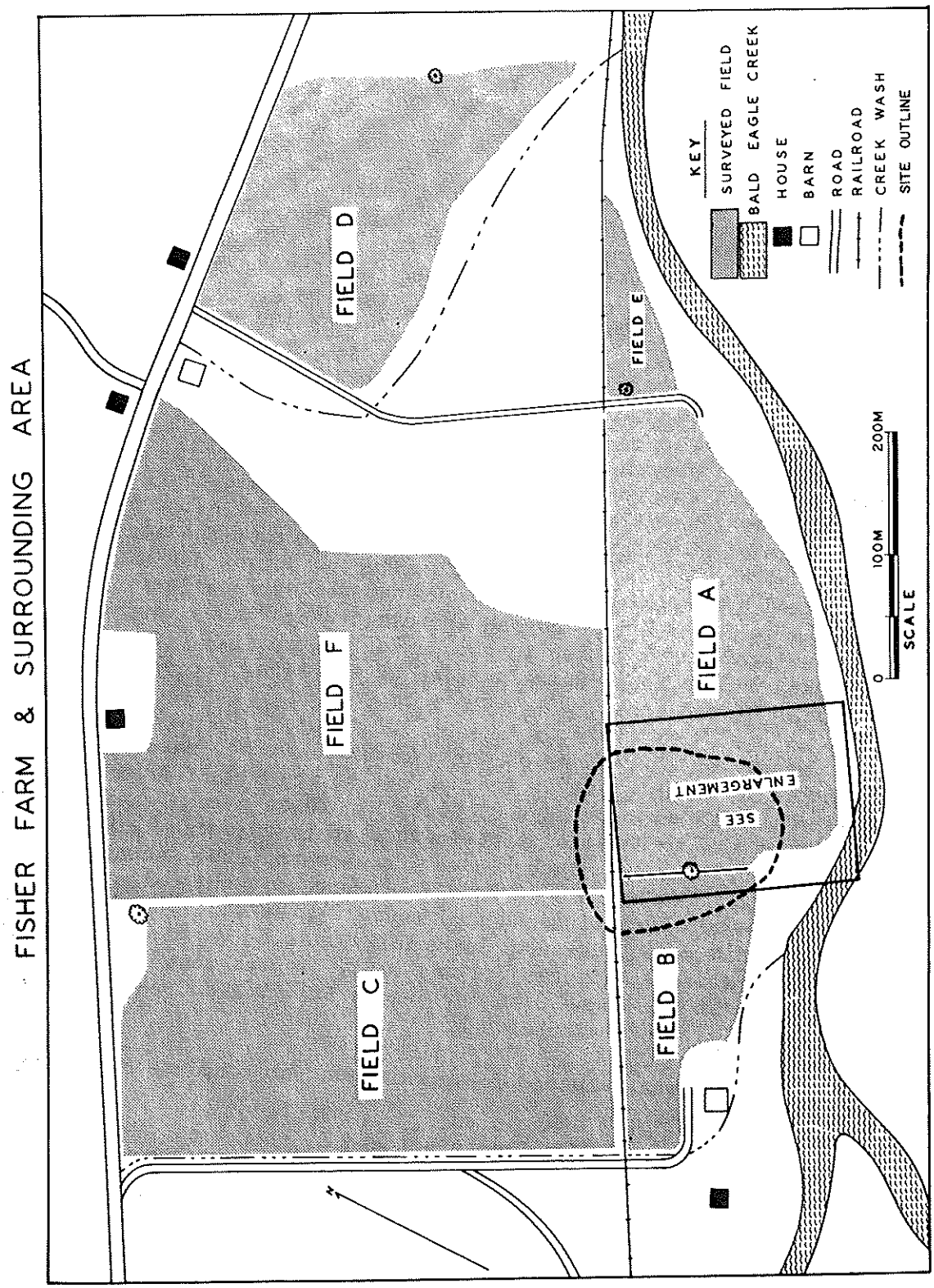


Figure 7.1: The Fisher Farm Site Environs

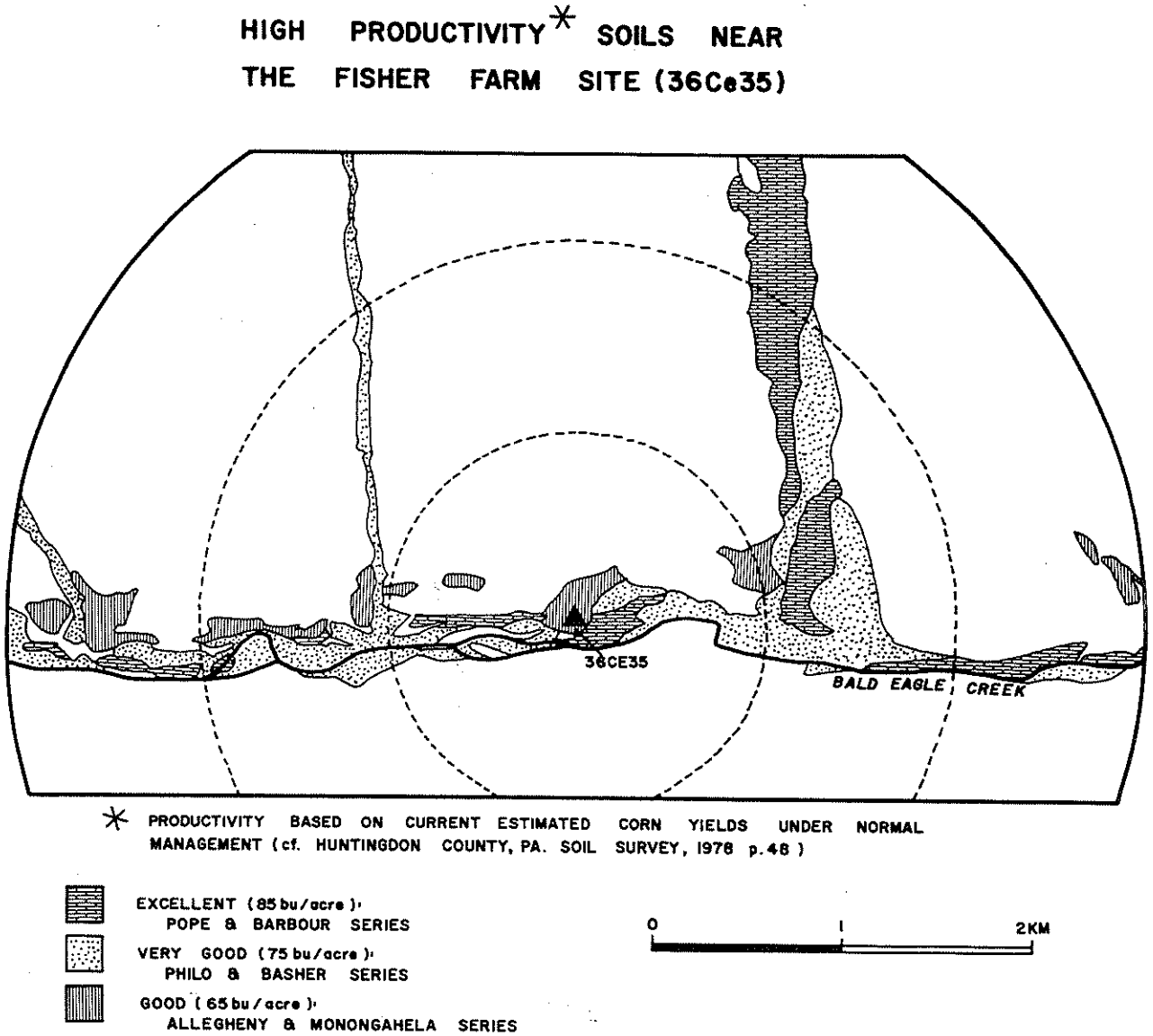


Figure 7.2: High Productivity Soils Near the Fisher Farm Site

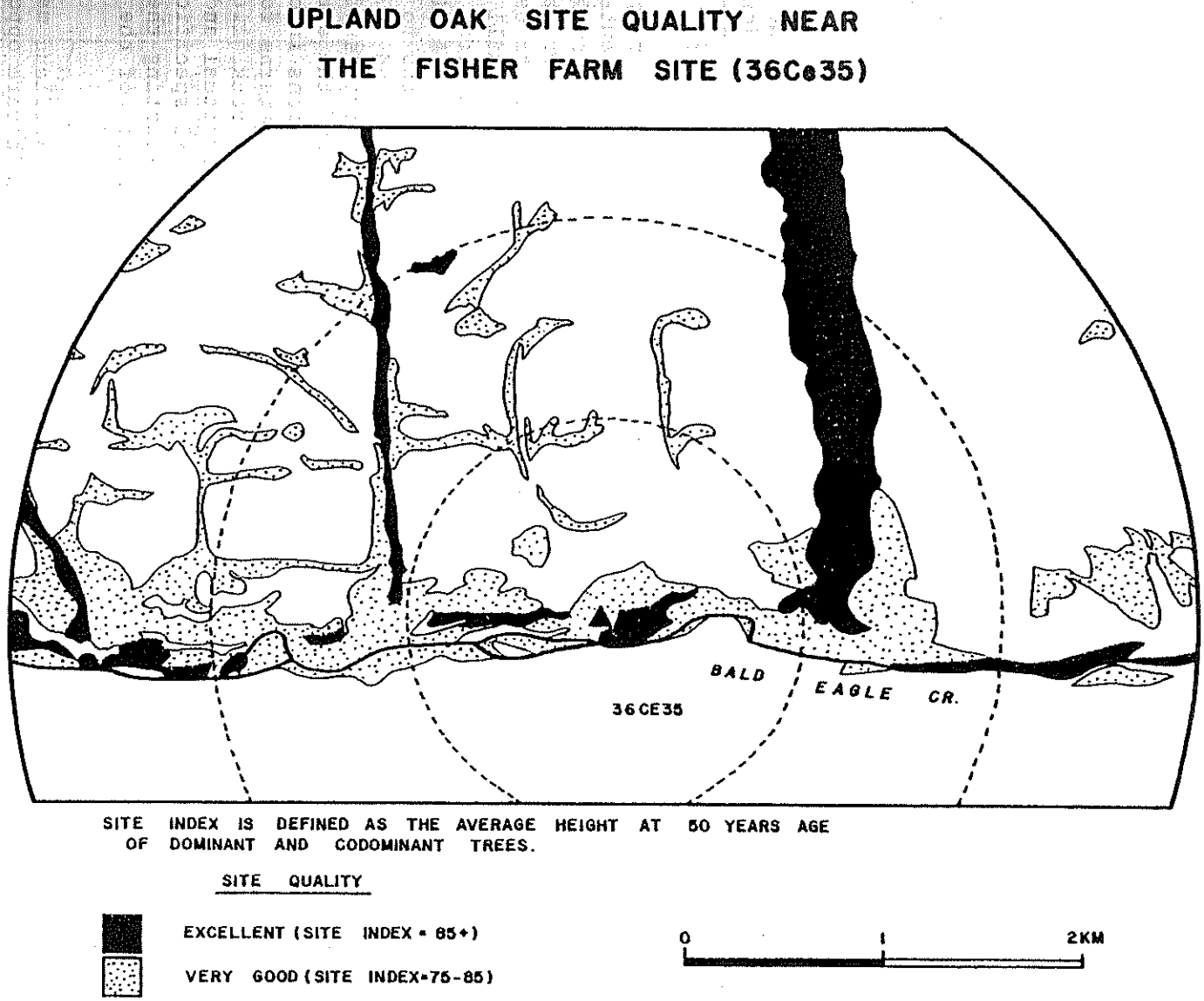


Figure 7.3: Upland Oak Site Quality Near the Fisher Farm Site

2. In keeping with other goals of the program, we were anxious to invest considerable effort in the excavation of a Late Woodland hamlet to offset the settlement pattern bias toward large, nucleated, stockaded Late Woodland villages along the principal water courses that was so apparent in the archaeology of the region.

3. Fisher Farm was to be excavated by successive field schools offered by the Department of Anthropology. Because of this we were anxious to select a site that promised to contain a variety of fieldwork settings, including both simple and complex stratigraphy, plow disturbed and undisturbed contexts, and aboriginal activity areas.

4. The site was located close the University's main campus in State College, minimizing the usual logistical concerns of such a project.

Fisher Farm was excavated during the summers of 1976-1978. The first season was under the direction of Mark Aldenderfer; the latter two were directed by the author. The first two seasons were spent excavating feature and activity loci on the terrace, the location of all primary household and community tasks associated with the hamlet. The last season was spent exploring the stratified stream channel adjacent to the terrace that served as a refuse dump throughout the Late Woodland occupation of the village. Figure 7.4 clearly shows the non-randomness of the excavation units resulting from the 3 year project. Several factors account for this. First, the unpredictability of the funding for the field school forced us to assume that each season would be the last at the site. A 3-year master plan was not possible. Second, each year the entire Fisher property was planted in feed corn, including the Fisher Farm Site. Arrangements were made each year with the farmers raising the corn to rent us a small portion of the site for excavation. The cost to the project was the market value of the corn that could have been raised on the tract rented to us. We attempted to minimize the rental cost by keeping the tract as small as possible. However, as our focus of attention shifted across the site, areas accessible one year were sometimes not accessible the next. A final reason for our using a highly selective excavation strategy relates to our surface collection efforts. The first several days of the 1976 and 1977 field seasons were spent intensively collecting the freshly plowed surface of the terrace area rented for that year. Both Aldenderfer and the author used the qualitative and quantitative results of these collections in our decisions on where to locate excavation units. In 1977 the patterns formed by high, intermediate, and low surface counts of fire-cracked rock, lithics, and ceramics were intensively sampled to discover their artifactual and feature counterparts below the surface. Chapters 8 and 9 deal specifically with our efforts to experimentally control the variables distorting the surface collected data while Chapters 11-13 present the results of the subsurface excavations.

The discovery of stratified deposits of discarded Late Woodland material in the stream channel next to the site provided us with a rare opportunity to test the chronologic integrity of a number of ceramic and projectile point styles. First, of course, we had to demonstrate the temporal sensitivity of the strata comprising the fill. A number of agronomists and geomorphologists from The Pennsylvania State University were invited

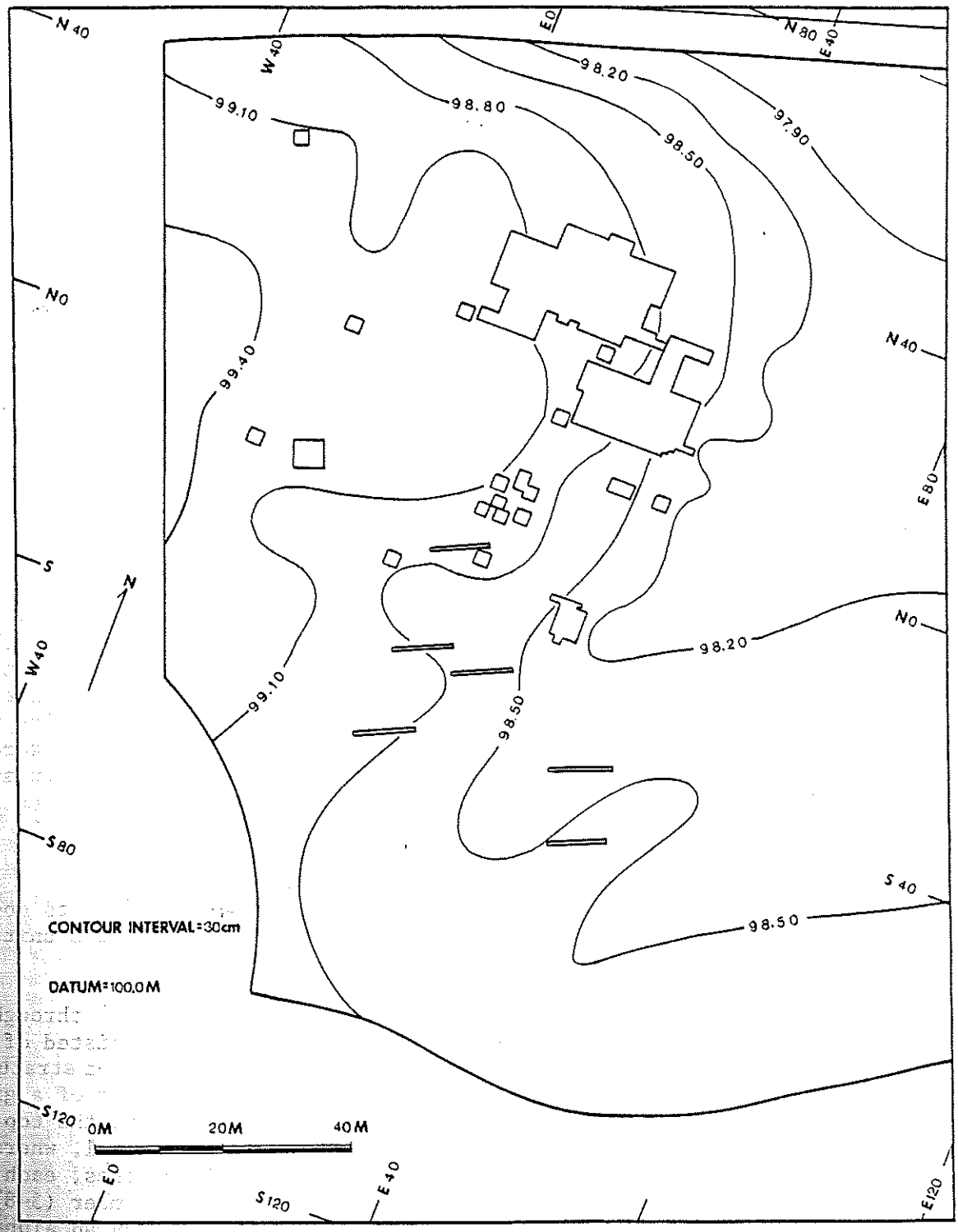


Figure 7.4: Excavation Units at Fisher Farm--1976 to 1978

← Stream →

to the site, all of whom impressionistically responded to the stream channel profiles as representing a very gradual filling process that had since been minimally disturbed. Jeff Gryta and Bill Waltman, then graduate students in geology and agronomy respectively, were assigned different aspects of this feature as research papers for courses taken under their major professors during that summer. Chapter 15 includes portions of these papers. Together they convincingly argue for the gradual accumulation of erosional and flood water sediments. These data, coupled with the radiocarbon sequence removed from the stratigraphy (Chapter 17), demonstrate the channel's suitability for testing the artifact sequence. Chapters 18 and 19 present the stratigraphic analyses. Each author concluded with similar reservations concerning the widely accepted "cultural identity model" of the artifact styles. An alternative model proposed by the author in Chapter 18 is felt to account for more of the patterning actually seen in the regional archaeological record and it should therefore be provisionally accepted.

II. NOTES ON FIELD METHODOLOGY

In order to follow some of the arguments in the text it is important for the reader to know the basic excavating and recording procedures used at Fisher Farm. For the most part, the terms used apply to standard field practices and they will not be defined here. However, some may be new to the reader.

The basic excavation unit used at Fisher Farm was a 2 m x 2 m square excavated in a number of levels to sterile subsoil. The majority of these units were oriented to conform to a N-S-E-W grid. The 0,0 point on the grid was located at a convenient spot in the center of the terrace and all unit locations were measured along the grid from this point. Elevations were also measured from a stake located on the terrace. Its value was arbitrarily assigned 100.00 m and all subsequent measurements were subtracted from that number. For continuity over the 3 years of excavations, a point on the railroad tracks at the 0E intercept was marked for horizontal and vertical provenience as were a number of other stable landmarks.

The southwest corner stake of each excavation unit marked its coordinate location. Thus, the remaining 3 corners of a 2 m x 2 m unit at N10E20 would be located at N12E20, N12E22, and N10E22.

We have made the distinction between "stratum" and "level" throughout the text and the terms should not be confused. A stratum consisted of any soil unit with recognizable color or textural properties--a stratum in the usual sense. A level was an archaeologically defined unit of a given thickness. For example, Level 1 may consist of the top 5 cm, the top 10 cm, or the entire thickness of Stratum 1. In the stream channel, where the stratigraphy was both clear and very important for our purposes, each stratum below the plowzone was equated with a Master Level number (3-8). More discrete levels within a Master Level were identified by an alphabetic suffix. Thus portions of Stratum 4 were excavated in 5 distinct 5 cm levels labeled "Levels 4A, 4B, 4C, 4D, and 4E." In this way, finer provenience distinctions than the Master Level could be made.

Across the terrace the stratigraphy consisted of a single, roughly 20-25 cm plow zone, or Stratum 1, and a sterile yellow-orange hardpan, called Stratum 2. For experimental purposes (see Chapter 8), a number of excavation units had the top and bottom halves of their plow zone removed separately. In these cases, Levels 1 and 2 were both from the plow zone. All other excavation units had their plow zones removed as a single 20-25 cm thick "Level 1."

Field Numbers (FN) were reference numbers associated with any object for which a specific, 3-dimensional point provenience had been taken. Master Sample Numbers (MSN) were numbers consecutively assigned to all non-artifactual samples (flotation, soil, pollen, radiocarbon, etc.). Both FN's and MSN's were assigned for bookkeeping purposes only.

CHAPTER 8

SURFACE COLLECTIONS FROM PLOW ZONE SITES: THE PROCESSES OF DISTORTION

CHRISTOPHER M. STEVENSON

I. THE PROBLEM

Many researchers are of the opinion that systematically collected artifactual material from the surface of plow disturbed archaeological sites yields only a limited amount of behavioral information. Goodyear has drawn attention to this problem.

> It should be pointed out that there has been some tendency to discount or minimize the research value of surface sites that exist solely in the plow zone. Even in the cases of surface sites that are strongly suspected of having their spatial relationships badly distorted, much useful information may be obtained.... In the case of heavily plowed fields there is still some debate as to what effects the plowing has had on the archaeological record. Sites which have been heavily plowed should be approached from an experimental point of view and the extent of spatial clustering or aggregation examined by mapping and with statistical techniques (1975:18).

Disturbed surface sites often constitute a substantial portion of the sites recorded in a regional survey. Consequently, research dealing with this type of site needs to be carried out so that data limitations and expectations can be anticipated.

This paper will take an experimental approach to the intra-site spatial analysis of one heavily disturbed plow zone site. Using information gathered from the 1976 and 1977 Pennsylvania State University field seasons at the Fisher Farm Site, this analysis will investigate the following problems: 1) To what extent does the sample of artifacts obtained from a systematic surface collection reflect the content of the subsurface assemblage? and 2) To what degree do the surface distributions of different material types reflect the subsurface distributions of these same materials?

II. PROCESSES DISTORTING SURFACE COLLECTIONS FROM PLOWED SITES

Three major distorting processes have been discussed in the literature with respect to surface material--the attenuation effect, the merger effect, and the conditions of surface visibility. Under certain conditions all three are known to have a substantial effect upon the preservation and subsequent recognition of spatial associations. In addition to these, a fourth process, the vertical sorting of artifacts in the plow zone, will be considered here.

The attenuation effect refers to a reduction in density of surface material as a result of the accumulation of sediments over a site. Redman and Watson (1970), Tolstoy and Fish (1975), and Rudolph (1977) have all discussed this phenomenon. Their independent conclusions suggest that cultural materials at a depth of 20 cm will be poorly represented on the surface and will become increasingly less visible as depth increases. The depth of disturbance resulting from agricultural practices bears directly on this problem.

Lateral displacement refers to the horizontal movement of artifacts across the surface or within the matrix of a site. While Roper (1976) has observed that lateral displacement has a limited effect on the spatial relationships of artifacts, Rudolph (1977) has shown that clusters of material will be modified by agricultural plowing to approximate a more rectangular shape. Such a process may contribute to what Tolstoy and Fish (1975) refer to as the merger effect. As defined by them, agricultural practices may have a smearing tendency, combining one concentration with a neighboring one of different density and thereby reducing the number of discrete clusters.

On a subjective basis, it has long been noted that under less than ideal conditions, surface collections may be distinctly biased toward larger or more brightly colored pieces of material. The presence of vegetation or the dry/dusty conditions common to plowed sites often prevents the recovery of representative samples. Ammerman and Feldman (1978) have quantitatively demonstrated this bias in their comparison of surface collections taken from the same site under "ideal" and "less than ideal" conditions.

In addition to the distortions of original archaeological context mentioned above, it is suspected that repeated plowing may differentially distribute artifacts vertically within the plow zone matrix on the basis of a single attribute or set of attributes (e.g. weight, density, surface area, thickness). If so, this process would contribute to the underlying, non-cultural patterning of surface material.

III. EXPERIMENT 1: MEASURING THE EFFECTS OF VERTICAL DISTORTION

Vertical sorting of artifacts in the plow zone is experimentally defined as the differential vertical displacement of artifacts according to one or more of the attributes of length, width, thickness, or weight. The vertical sorting of artifacts should be characterized by a difference in means between two artifact populations of similar material derived from two vertically separate levels in the plow zone. The population mean of one of the metric traits for an arbitrary level should be either smaller or larger than the remaining arbitrary level, and the dispersion around the mean (variance) should be of a different magnitude. In addition, a single standard deviation of the artifacts in the upper half of a plow zone layer should incorporate greater variation in the metric variability of the attribute than should a standard deviation for the artifacts in the lower half.

The following experiments are based on data collected during the 1976 and 1977 excavations by The Pennsylvania State University at Fisher Farm. The Fisher family has farmed this location for the past 100-125 years without interruption. Of the large number of 2 m x 2 m test pits located on various portions of the site, 8 were excavated in 10 cm arbitrary levels through the plow zone. Of this latter set of test trenches, 4 provided large enough samples to determine whether statistically significant differences existed between artifact populations in the upper and lower 10 cm arbitrary levels. For the purposes of analysis, excavated materials were segregated according to the material type (jasper, black flint, gray chert, and ceramics) since there was a possibility that each material might respond differently. Each artifact was measured for the attributes of length, width, thickness, and weight with calipers and a single pan triple beam balance. Descriptive statistics were calculated for each arbitrary level per test pit with SPSS program BREAKDOWN (Nie et al. 1975).

Artifact populations in this study were defined on the basis of arbitrary excavation levels of 1-10 cm and 10-20 cm. All arbitrary levels were isomorphic between the 4 trenches used in this analysis. A t-test statistic was computed for the population means to determine if a statistically significant difference existed between the artifact attributes for each arbitrary level.

The results from the 4 excavated trenches tend to verify the presence of vertical sorting in the plow zone. Smaller and lighter objects selectively accumulate in the upper 10 cm of the plow zone. However, vertical sorting does not appear in every trench, it is not reflected in every class of material, nor is it a constant phenomenon among those material classes where it occurs.

Items that are 12-13 mm in length and 0.25-0.38 g in weight are differentially sorted into the upper 10 cm. The characteristics of the sorted population have fulfilled the requirements predicted previously. The mean length of the first arbitrary level is smaller by 1.2-3.5 mm. The mean weight differs by 0.3-0.5 g. In the trenches where these population differences are present, they are significant at the 0.05 confidence level or better.

Vertical sorting operates on different attributes for ceramics and lithics. For ceramics, weight appears to be the key variable, while length is the critical variable for lithics.

IV. EXPERIMENT 2: SURFACE TO SUBSURFACE COMPARISONS

Given that vertical sorting appears to be operating within the test pits, it was questioned whether or not the process had an observable effect on surface samples collected from the site. A controlled surface collection of 2 m x 2 m collection units over 20 m^2 was carried out during the 1977 season in order to assess the correspondence between surface and subsurface materials. Of direct bearing to this question is the determination of the most accurate unit of observation (collection grid size) which

will reveal the content and form of subsurface distributions. Twenty-one excavation units fell within the control area during the course of excavation, thus allowing surface/subsurface comparisons to be made.

In order to test the hypothesis that surface densities are predictive of subsurface densities, comparisons of two sorts were made. First, total counts for each 2 m^2 were compared between their surface and subsurface. Second, correlations between the surface and subsurface were made according to individual material types such that unique variation might be recognized.

Table 8.1 indicates that there is little predictive potential in estimating subsurface densities when considering 2 m^2 spatial units. The correlations between surface counts and subsurface counts are extremely low. Surface and subsurface units were subsequently enlarged to 4 m^2 units. All possible combinations of this size unit which could be derived from the set of corresponding excavated and surface collected units were calculated. Correlations were then made between the surface and subsurface units.

Table 8.1. Correlation of Surface to Subsurface Counts

(2 m x 2 m, n=21)

Material	Correlation	R-Squared	Significance
All materials	0.18002	0.03241	0.21137
Lithics only	0.14581	0.02126	0.25867
Black flint	-0.01613	0.00026	0.47160
Red jasper	0.30605	0.09367	0.08299
Gray chert	0.01191	0100014	0.47903
Ceramics	0.04398	0.00193	0.42296

The results shown in Table 8.2 indicate that for all materials or classes of material combinations, except for gray chert and ceramics, high correlations at significant levels are obtained. This suggests that a 4 m x 4 m collection unit is the minimal grid collection unit dimension which should be used at Fisher Farm to achieve an accurate assessment of what is below the surface. This is only an approximation, since units of slightly smaller or larger size could not be generated for comparison. The manner in which the data was originally collected (2 m x 2 m units) precluded the formation of 3 m or 5 m sided units. Similar correlations for collection units 4 m x 6 m in size were made, with no improvement in predictive value.

Percentages of individual material types were calculated for the 4 m x 4 m units since this unit appears to be the smallest reliable unit of observation. The results are presented in Table 8.3. These data illustrate the nature and direction of the deviations from a perfect correlation for each material type.

Table 8.2. Correlation of Surface to Subsurface Counts
(4 m x 4 m, n=8)

Material	Correlation	R-Squared	Significance
All materials	0.77087	0.59424	0.01257
Lithics only	0.81772	0.6686	0.00657
Black flint	0.78102	0.60999	0.01106
Red jasper	0.95540	0.91279	0.00091
Gray chert	0.49908	0.24908	0.10410
Ceramics	0.30737	0.09447	0.22948

From Table 8.3 the following generalizations can be made:

Ceramics are consistently under-represented on the surface.

Gray chert is always over-represented on the surface.

Jasper is proportionally equal (±5%) or slightly under-represented on the surface.

Black flint fluctuates between being slightly over-represented and under-represented on the surface.

We will now offer some tentative explanations for these patterned deviations.

A. CERAMICS

The fact that ceramics are under-represented on the plow zone surface led us to suspect a collecting bias toward larger sherds. Although the control area was collected under what are considered ideal conditions (the morning after a rainfall in the early summer), it was possible that the light brown ceramics may have been camouflaged against the yellow-brown soil background. To assess this, the mean length and width was computed for the surface collected sherds, and compared to similar measurements for the subsurface population. The results indicate that the mean length and width is greater in the surface sample by 2.0 mm and 1.5 mm respectively. Since lighter and smaller ceramics tend to be more common in the upper half of the plow zone than the lower half, there can be little doubt that collecting bias has influenced the surface collection.

B. CHERT

The mean length of chert artifacts in all cases where sample size is adequate falls within the size parameters that are most subject to vertical sorting. This explains the consistent over-representation of chert on the surface plow zone. We further argue that the portion of the chert core reduction strategy carried out at Fisher Farm may have produced debitage that predominantly falls within the 11-13 mm size range. This would make chert more susceptible to distortion by sorting than materials which have a greater variation in the dimensions of their metric attributes.

Table 8.3. Proportional Comparison--Surface to Subsurface

(4 m x 4 m, n=8)

	Surface		Subsurface	
	Count	% of Total	Count	% of Total
Sherds	(4)	23.53%	(430)	44.93%
Gray chert	(6)	35.29%	(138)	14.42%
Red jasper	(1)	5.88%	(108)	11.28%
Black flint	(6)	35.29%	(281)	29.36%
Sherds	(2)	7.69%	(792)	44.29%
Gray chert	(10)	38.46%	(233)	13.03%
Red jasper	(5)	19.23%	(282)	15.77%
Black flint	(9)	34.61%	(481)	26.90%
Sherds	(2)	11.76%	(673)	44.80%
Gray chert	(4)	23.53%	(194)	12.91%
Red jasper	(3)	17.65%	(191)	12.71%
Black flint	(8)	47.06%	(444)	29.56%
Sherds	(2)	10.00%	(500)	35.81%
Grey chert	(6)	30.00%	(161)	11.53%
Red jasper	(5)	25.00%	(284)	20.34%
Black flint	(7)	35.00%	(451)	32.30%
Sherds	(3)	14.28%	(368)	33.36%
Gray chert	(5)	23.81%	(117)	10.60%
Red jasper	(3)	14.28%	(216)	19.58%
Black flint	(10)	47.62%	(402)	36.44%
Sherds	(2)	10.00%	(324)	33.92%
Gray chert	(6)	30.00%	(108)	11.30%
Red jasper	(4)	20.00%	(228)	23.87%
Black flint	(8)	40.00%	(295)	30.89%
Sherds	(1)	7.69%	(200)	26.99%
Gray chert	(5)	38.46%	(70)	9.44%
Red jasper	(3)	23.07%	(237)	31.98%
Black flint	(4)	30.76%	(234)	31.57%
Sherds	(1)	6.66%	(119)	18.33%
Gray chert	(6)	40.00%	(70)	10.78%
Red jasper	(4)	26.66%	(240)	36.98%
Black flint	(4)	26.66%	(220)	33.90%

C. JASPER

Jasper varies between being either representative of the subsurface assemblage or slightly under-represented on the surface. The mean length of jasper debitage ranges between 15-18 mm. If one examines the variance for the attribute of length in the upper 10 cm arbitrary level, it is clear that it is almost always large. We may infer that enough variation for this metric attribute exists so that severe distortion will not result from vertical sorting. The tendency for jasper debitage to be larger than the size class most subject to vertical sorting may account for its occasional under-representation.

D. FLINT

It was observed that black flint is either under-represented or over-represented. The mean length for flint in the upper arbitrary level of the 4 test units ranges between 11-13.6 mm. The dispersion around the mean for this material is greater than it is for chert and ceramics, but it is much less than jasper. Thus, flint artifact populations may be subject to distortion from vertical sorting depending upon the slight variations of the mean around the critical size range.

V. SUMMARY

The preceding pages have pointed out discrepancies between samples collected from the surface of the plow zone and the corresponding subsurface artifact populations at Fisher Farm. We have proposed that agricultural practices may contribute to the vertical sorting of artifacts within the plow zone matrix. This process may lead to non-representative surface distributions if the attributes of the artifact population fall within a critical size range.

To determine if surface artifact distributions can be of predictive value in determining the numbers of subsurface artifacts of comparable material, we have experimented with different grid sizes or units of observation. Although a considerable amount of variation is present, a 4 m square appears to be the minimal unit of observation which yields reliable information for most artifact classes. Material-specific characteristics influencing the accuracy of subsurface predictions were pointed out and their impact was discussed.

The next chapter will consider those surface patterns larger than 4 m squares which may still represent meaningful differences in aboriginal activities within the Fisher Farm Site.

CHAPTER 9

AN ANALYSIS OF PLOW DISTURBED ACTIVITY AREAS AT FISHER FARM

CHRISTOPHER M. STEVENSON

I. INTRODUCTION

The concern of this chapter is the degree to which distributional data, generated from systematically collected plow zone materials, can contribute to the delineation of activity areas at Fisher Farm. This problem will be addressed by examining the relationship between buried feature configurations and artifact assemblages recovered from the surface and subsurface of the plow zone. In each case the combined use of artifact assemblages and features will be used to postulate functional correlates which can be tested independently at future points in this report.

Binford's analysis of Nunamuit hunting camp behavior has demonstrated that there is a "...statistical tendency for given activities to be repeatedly localized in the same places..." (1978:352). This observation supports the commonly held assumption that the differential accumulation of archaeological material in spatially discrete loci within a site often reflects the repetitious performance of particular tasks. Binford's research thus encourages the analysis of intra-site spatial patterning and the factors influencing our interpretation of it.

As both this chapter and Chapter 8 demonstrate, continuous agricultural plowing over a 100+ year period creates numerous problems for those trying to define and interpret associations between artifact distributions. Even under ideal conditions of recovery, spatial information is lost. By examining high density subsurface loci, however, approximations of the original distributions of material can be made. Surface assemblages permit only general predictive statements regarding activity areas, both because of the biases inherent in surface material and their small size (see Chapter 8). Assemblages from within the plow zone are affected by somewhat different sorting biases and tend to be larger, thus often allowing for more precise interpretation.

II. SUBSURFACE DISTRIBUTIONS, AREAL CORRESPONDENCE, AND ACTIVITY AREA RECONSTRUCTION

An approximately 500 m^2 section of the Fisher Farm excavations will be considered in this analysis. Throughout this section, the stratigraphy consisted of a highly disturbed plow zone (ca. 20 cm deep) underlain by an unplowed, sterile, sandy clay layer. All features appeared at the top of this second layer. An examination of the layer revealed an area of concentrated domestic construction, 72 features, and numerous feature-like stains. The precise function of the majority of these features was

not known at the time this reasearch was carried out (see Chapters 11 and 12 for further discussion). For the purposes of discussion, the 500 m^2 section will be partitioned into 3 separate areas; Area A, Area B, and Area C (Figures 9.1-9.4).

Area C has within its boundaries most of the concentrated postmold patterns interpreted to be domestic structures. Near the northern perimeter of Area C is Feature 28. This is a unique feature, inferred to be a controlled heating facility for the preservation of foodstuffs and/or ritual sweating (see Chapter 12). Around this feature are several pits, numerous stains, and scattered postmolds.

Area A also contains evidence of domestic structures. Additionally, two concentrations of stains and features are discernable, one in the northwest corner and another in the southern quarter.

Area B shows no evidence of postmold patterns indicative of structures. In the western-most section of this area is an alignment of 4 pits, 2 of which show evidence of intensive burning. Features 35, 56, 57, 59, 62, and 73 are burial pits. The eastern edge of this area intrudes onto a filled-in streambed which appears to have been an active dumping area during the Late Woodland period (see Chapter 15).

The surface and subsurface distributions of ceramics, utilized flakes, jasper, bifacial tools, chert, black flint, lithic count, and lithic weight were mapped for all areas considered in this analysis. Lithic count and lithics weight were included in the analysis as a way of distinguishing at a very general level between loci of lithic reduction and loci of tool maintenance and final preparation. For example, in the latter situation one would expect high counts in areas of a particular material's distribution which did not spatially overlap areas with high lithic weight. As discussed below, measures of association were generated for all artifact distributions and for artifact distributions versus structure areas.

III. COMPUTER MAPPING AND MEASURES OF AREAL CORRESPONDENCE

In order to visually display artifact distributions from the surface and subsurface levels of each area, the computer mapping program SYMAP was used. This is a very flexible graphics system which allows the operator to display a measured variable on a two-dimensional surface. The data are grouped by assigning different symbols to discrete intervals. Data values are assigned to a specific point on a grid, which in this case corresponds to a single excavation or surface collection unit. On the basis of a weighted distance algorithm, each of the data points is evaluated with respect to its immediate neighbors. Finally, areas with the appropriate interval designation are symbolized and displayed.

The determination of interval gradations (up to 10 may be specified) is a very subjective process. A wide variety of patterns may be created from a single data set depending on how the operator defines the class interval values. To minimize subjectivity, intervals were generated for

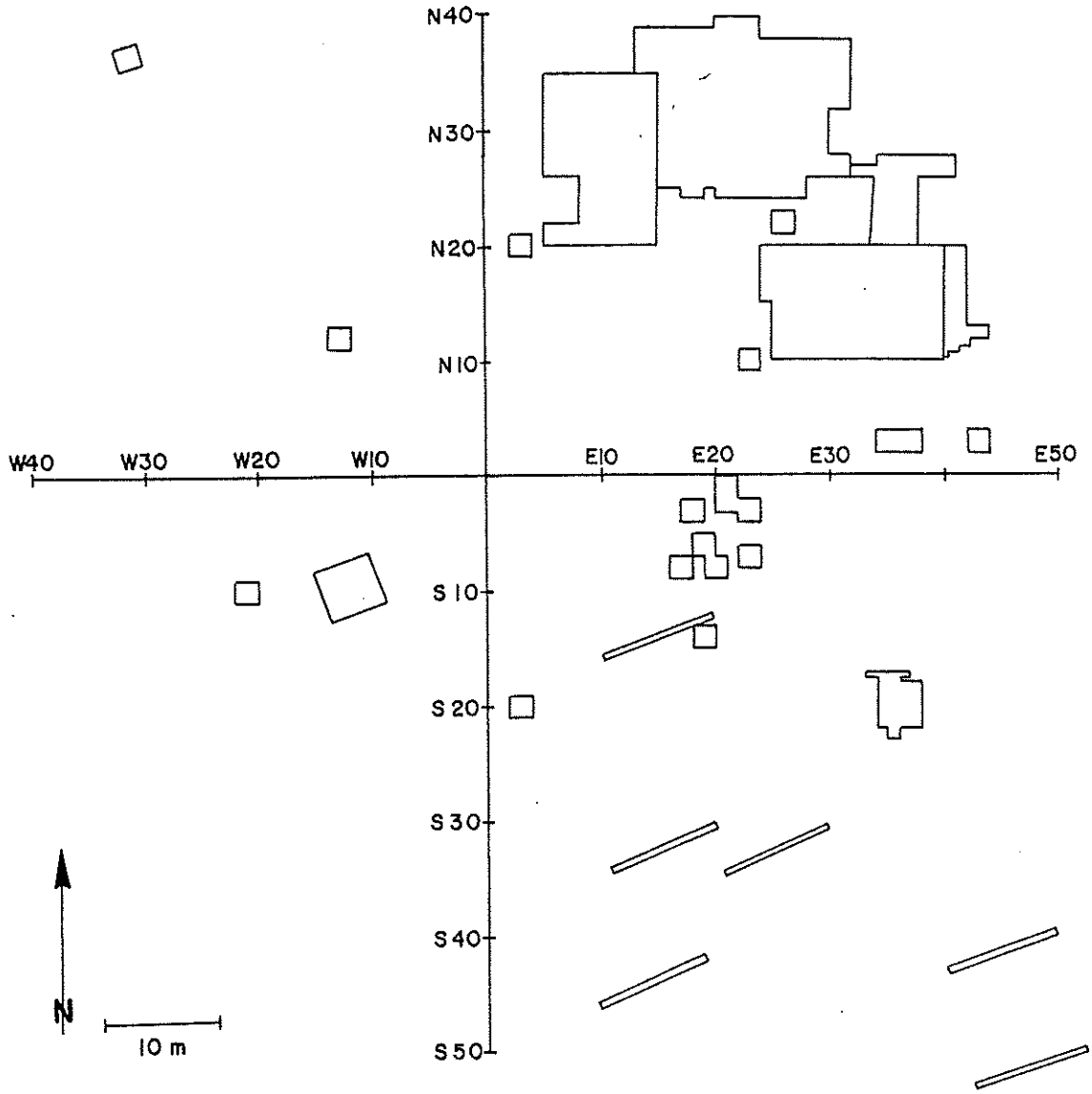


Figure 9.1: Grid Provenience of Excavation Units

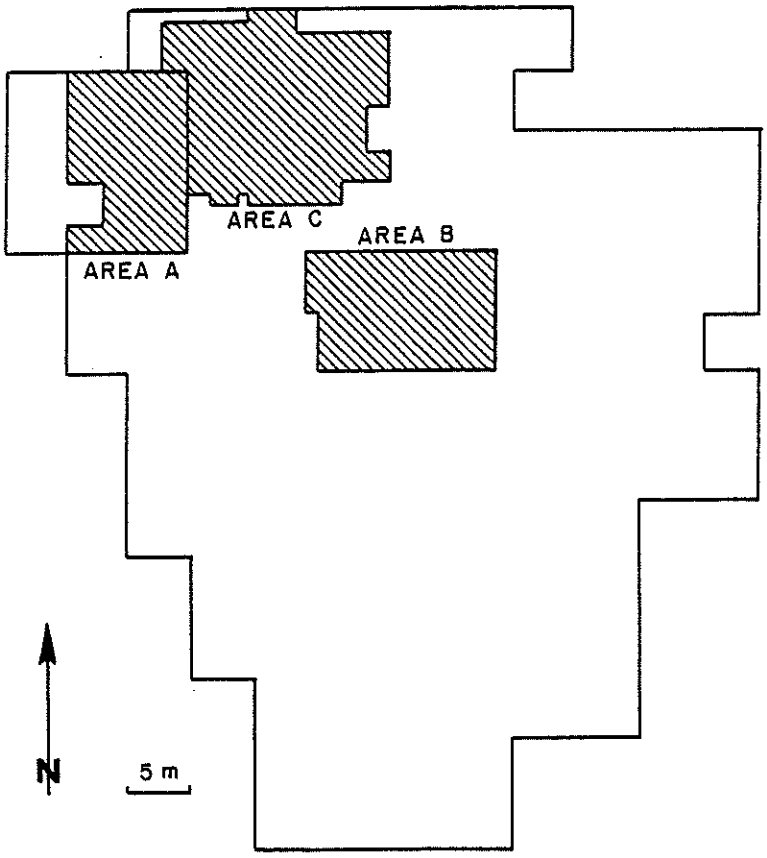


Figure 9.2: Relationship of Areas A, B, and C to Zone Surface Collected in 1977.

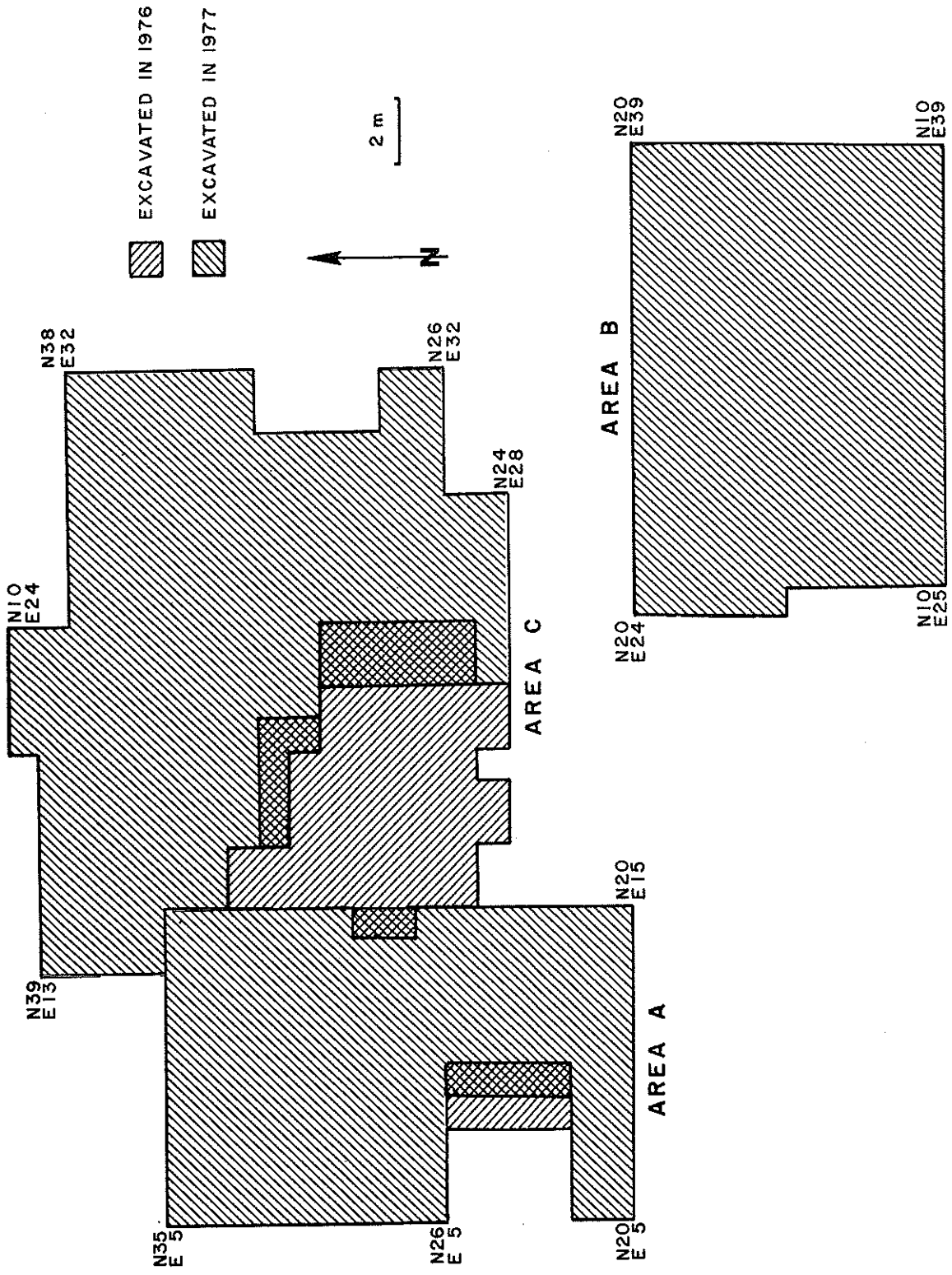


Figure 9.3: Excavation History of Areas A, B, and C

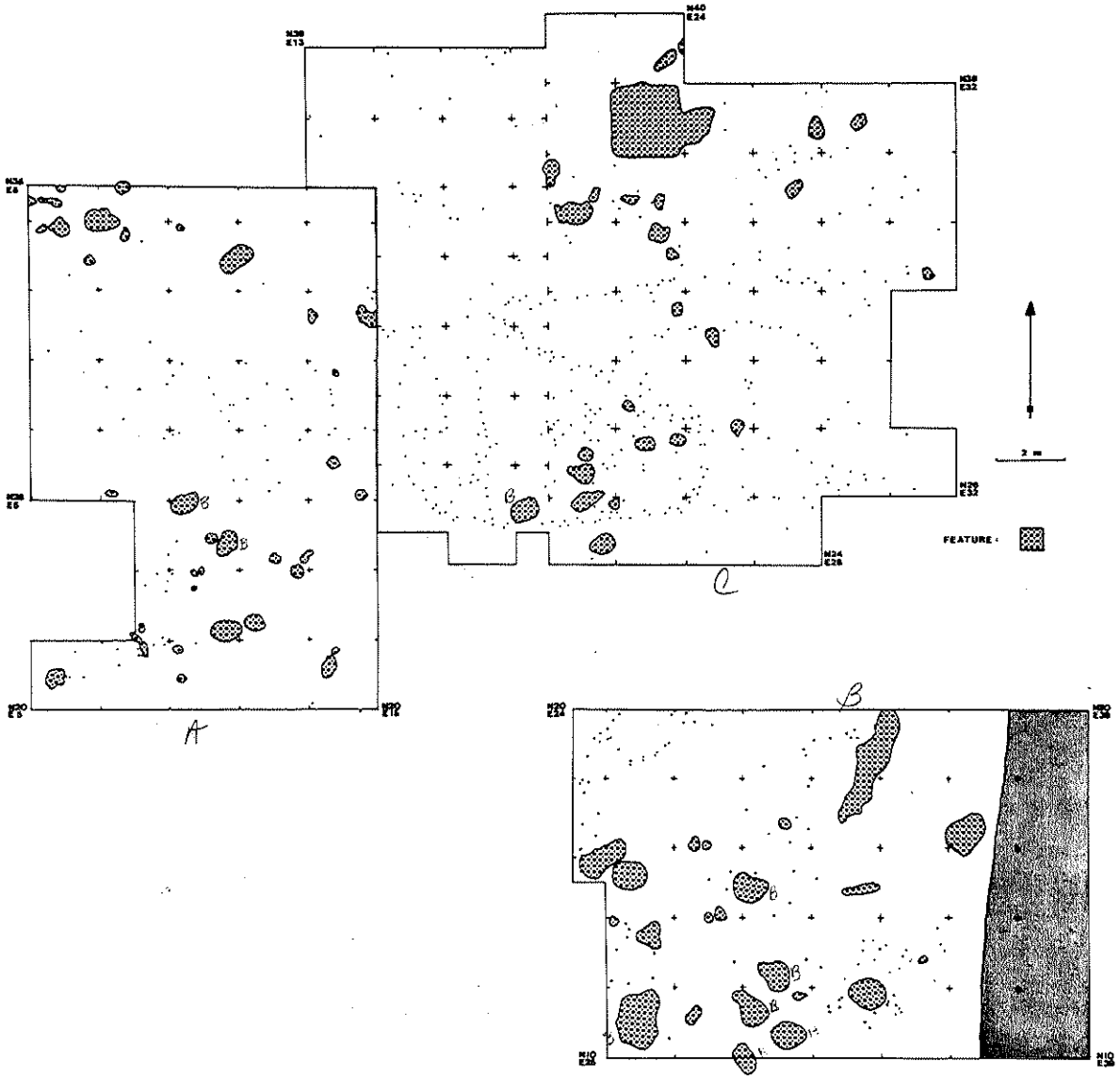


Figure 9.4: Feature and Postmold Arrangement in Areas A, B, and C

this data set by sorting the values for each variable in descending order and then by dividing the array into octiles. In some instances this was not possible. For example, the distribution of bifacial tools could only be displayed as high, medium, low, and empty areas since the data value extremes were zero and three. When two adjacent octiles shared identical values the items in one octile were transferred to the next upper or lower interval depending on which transfer required the fewest moves. The number of items per octile was kept as equal as possible when moving data values so as not to destroy the original objective of histogram equalization.

The maps generated by the SYMAP program are, in part, fictitious representations. We assume them to be approximations of archaeological context, mirroring the shape of actual activity areas and artifact distributions since their shapes are amorphous. It is believed that this technique introduces less error than the rectangular spatial distributions which would be generated from quadrat data, although this assumption has not been tested.

For the present analysis, the Lorenz Curve was used to provide a measure of areal association between separate distributions. The Lorenz Curve (Taylor 1977) provides a numerical assessment of areal correspondence between two distributions. It was initially used in geography by Wright (1937) and has since been applied in both sociological and land use studies. The spatial relationship between two variables may be either graphically displayed or a simple index of similarity (D_a) may be produced. The D_a is obtained with the following formula:

$$D_a = 1.00 - \frac{\Sigma(x_i - y_i)}{2}$$

where x_i and y_i are the uncumulated percentages for each pair of corresponding quadrats. In the tables which follow, the higher D_a values represent greater degrees of areal correspondence between the two distributions under consideration.

One should be careful when applying the Lorenz Curve to a set of data since there are some limitations to the methodology. First, data must be in the form of frequencies or some other direct measure of area. Population counts per quadrat, or number of square feet qualify, but continous data such as rainfall or temperature measures may not be used since this type of information is areally continuous rather than spatially discrete. Second, changes in quadrat placement over an area can greatly effect the D_a value if distributions themselves are similar in size to the grid units. Third, changes in quadrat size have systematic influences on D_a values. Lower values will be produced if quadrats are large and few in number since there is less chance that a unit with few or none of one of the two groups being compared will occur. Fourth, the Lorenz Curve produces a single measure of intra-area association. It is not sensitive to the arrangement of distributions within the measured area.

Despite these problems, the Lorenz Curve was selected for use since certain aspects of the data suggested that these limiting factors would

be of minimal influence. The data derived from the mapped portions of the site consists of population counts--in this case, the number of characters per quadrat taken from the SYMAP output. The number of characters per inch and map scale were consistent for all comparisons, thus eliminating any distortion. The problem of quadrat placement did not appear as if it would severely affect the D_a values (by producing low measures of areal association when precisely the opposite was true). Initially, the grid placement was determined in the field on an arbitrary basis; 5 m x 5 m units for the surface collection and 2 m x 2 m units for the excavated portions of the site. The subsequent mapping of surface and subsurface materials utilized the original grid placement and grid size. Most importantly, the number of grid units used in the computation of any single D_a value was large (the range was 36-136) and the resulting high density areas are usually larger than a single quadrat. No changes were made during the course of analysis with respect to grid size.

As will be seen in the following tables, measures of areal association, even for the most highly associated distributions on a visual basis are quite low. These higher measures never exceed 0.787 and are most frequently at the 0.4 to 0.5 level. Low indices result when one distribution contains several cells (quadrats) with high counts and the corresponding cells in the second distribution have low counts. Thus, even if one distribution is completely subsumed by another, small deviations between corresponding cells will lower the D_a value. A value of 1.0 is only possible when counts for all cells are equal between the two distributions. We have arbitrarily chosen a D_a value of 0.400 or above to reflect significant and potentially meaningful overlap between two distributions.

IV. ANALYSIS OF THE SUBSURFACE PLOW ZONE ASSEMBLAGE

Indices of association were generated for Areas A, B, and C separately. As expected from the earlier discussion, different patterns of association emerged between the three areas. Area A shows an association between lithic weight and lithic count along with the co-occurrence of these categories with jasper and flint (Table 9.1 and Figures 9.5-9.6). The D_a values for bifacial tools indicate complete spatial disassociation with all artifact categories except for some slight overlap with ceramics.

In Area B the spatial uniqueness of bifacial tools disappears. Except for the association between utilized flakes and chert, overlap with other artifact categories remains low, 0.2-0.3 (Table 9.2 and Figures 9.7-9.8). Other differences between Areas A and B are increased co-occurrences of chert and flint, bifacial tools and chert, as well as chert and lithic weight.

Area C also reflects differing patterns of spatial association (Table 9.3 and Figures 9.9-9.10). Of the three subareas, Area C is the only one which shows a high association between ceramics and jasper. This area is also distinguished by high flint weights associated with low counts, and a high degree of association between ceramics and flint.

Table 9.1: Measures of Association in the Subsurface Assemblage--Area A

	Flint	Chert	Bifacial tools	Jasper	Utilized flakes	Ceramics	Lithics (c)
Lithics (wt)	0.308	0.128	0.000	0.787	0.268	0.109	0.400
Lithics (c)	0.640	0.336	0.000	0.552	0.663	0.080	
Ceramics	0.136	0.162	0.292	0.128	0.104		
Utilized flakes	0.602	0.537	0.000	0.351			
Jasper	0.412	0.207	0.000				
Bifacial tools	0.000	0.248					
Chert	0.273						

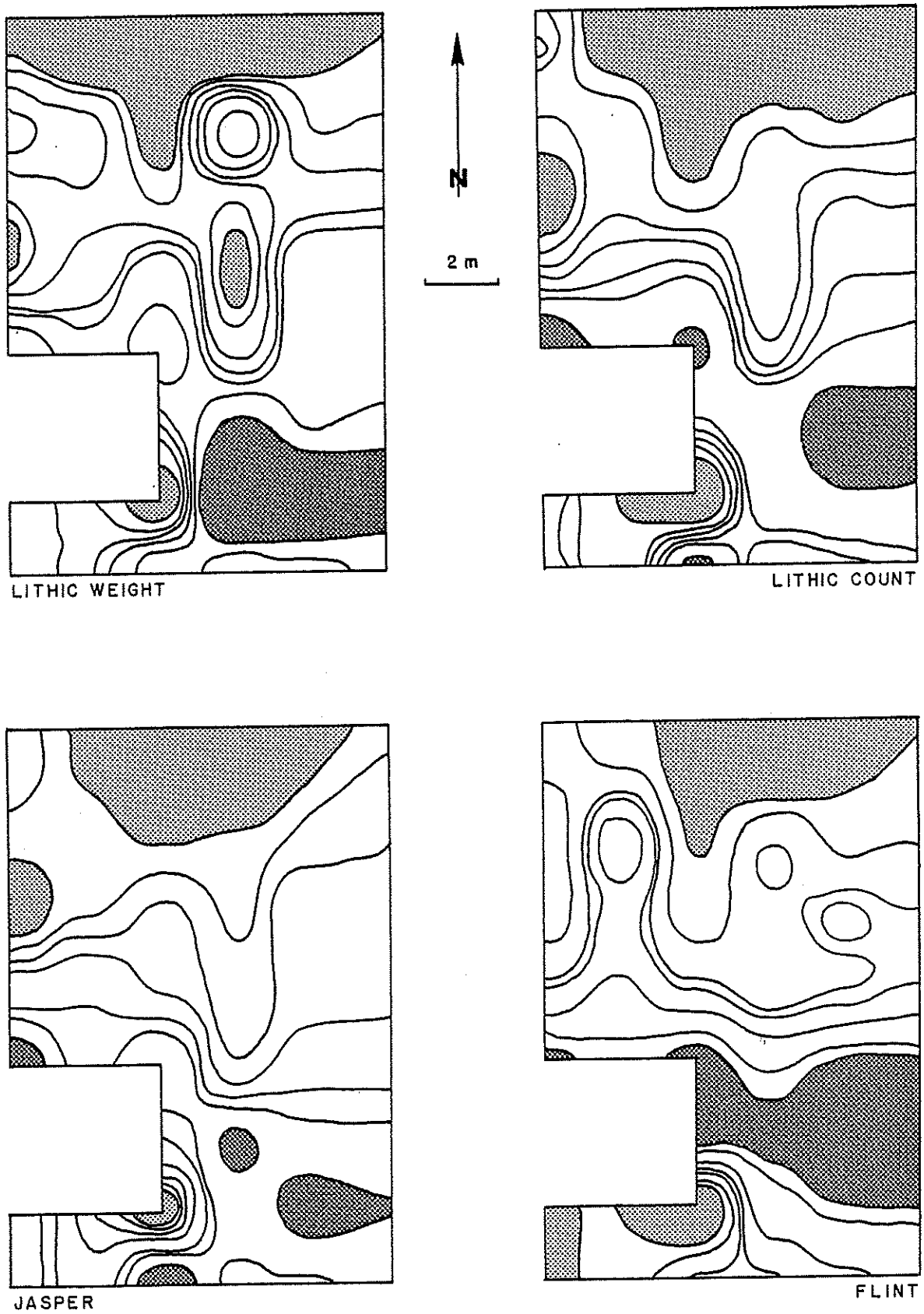


Figure 9.5: SYMAP of Area A--Lithic Weight, Lithic Count, Jasper, Flint

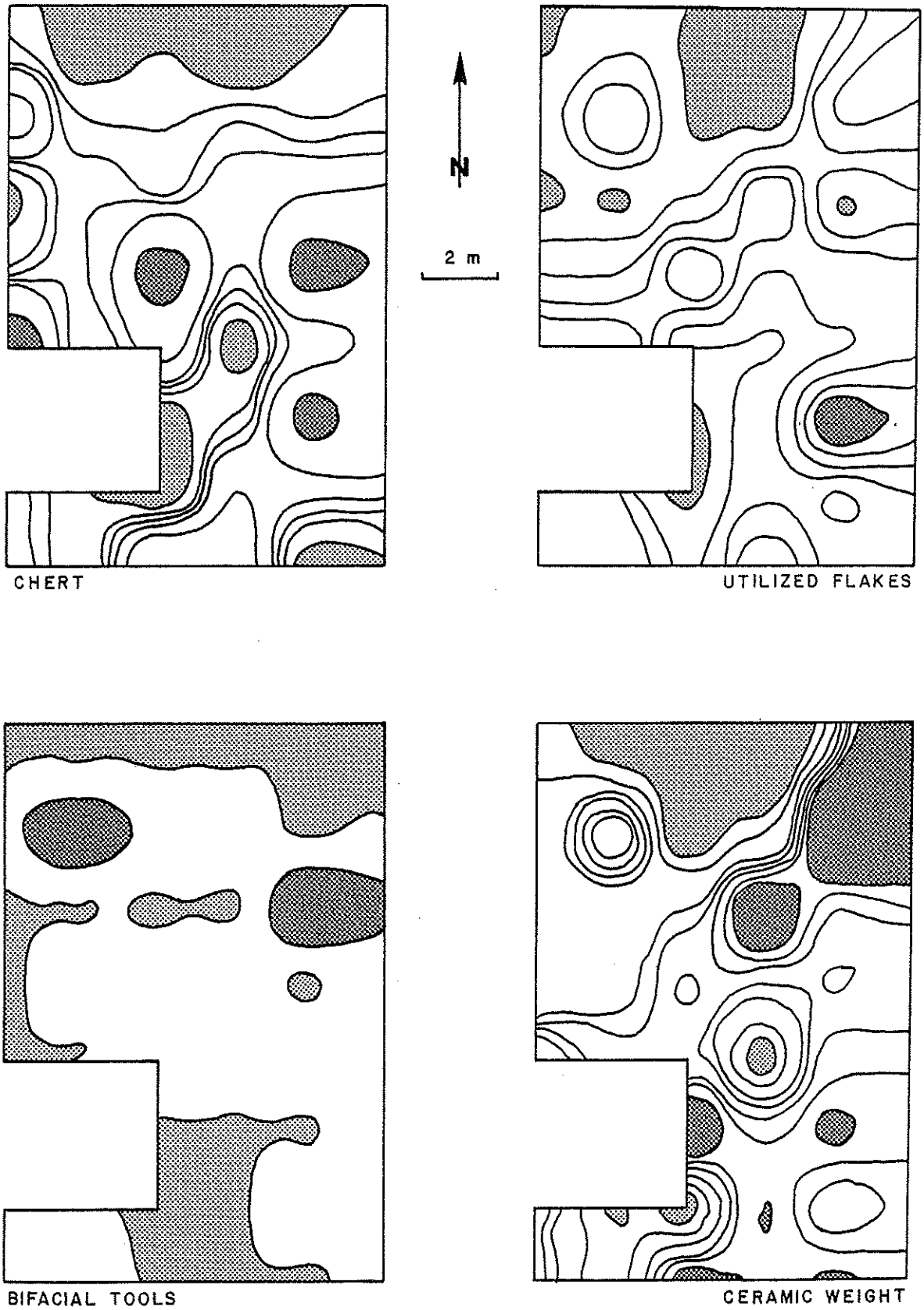


Figure 9.6: SYMAP of Area A--Chert, Utilized Flakes, Bifacial Tools, Ceramic Weight

Table 9.2: Measures of Association in the Subsurface Assemblage--Area B

	Flint	Chert	Bifacial tools	Jasper	Utilized flakes	Ceramics	Lithics (c)
Lithics (wt)	0.303	0.514	0.256	0.562	0.193	0.264	0.569
Lithics (c)	0.343	0.532	0.234	0.516	0.260	0.306	
Ceramics	0.152	0.470	0.222	0.239	0.279		
Utilized flakes	0.312	0.504	0.478	0.125			
Jasper	0.293	0.295	0.262				
Bifacial tools	0.417	0.214					
Chert	0.499						

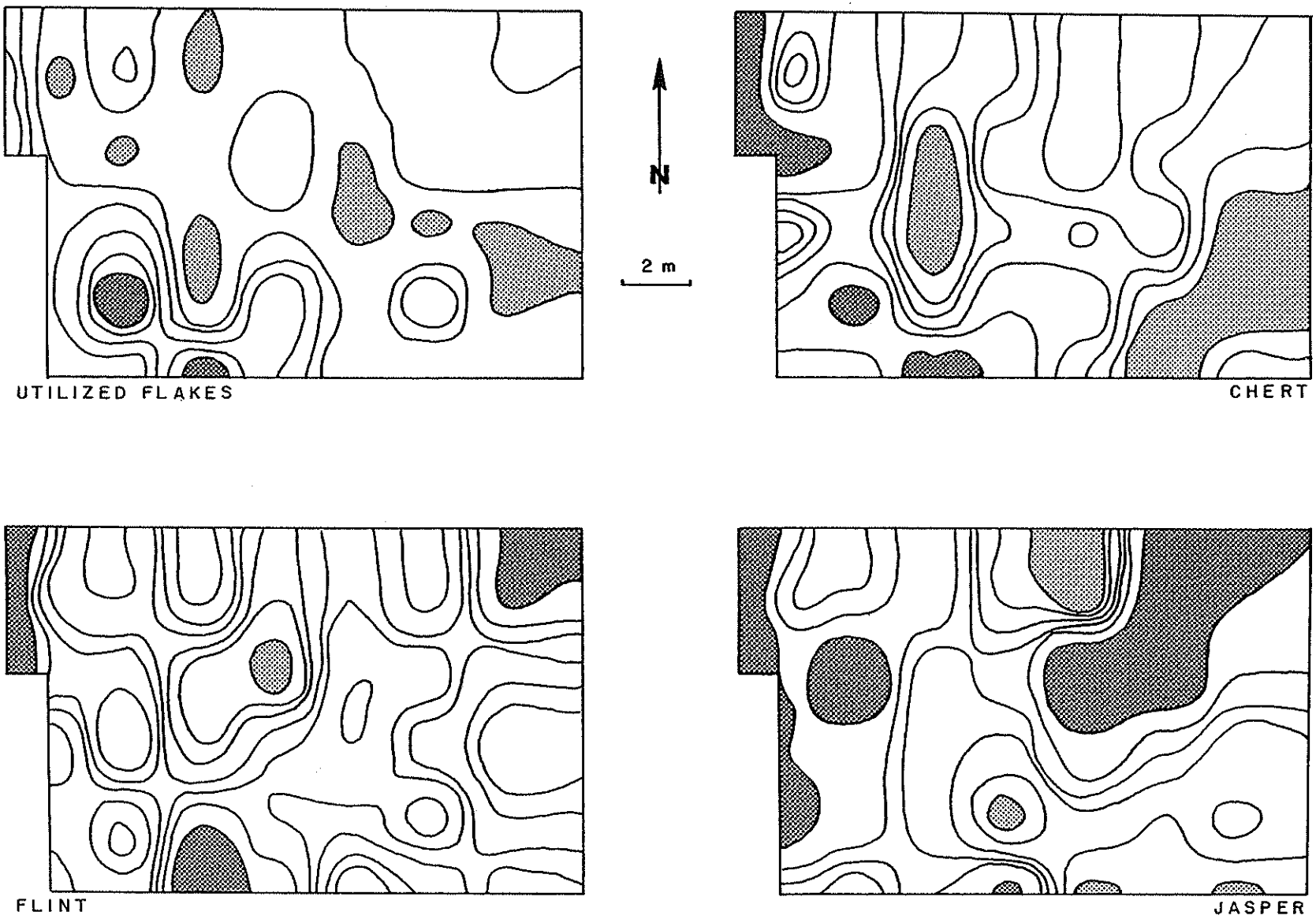


Figure 9.7: SYMAP of Area B--Utilized Flakes, Chert, Flint, Jasper

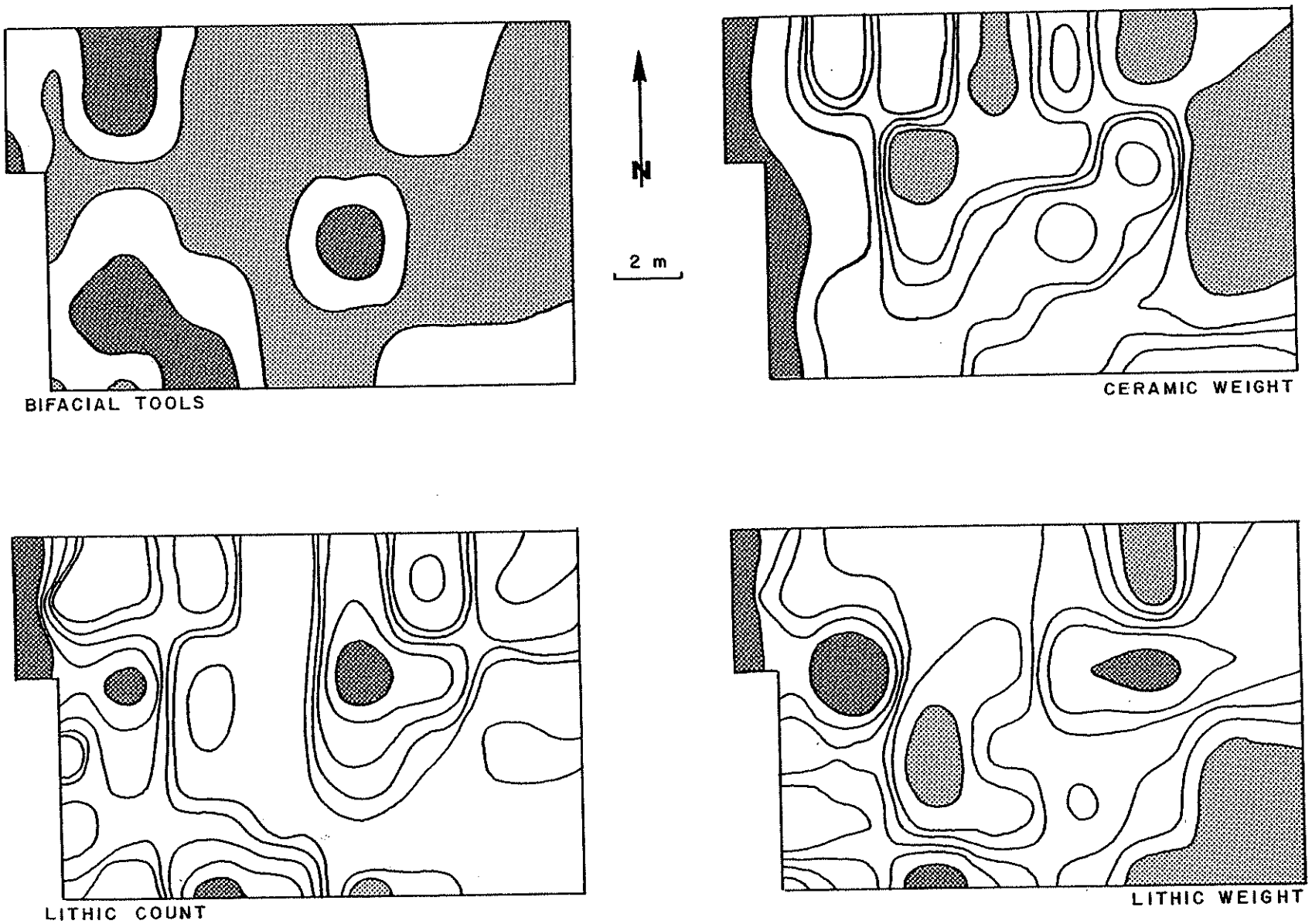


Figure 9.8: SYMAP of Area B--Bifacial Tools, Ceramic Weight, Lithic Count, Lithic Weight

Table 9.3: Measures of Association in the Subsurface Assemblage--Area C

	Flint	Chert	Bifacial tools	Jasper	Utilized flakes	Ceramics	Lithics (c)
Lithics (wt)	0.729	0.379	0.115	0.495	0.332	0.772	0.436
Lithics (c)	0.255	0.689	0.058	0.713	0.097	0.579	
Ceramics	0.668	0.462	0.120	0.630	0.322		
Utilized flakes	0.386	0.043	0.164	0.172			
Jasper	0.369	0.661	0.134				
Bifacial tools	0.161	0.029					
Chert	0.181						

Figure 9.9: SYMAP of Area C, Ceramic Weight, Jasper, Flint, Chert

Figure 9.9: SYMAP of Area C--Ceramic Weight, Jasper, Flint, Chert

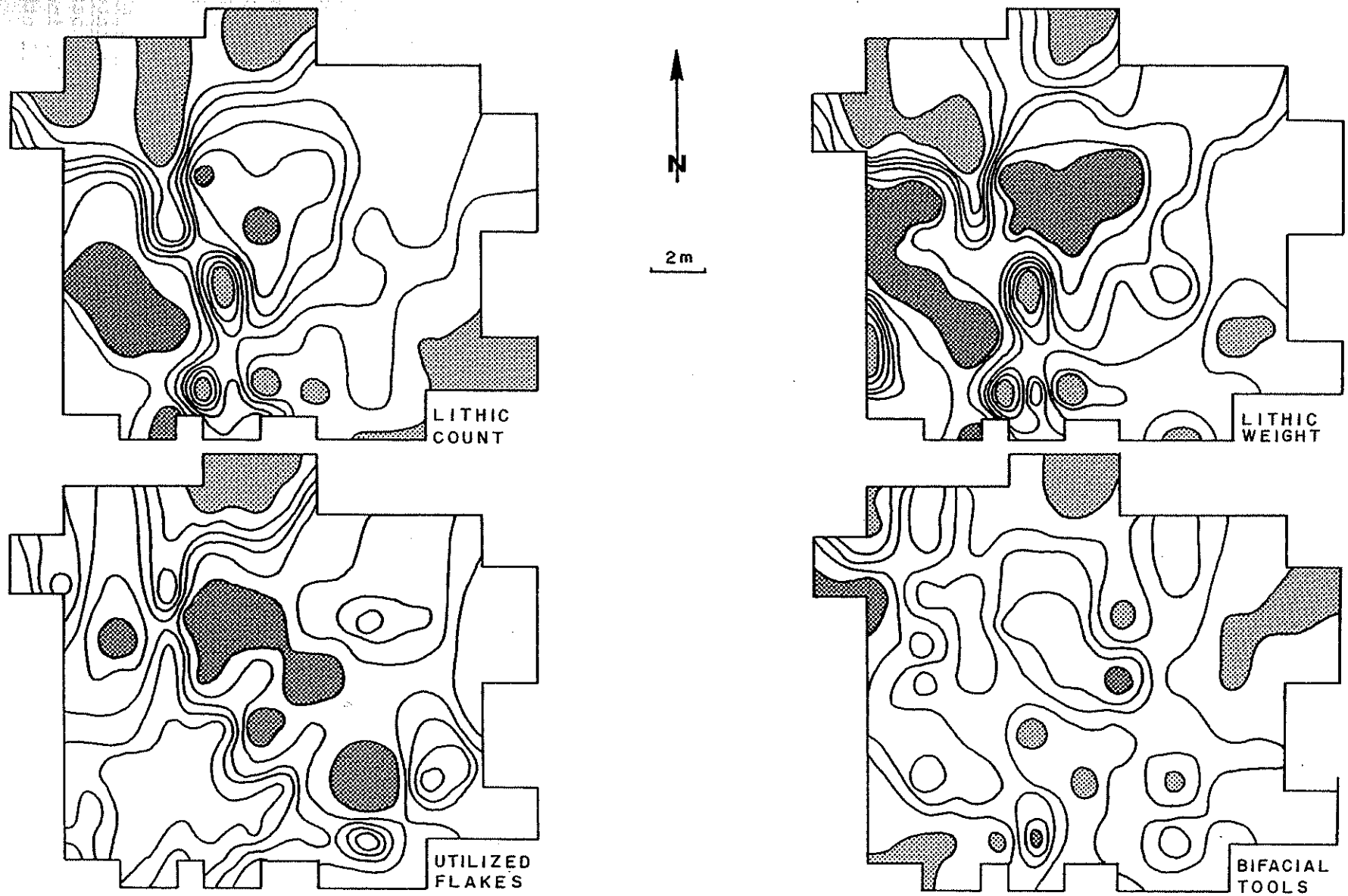


Figure 9.10: SYMAP of Area C--Lithic Count, Lithic Weight, Utilized Flakes, Bifacial Tools

The approach used above was also applied to the area of domestic structural remains (Table 9.4). The outline of this area was drawn on a transparent grid and character counts from the SYMAP distributions were tabulated for each quadrat. The Lorenz Curve was then computed for each artifact category. D_a values in Table 9.4 thus represent the degree of areal association between each of the 8 artifact categories and the area enclosing the postmold patterns of structures.

If the areas within which houses occur are examined individually, slight differences occur. Area B has a zero D_a value for all categories since no structures are present. Area A exhibits two zero indices, and reveals some slight overlap between lithic count, ceramics, utilized flakes, bifacial tools, and flint. Chert, however, exhibits a high degree of spatial association with the postmold concentration area and has a D_a value of 0.493. Area C reflects a low but consistent affinity between all artifact categories and the structure area. Looking at the artifact density maps of Areas A and C and their corresponding subsurface features, it is apparent that high artifact densities co-occur in the western portions of the domestic zone, but are discretely distributed with respect to the other portions.

On the basis of analyses of the subsurface plow zone artifacts and their spatial correspondence with features, what may we justifiably infer from this patterning?

Inference 1: Non-contemporaneity of structures--If we assume that activities which produce significant amounts of refuse were not performed within structure areas (or that debris was removed from these areas on a regular basis) then we see a minimal amount of overlap between structures in the eastern portion of Area C and any of the artifact distributions. However, the occurrence of high density areas in the western portion of Area C leads us to believe that these structures were not contemporary with some or all of the others. If one also accepts the proposition that people will erect structures in areas devoid of high refuse concentrations, then we may propose that the western structures were earlier than the eastern ones.

Inference 2: Domestic activity areas outside of but adjacent to structures--A visual examination of each artifact category used in the analysis readily shows that high counts or weights occur directly adjacent to structures in the eastern portion of Area C (the western one-third of Area C was not considered due to the apparent relocation of activity areas at these loci). Except for around Feature 28, there is a low frequency of features in the area. The association between all material suggests that no specific activity is predominant. We postulate the area between Feature 28 and the eastern structures to be one of varied domestic activity.

Inference 3: High concentrations of bifacial tools that are associated with features of both high and low carbon content indicate processing-storage activity areas--The D_a values for associations between bifacial tools and other categories are extremely low for Area A, indicating a minimal areal overlap of this artifact category with all others.

Table 9.4: Measures of Association--House Area versus High Density Areas

	Flint	Chert	Bifacial tools	Jasper	Utilized flakes	Ceramics	Lithics (c)	Lithics (wt)
Area A	0.014	0.493	0.255	0.000	0.077	0.118	0.016	0.000
Area B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Area C	0.133	0.242	0.079	0.329	0.330	0.240	0.272	0.171

Five of the seven indices are zero, indicating complete spatial separation. In the northwest corner of Area A the bifacial tool distribution overlaps a concentration of features with small amounts of carbon in their fill. This association is unique for the study area and may indicate a distinctive processing-storage activity.

Inference 4: High concentrations of ceramics not associated with the other artifact categories are indicative of areas where features are absent--North of the structures is a localized concentration of ceramics which is not associated with any other artifact distribution or any features. No behavioral correlates to this pattern are offered.

Inference 5: The co-occurrence of high concentrations of all artifact categories except for bifacial tools is indicative of concentrations of subsurface features and soil stains--The area directly south of the postmold concentration in Area A contains numerous features and soil stains in addition to two burials. Bifacial tools are of very low density, while black flint is the most highly concentrated and widely spread of the material types. High concentrations of other categories are present and are restricted in their distribution. Plow disturbance of the pit fills in this feature-rich area is assumed.

Inference 6: The co-occurrence of high concentrations of all artifact categories, including bifacial tools, may represent intensive processing areas--A visual examination of the distributional maps for Area B reveals that high concentrations of all artifact categories are found in the western third of the excavated unit. These artifact distributions either overlap or are within 4 m of an alignment of 4 carbon dense features.

In summary, it has been possible to recognize 6 spatially discrete areas within the excavated portion of the site on the basis of artifact and feature distributions (Figure 9.11). To reiterate, these areas have been inferred to be: 1) generalized activity areas, 2) structure areas, 3) non-feature, high ceramic areas, 4) intensive processing areas, 5) processing-storage areas (bifacial tools/features), and 6) feature-stain areas (black flint/absence of bifacial tools). It has not been possible to derive associations for 2 additional areas on the site. These include the cluster of burials in Area B and the prehistoric stream on the eastern edge of the site. No diagnostic artifact patterning serves to identify these areas. No doubt the deposition of more recent alluvium in the stream bed has buried cultural material which may have served to identify its unique character.

Of interest at this point is the degree to which the patterns recognized at subsurface levels are visible on the surface. Are the same spatial configurations discernable? If not, what type of patterning is present and is it analytically useful?

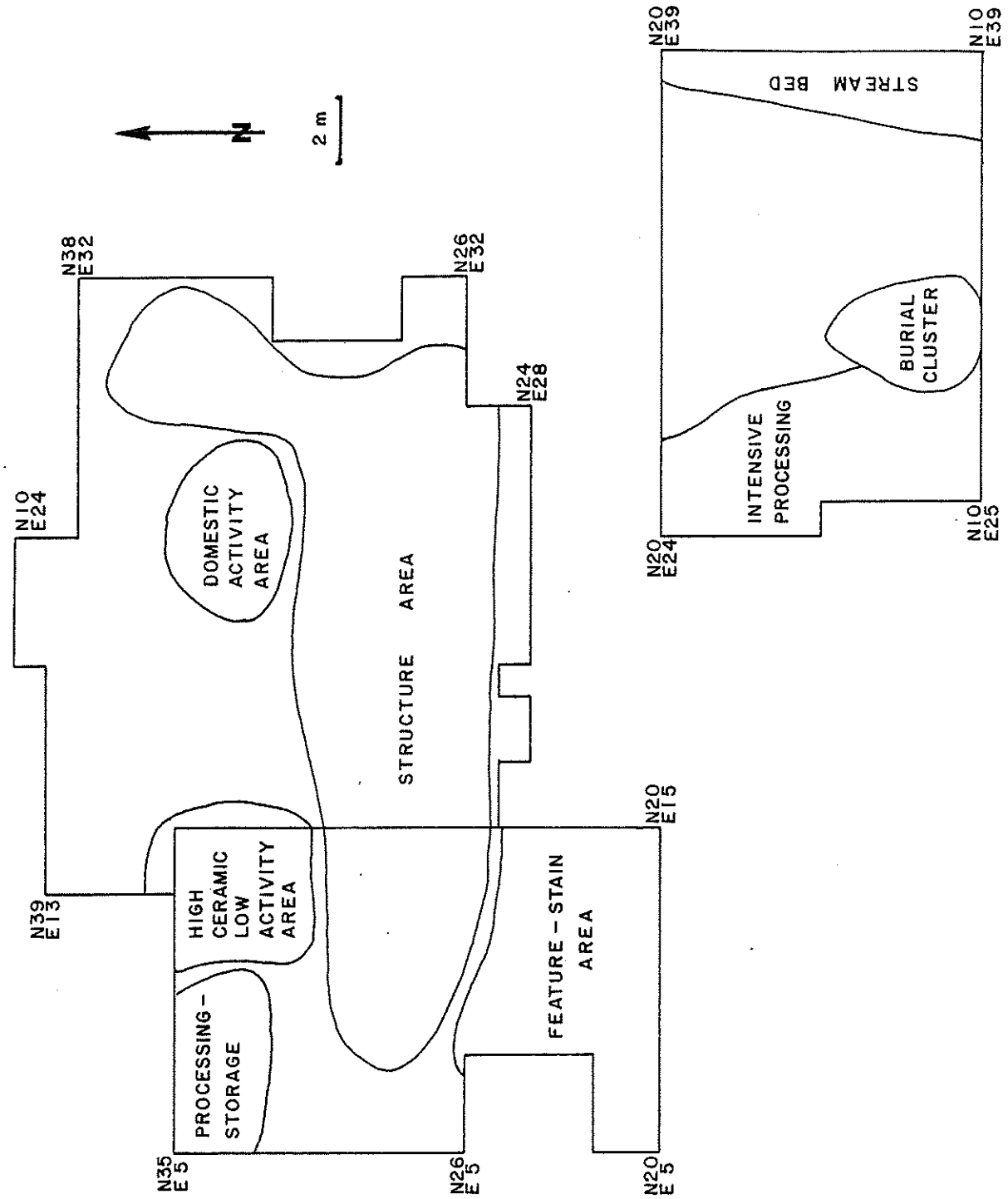


Figure 9.11: Hypothesized Activities in Areas A, B, and C

V. ANALYSIS OF THE PLOW ZONE'S SURFACE ASSEMBLAGE

In order to determine if there is any correspondence in spatial patterns between subsurface and surface distributions, D_a values were calculated between all artifact categories for each level of observation. To generate these, maps of the surface collection corresponding to the approximately 500 m^2 study area were produced. Overlapping quadrats of identical scale were drawn. Character counts per quadrat were then made for each artifact category where high concentrations were present.

Table 9.5 presents the resulting D_a values. The diagonal of the table is of specific interest since it shows the D_a values for artifact categories compared between surface and subsurface. It can be readily observed that all indices fall well below the significance level chosen to show the correspondence between two distributions. We may infer from this that the spatial patterns recognized among high artifact concentrations at subsurface levels may not always be recognized on the surface. This outcome was in part anticipated given the experiments presented in Chapter 8. There it was determined that the smallest accurate surface collection unit approximated a 4 m x 4 m square. Given this we must move to a more general level of observation and look at patterns which emerge when the site as a whole is examined.

Considering the entire area surface collected in 1977 at Fisher Farm, two general and spatially distinct patterns may be recognized (see Figures 9.12-9.15). First, the northern area of the site shows a high concentration of black flint which is more or less isomorphic with the "structure" and "generalized activity" areas discussed earlier. D_a values generated for the northern half of the site indicate that, except for chert, flint is associated at low levels with all other artifact categories (Table 9.6). Given the apparent tendency for chert to be overrepresented on the surface as a result of verticle sorting (see Chapter 8) we may infer that flint is a distinguishing attribute for "structure" and "generalized activity" areas.

A second general trend concerns the surface distribution of ceramics. In the northern half of Area A a dense ceramic area has been defined with no subsurface features. In the southern quarter of the area, a clustering of features was defined which exhibited an association with all artifact categories except bifacial tools. The surfaces of both these loci are associated with a high ceramic concentration. Thus we propose that high concentrations of surface ceramics may be indicative of areas where no subsurface features are present or of clusters of features which show very limited amounts of burning.

These two observations are all that can be justifiably extracted from the surface distributions given the available data.

VI. CONCLUSIONS

The century of plowing at Fisher Farm prior to its excavation resulted in severe damage to the integrity of many features and artifact distributions. Additional interpretive problems resulted from sequential prehistoric

Table 9.5: Measures of Association--Surface to Excavated Area

	Flint	Chert	Bifacial tools	Jasper	Utilized flakes	Ceramics	Lithics (c)	Lithics (wt)
Lithics (wt)	0.000	0.000	0.000	0.000	0.118	0.000	0.000	0.000
Lithics (c)	0.222	0.159	0.287	0.231	0.370	0.267	0.112	0.251
Ceramics	0.233	0.161	0.118	0.013	0.143	0.105	0.133	0.009
Utilized flakes	0.029	0.154	0.305	0.087	0.126	0.117	0.074	0.062
Jasper	0.066	0.115	0.182	0.134	0.026	0.074	0.121	0.127
Bifacial tools	0.000	0.000	0.102	0.057	0.000	0.000	0.035	0.004
Chert	0.086	0.181	0.360	0.165	0.238	0.162	0.097	0.142
Flint	0.220	0.044	0.083	0.097	0.419	0.180	0.060	0.202

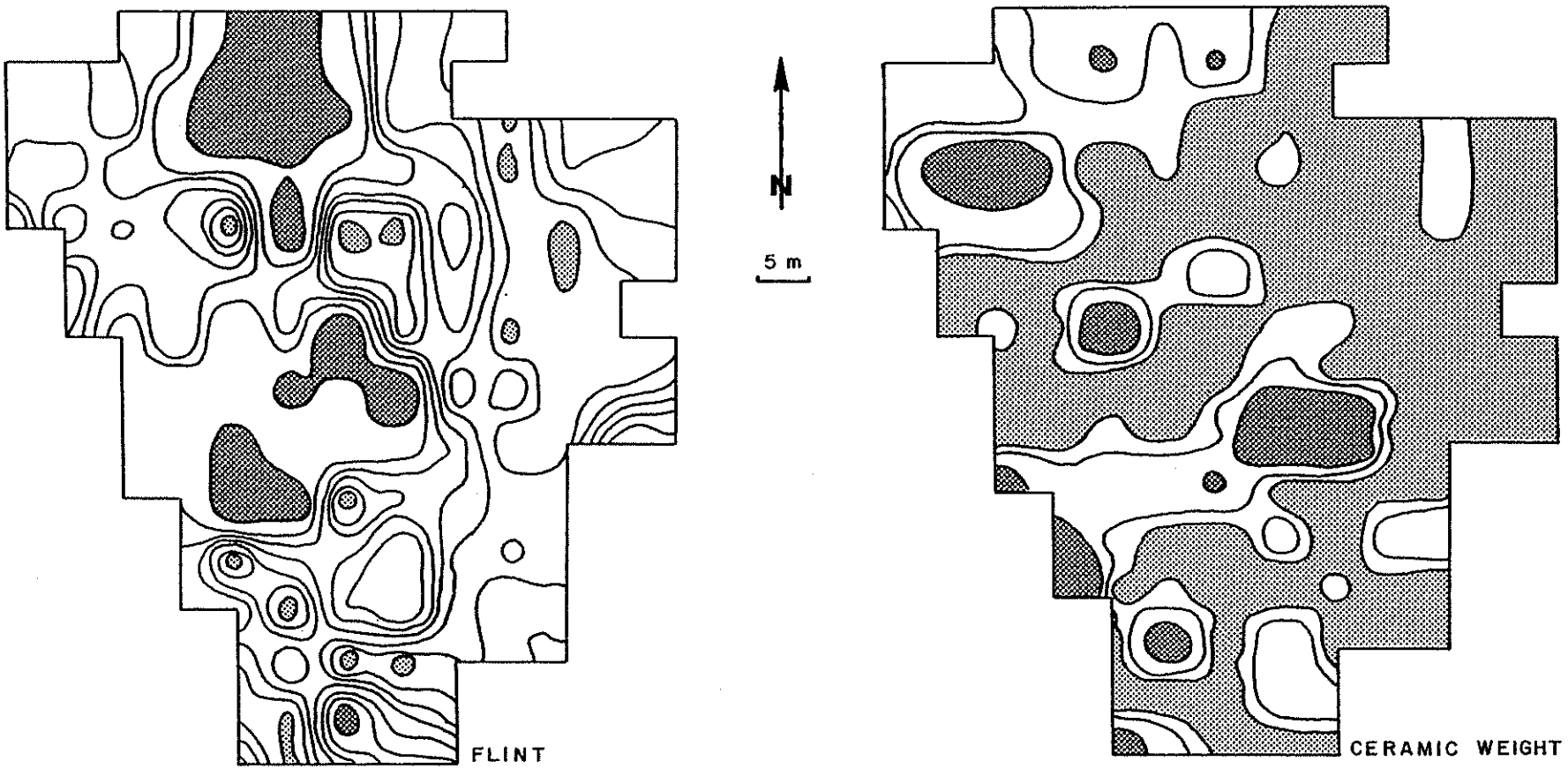


Figure 9.12: SYMAP of 1977 Surface Collected Area--Flint, Ceramic Weight

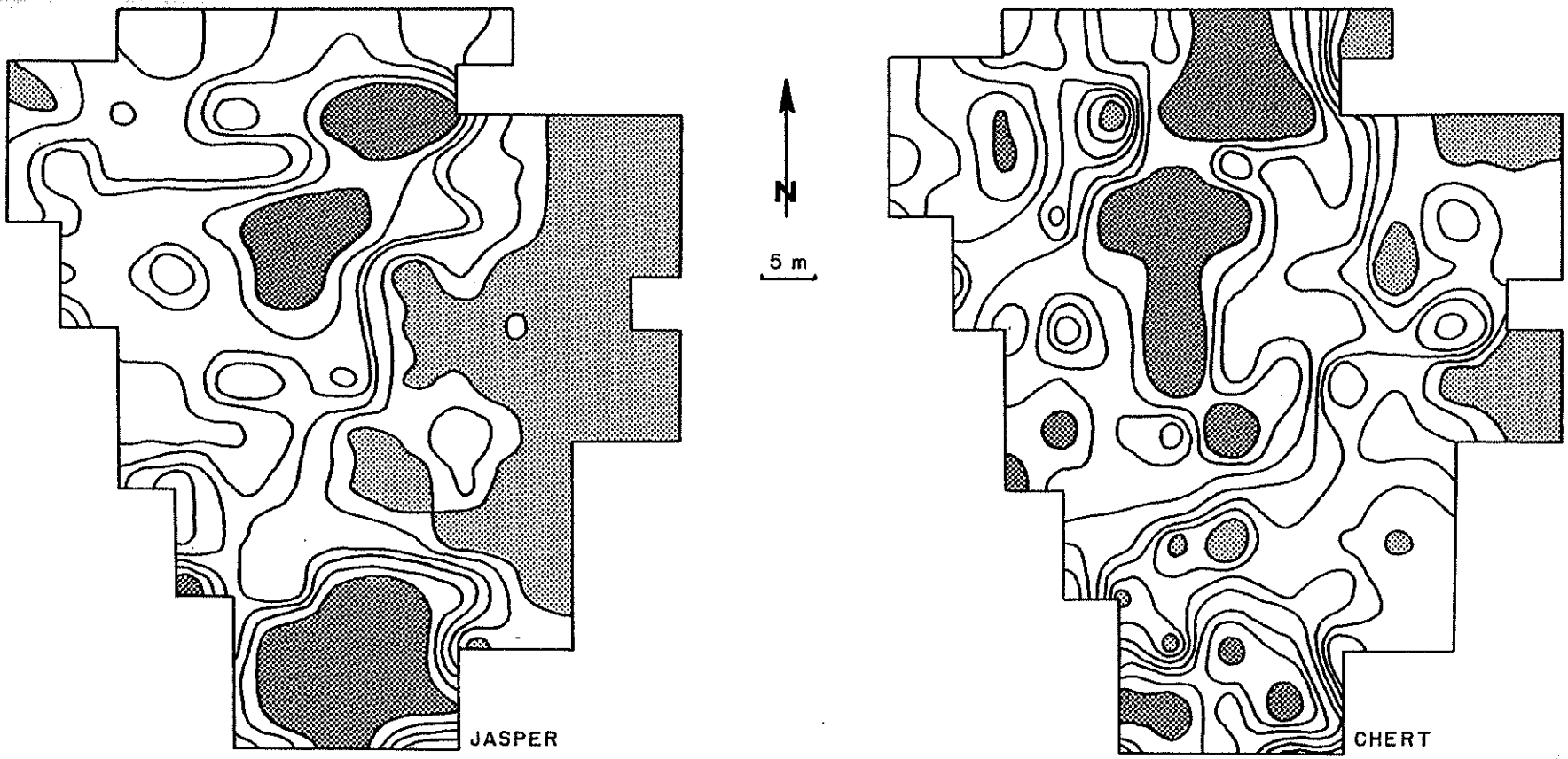


Figure 9.13: SYMAP of 1977 Surface Collected Area--Jasper, Chert

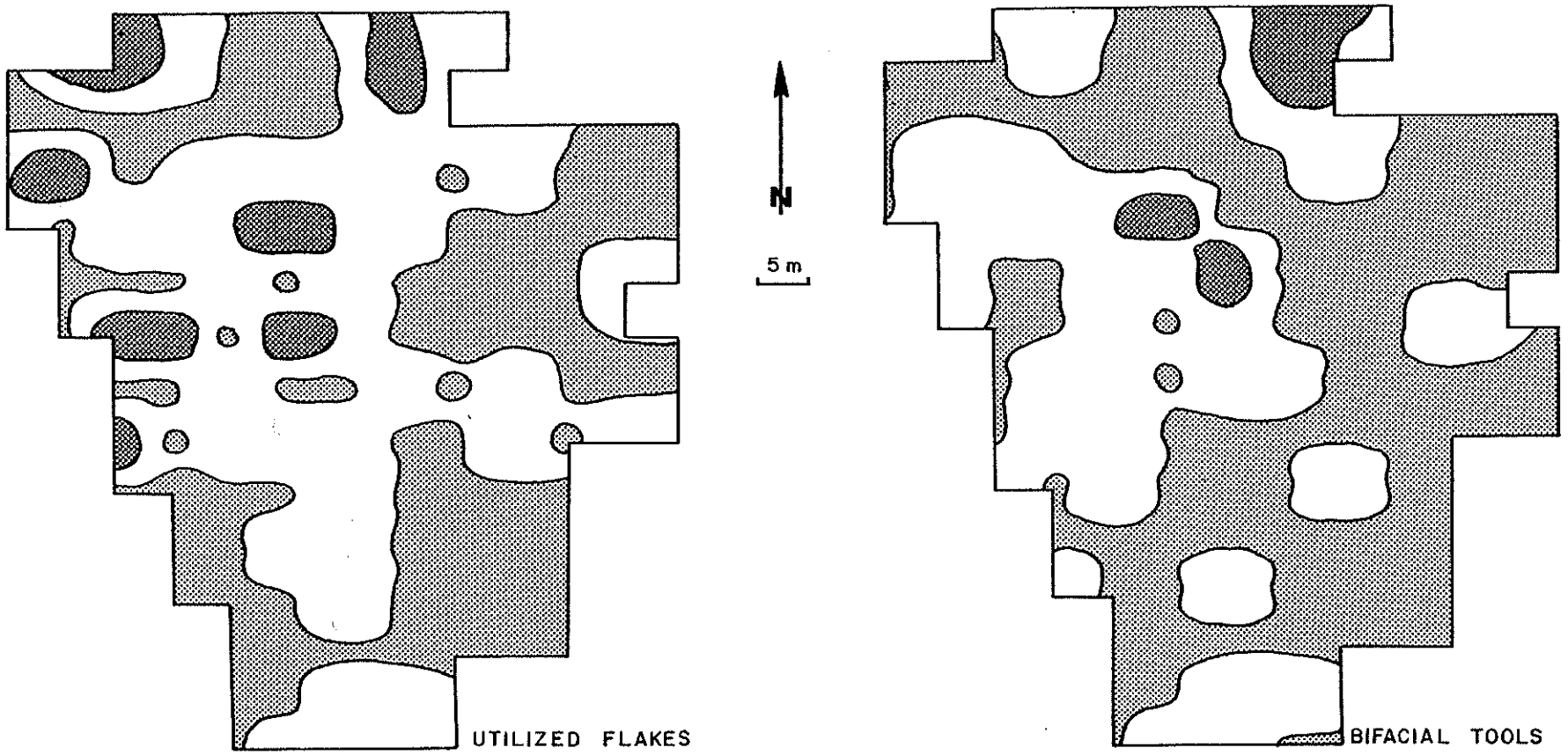


Figure 9.14: SYMAP of 1977 Surface Collected Area--Utilized Flakes, Bifacial Tools

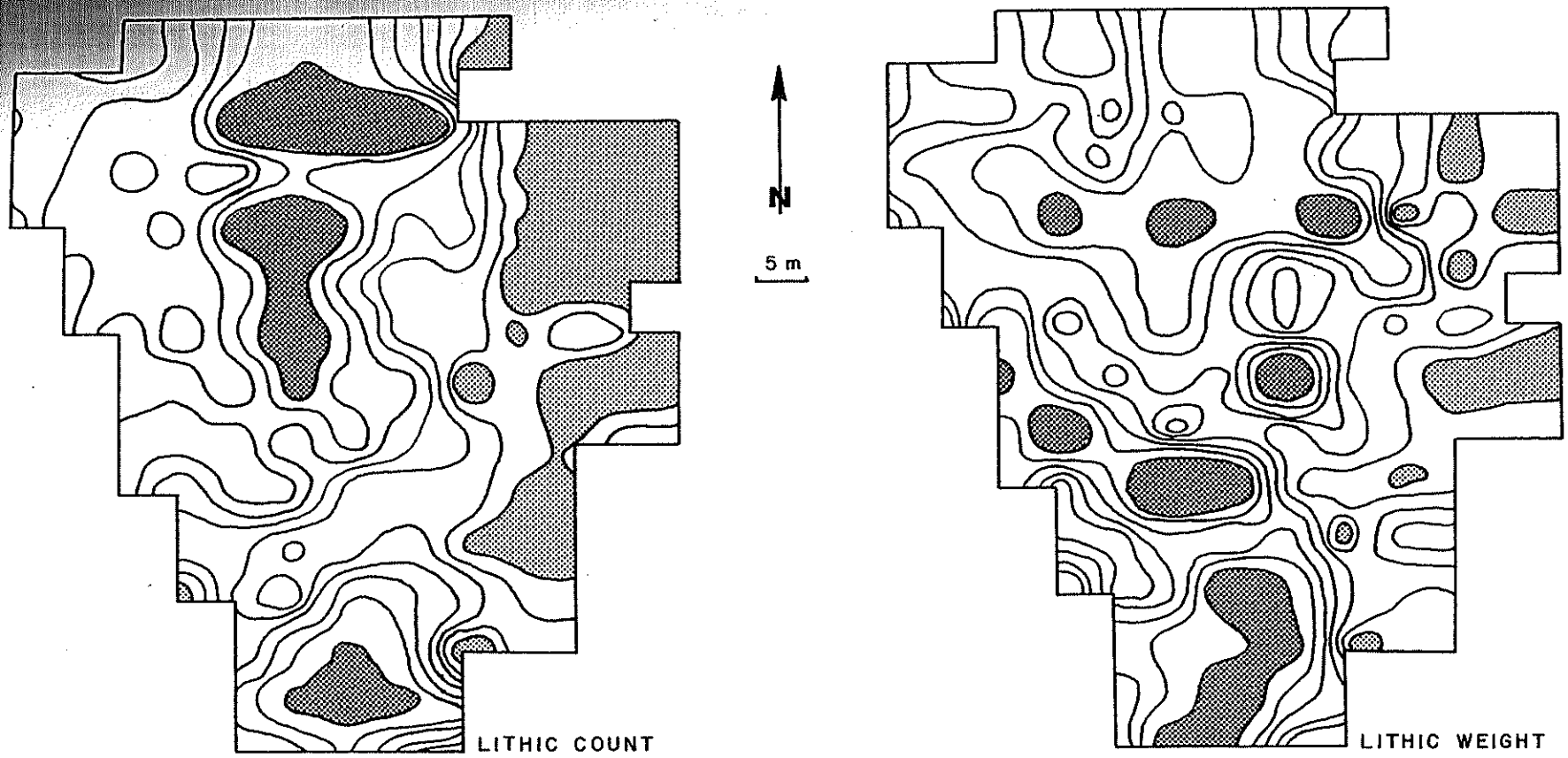


Figure 9.15: SYMAP of 1977 Surface Collected Area--Lithic Count, Lithic Weight

Table 9.6: Measures of Association in the 1977 Surface Collection--Northern Half Only

	Flint	Chert	Bifacial tools	Jasper	Utilized flakes	Ceramics	Lithics (c)
Lithics (wt)	0.205	0.390	0.220	0.263	0.186	0.198	0.322
Lithics (c)	0.514	0.613	0.373	0.506	0.275	0.065	
Ceramics	0.086	0.143	0.000	0.052	0.175		
Utilized flakes	0.169	0.387	0.305	0.278			
Jasper	0.168	0.567	0.413				
Bifacial tools	0.179	0.437					
Chert	0.400						

occupations and shifts in activity spacing over the site. Perhaps the most significant problem resulted from the general lack of knowledge about the systemic context of this material and its flow through the cultural system. As a result, this exercise is, at best, an attempt to delimit broad areas of prehistoric activity. The behavioral correlates of these activities are offered as hypotheses for testing in other, more controlled studies of Fisher Farm material remains.

The author regards the formulation and testing of behaviorally grounded hypotheses to be a very important task, one which provides direction to research and results in clearly interpretable conclusions. To this end the contribution of surface and subsurface plow zone collections is of major importance. The Fisher Farm example is an extreme test of the utility of plow zone collections, given the shallowness of the site and its long agricultural history. That any interpretable patterns remained at all is a pleasant discovery.

It can be concluded that here, and probably in similarly extreme circumstances elsewhere, surface collections can provide information on the gross structural parameters of activity areas which can be useful for developing sampling and excavation strategies. Subsurface plow zone collections can provide important supplementary detail to more discrete activity loci, activities which may or may not have related subsurface features. The complimentary nature of plow zone collections to the behavioral analysis of activity areas demands their collection on virtually all occasions. The practice of bulldozing shallow, plow disturbed sites prior to archaeological efforts, so common in the Northeast, is viewed as limiting, <u>a priori</u>, the types of data that can be retrieved from a site and the behavioral information these data can provide.

CHAPTER 10

THE ANALYSIS OF FLOTATION SAMPLES FROM THE FISHER FARM SITE

LORRAINE M. WILLEY

I. INTRODUCTION

Flotation samples were collected at Fisher Farm in an attempt to: 1) recover a representative sample of archaeological materials in the size categories traditionally overlooked by field designs employing dry screening alone, and 2) make intra-site comparisons of the sampled matrix. In particular, it was felt that preserved botanical remains recovered by flotation would aid in the delineation of the Late Woodland economic base, the seasonality of occupation, the functional characterization of features, and the evolution of subsistence practices.

During the 1976-1978 field seasons, 172 flotation samples were collected and initial processing to obtain the organic remains was carried out. Of these samples, 51 have been further separated into their various components. These components include seeds, other botanical remains, other organic remains, and miscellaneous materials. In each of these components both modern and aboriginal remains have been identified.

II. METHODOLOGY

Flotation samples were routinely collected in two different contexts. Virtually all aboriginal features that had not been seriously contaminated by later rodent burrowing were sampled. Sampling usually consisted of filling one or more clean cloth bags with unsorted feature fill. Given that the relationship between sample and feature volumes was known, the comparison of material quantities between features was possible. The second sampling context was that of non-feature areas. Samples of this type were principally collected during the 1978 excavations of the stratified area adjacent to the site in an effort to monitor between strata variation in contaminants and aboriginal botanical remains. Standardized 2 l volumes of sample matrix were employed here since the total volume of each strata was obviously unknown.

Galvanized metal basins with false bottoms of 1/16" steel mesh screen, similar to those described by Struever (1968), were used in the water separation phase of analysis. The nearby Bald Eagle Creek had areas with optimum depth and stream velocity, so the operation was carried out on-site. Freshly separated remains were air dried for 24 hours indoors and then sealed in plastic bags along with provenience information.

The 51 samples that have been further examined were dry screened through various size meshes in order to separate the materials prior to more intensive hand sorting. The meshes ranged from 9-20 to the inch.

After the first few samples were processed, it was clear that the only materials passing through the 20-to-the-inch screens were minute fragments of burned wood or grasses, modern roots, dust, and dirt--not identifiable seeds. As a result, these tailings were placed in a single bag and no further hand separation was performed on them.

Seeds were separated, identified where possible, and placed in labeled plastic bags. The other materials, such as burned wood, modern roots, etc., were also placed in labeled bags. Once the sample was entirely separated, the individually bagged specimens were weighed and replaced in their original bags containing provenience tags and a sample number assigned during analysis.

Identification of the materials was carried out with a 15x hand lens and a variable power microscope in conjunction with several seed and plant manuals (Britten and Brown 1913; Grimm 1962; Delorit 1970; Montgomery 1977) and the seed collection of the Herbarium, Department of Plant Pathology, The Pennsylvania State University. Most identifications were conservatively limited to genus, with species designations assigned only to those specimens for which diagnostic criteria were clearly observable.

III. THE DATA

The recovered materials have been classifed into 2 major categories: 1) those of aboriginal origin, and 2) those present as a result of modern intrusion.

Evidence of burning was the principal determinant for distinguishing material of aboriginal origin. Hubbard notes that there are 3 major reasons why the carbonization of organic materials occurs:

> (i) They are burned intentionally: such is the case of wood in fires, chaff in bonfires or stubble-burning, etc.
> (ii) They are burned accidentally, as a hazard of their usual functions; such as the cooking of food, the parching of crops, or the fire hardening of a wooden tool.
> (iii) They are burned accidently, during a calamitous fire (1976:262).

The following items were included in the seed category of aboriginal remains.

Zea mays (Corn)--This is believed to be a staple crop of the Woodland Period. Carbonized specimens were found in Features 4, 12, 28, and 48.

Helianthus sp. (Sunflower)--One specimen of this genus, fragmentary and highly carbonized, was recovered from Feature 28. This is one of the more tenuous identifications because of the condition of the specimen.

Phaseolus sp. (Bean)--One highly carbonized example was recovered from Feature 28. This identification is relatively secure even though only half of the specimen remains.

Cucurbita pepo (Pumpkin/Squash)--A badly carbonized fragment from Feature 28 has been tentatively identified as belonging to this genus and species.

Chenopodium sp. (Goosefoot)--Examples of this genus were located in Features 4, 15, 28, and 29. The majority appear to be burned and are thus considered of aboriginal origin. However, since Chenopodium is commonly found in disturbed areas today, it is possible that some of the specimens were intrusive as well. This genus is believed to be part of a weed seed subsistence pattern beginning at the end of the Archaic Period and continuing through the Woodland Period (Yarnell 1964, 1971, 1974a, 1974b; Struever 1971; Struever and Vickery 1973; Watson 1974b;also see Chapter 14).

Polygonum sp. (Smartweed)--The majority of these specimens were badly burned, and while they could be definitely identified as Polygonum, species distinctions were impossible to determine. Seeds of this genus have been found in a subsistence context at the Ozark Bluff Dweller sites (Gilmore 1931).

Rubus sp. (Raspberry)--Two specimens from Feature 28 appeared to have been scorched while the rest are probably of modern origin.

Juglans sp. (Walnut)--Carbonized specimens of the shells of this common nut food were found in Features 12, 28, and 41.

Carya sp. (Hickory)--Carbonized hickory shells were found in Features 4 and 28.

Quercus sp. (Oak)--One carbonized specimen of the nut meat was found in Feature 28.

All of these plants have been identified either archaeologically or ethnographically as part of the subsistence pattern of the North American Indian and most have substantial archaeological associations from the Woodland Period in the Northeast.

In addition to the botanical subsistence remains, several other materials of aboriginal origin appeared in the flotation samples. These included burned wood chips, bark, and grasses. Flint debitage and ceramic sherds were also found in several features. These were probably the result of flint knapping and cooking or kiln activities, respectively. Finally, a small number of burned bone fragments, probably a result of food preparation, were found in Features 4, 12, and 48.

Material recovered from the flotation samples that could be classified as modern intrusives included 18 types of seeds, roots and leaf fragments, wood, weed spikes, hemlock or yew needles, small land snails, insect parts, dirt balls, slate fragments, and stones and pebbles.

It appears that the inclusion of the dirt, slate, and stones in the samples is a result of problems in the initial flotation separation process. The rest of the organic materials are contaminants resulting from the following disturbances:

Plowing--Fisher Farm is a shallow site, and with newly introduced deep plowing techniques much of the feature material has been significantly gouged and disturbed.

Roots and Cracks--The large number of roots present in the samples testify to the closeness of the features to the surface. Holes left by these roots over the years serve as another avenue for modern seeds into the archaeological deposits. Cracking of the soil during periods of freezing or extreme dryness may well have the same effect.

Earthworms and Insects--Earthworms and burrowing insects also provide a means for contamination of the cultural deposit. Remains of the latter were common to all of the examined samples.

These types of contamination and others that do not seem to be applicable to the Fisher Farm Site are discussed at length by Keepax (1977:221-229).

The quantity of unidentified seeds and seed fragments was rather small, making up less than three-tenths of one percent of any sample. The material included in this category was unidentifiable because of extensive burning or fragmentation which obliterated identifying features. The only exceptions to this were 2 types of modern seeds for which positive identification could not be made. One specimen, present in several samples, appeared to be a member of the Parsley family, while the other, possibly a member of the Capsella (Shepard's Purse) family, was present in 2 samples.

The results of all flotation samples analyzed to date can be found in Chapters 11 and 12.

CHAPTER 11

A FUNCTIONAL ANALYSIS OF THE FISHER FARM FEATURES

JAMES W. HATCH AND CHRISTOPHER M. STEVENSON

I. INTRODUCTION

This analysis will consider the morphology, contents, and intra-site village location of the 59 features discovered during the 1977 excavations of the terrace at Fisher Farm in an effort to reconstruct their function and associated activity areas. The 2 features discovered during the 1976 excavations were both burials and will be discussed fully in Chapter 13. The 17 features excavated in 1978 were all from the stratified stream bed deposits and represent either lenses formed by individual dumping events of village debris or borrow pits resulting from storage or clay mining. These features are qualitatively distinct from those discovered in the village proper in 1977 and, like the 1976 burials, will not be considered here.

We suspect that through years of plowing the uppermost portions of many of the terrace features were removed and their contents displaced. Such plowing was also responsible for the introduction of modern botanical elements into the flotation samples excavated from these features (see Chapter 10). These factors will be controlled, where possible, in the analyses that follow.

This research is both an application and an outgrowth of the taxonomic model proposed by M.C. Stewart (1975; 1977). Her work at the multicomponent Late Woodland Engelbert Site in New York included an analysis of 328 subsurface features very much like those at Fisher Farm. Dissatisfied with the non-explicit feature taxonomy employed in the archaeology of the area, Stewart turned to the northeastern ethnographic record for feature descriptions and their archaeologically discernible correlates. From this work she offers a formal dendrogramatic taxonomy as well as suggested key attributes for ordering other collections of features and traits useful in distinguishing each feature category. Her model's application here will be as a source of hypotheses against which to evaluate the function of each feature.

II. THE FEATURES AND THEIR CONTENTS

Numerous field observations were made on each of the 59 features during the 1977 field season, and many of these are useful in a functional analysis of this sort. The rather small number and great diversity of features in our sample precludes the necessity of computerized, numerical taxonomic assistance. Instead, a few summary statistics related to feature shape, size, and contents are felt to adequately characterize the diversity in the sample.

Both our impressionistic reactions to the size and shape of these features and the results of Stewart's discriminant function analysis of these attributes at the Engelbert Site suggest that the shape of a feature at its surface (its opening), its depth relative to the opening, and its absolute size are its three most important morphological characteristics. The first of these attributes, the shape of the orifice, is easily expressed as:

$$L/W \qquad (1)$$

and will be referred to here as the "Length-Width Ratio." Quite obviously, circular or square (ours were always circular) openings will obtain a value of 1.0 while more rectangular-or oval-shaped openings will have larger ratio values. The next attribute, "Ratio Depth," is expressed here as:

$$\frac{(L + W)/2}{D} \qquad (2)$$

that is, the average dimension at the surface divided by the depth. All of these values were calculated from the feature forms completed in the field and are based on metric measurements taken along maximum dimensions. Absolute size, the last morphological attribute, is expressed here as the volume. Volume estimates were derived from the field graphics of each feature. Only two formulas were used, with probably no more than 10% error in their application to any feature. If the basic profile shape was that of an inverted cone, either complete or truncated, the formula:

$$V = 1/3\pi r^2 h \qquad (3)$$

was used. For conical profiles, this formula was sufficient. For truncated conic profiles, however, an imaginary point was placed below the feature where the approaching sides would intersect and a plane was drawn through the resulting cone at the bottom edge of the feature. The volume of the smaller cone below the feature (also expressed as $V=1/3\pi r^2 h$) was subtracted from the volume of the larger cone that included both the smaller cone and the feature, thus leaving the volume of the feature. For basically rectangular feature profiles, the formula:

$$L \times W \times D \qquad (4)$$

incorporating length, width, and depth measurements was used.

The material categories discovered in the features at Fisher Farm include botanical remains, bone (both human and non-human), fire-cracked rock (usually sandstone), utilized stone tools, non-utilized lithic debitage, and ceramic sherds. Except for the botanical remains, the vast majority of the material recovered from the features was found during excavation. Virtually all of the botanical material and a small number of items from the other categories were recovered from flotation samples.

Flotation samples were collected and water separated from 90% of the features. Since the sampled percentage of the total volume of each feature varied tremendously (from 10-100%), we have incorporated "Botanical Density," or the number of g of separated material per m^3 of fill, as the measure of botanical content. Modern roots, pebbles, and other non-botanical inclusions were removed prior to weighing the separated material.

Bone remains from Fisher Farm were a rarity due to the slight acidity of the soil, the shallowness of the site, and the severity of the local climate. As discussed in Chapter 13, even the human burials were primarily identified by their enamel tooth caps. All bone found in non-burial contexts had been burned. Because of these problems, bone remains were recorded simply as "present" or "no evidence." Fire-cracked rock, utilized lithics, non-utilized lithic debitage, and sherds were simply counted.

Table 11.1 presents the data values for the 59 features under consideration. Looking at their non-botanical contents, it is clear that very few of the features contained much artifactual material. Figure 11.1 illustrates the similarity in the distributions of 4 feature content categories. Bone remains were likewise found in only 11 of the 59 features, with 7 of these being the human burials. Given the sparcity of material, it is apparent that non-botanical associations will be of little use in discriminating feature categories.

The only exception is fire-cracked rock. When those features containing fire-cracked rock are plotted against those with known botanical density we see an association threshold (Figure 11.2). Below 400 g/m^3 fire-cracked rock occurs in only 21% (5 of 24) of the features. Above 400 g/m^3 fire-cracked rock occurs in 53% (9 of 17). The average number of rocks below 400 is only 1.3, while above 400 the average is 10.4. Based on these percentages and the overall shape of the Botanical Density Curve (400-499 is the next category after the inflection point), we will analytically associate the aboriginal presence of fire with either fire-cracked rock or botanical densities in excess of 400 g/m^3. Features without fire-cracked rock or with botanical densities less than the 400 will normally be regarded as not associated with fire.

III. FEATURE MORPHOLOGY AND FUNCTION

A scatterplot of the 59 features using the variables Length/Width Ratio and Ratio Depth illustrate the diversity of forms encountered at Fisher Farm (Figure 11.3). Since we concur with Stewart that attributes of form (size and shape) are the most closely connected to the primary or intended function of any feature (1977:149), we can anticipate a variety of functions to be represented in this sample. At the same time her analysis of the Engelbert features proved that the distinction between fire and non-fire pits is the most useful identifier of function in subsurface facilities. Because of this, we will begin our analysis by replotting the non-burial features on two separate figures, fire (Figure 11.4) and non-fire (Figure 11.5), based on the fire-cracked rock and botanical density criteria discussed above. At the same time volume, the third morphological variable, can be incorporated. In doing so, several clusters of features emerge, based on similar attributes of shape and/or size, that are logical places to begin the hypothesis testing procedure. Table 11.2 and Figures 11.6-11.10 show the locations of the various feature categories in Areas A-E.

Table 11.1: Attributes of the 59 Features Excavated in 1978 at the Fisher Farm Site

Feature	Provenience	Length (cm)	Width (cm)	Depth (cm)	Volume (dm^3)	Flotation Sample	Botanical Density (gm/m^3)	Radiocarbon Sample	Botanical Identification	Fire-Cracked Rock	Utilized Lithics	Jasper	Black Flint	Chert	Ceramics*	Bone	Human Remains
1	S10.3W15.2	13	13	14	.9	+		+		1					3-G		
4	S10.3W15.2	215	120	1-3	51.6	+		+	Fig. 11.4	2				3	12-G		
5	N36E26	73	47	2	8.7	+							1		3-G		
6	S11.25W14.5	24	18	24	2.7	+				1							
7	N34E26	36	21	40	3.0	+		+		+							
8	N34E26	70	50	10	25.7	+									16-G		
9	S20E34	120	82	23	60.7	+		+									
10	S9.08W14.14	25	25	15	2.3					5							
11	S9.08W14.14	38	30	10	2.9	+				3	1			16	2CI,12G	+	
12	S9.08W14.14	39	31	16	4.9	+		+	Fig. 11.6					1	2-G	+	
16	N32E24	53	35	47	61.0	+		+		4							
17	S10.75W15.5	125	83	5-7	62.2	+				3					3-G		
18	N26E22	33	23	9	1.7	+	130								6-G		
21	N30E22	29	22	15	2.5	+		+		1							
23	S10.75W15.5	22	22	17	2.1	+	320								1-G		
24	N26E24	22	15	24	16.4	+											
26	N34E22	32	17	37	7.0	+	760										
27	N34E22	42	28	26	8.2	+	100										
28	N36E22	298	230	7	1104.0	+	8480	+	Fig. 12.3		16				2-G		
29	S9E19	117	58	29	57.5	+		+	Fig. 11.7		15	1	1	1	166-G		
															4-S		
															1-SF		
															1-CI		
															5-G		
32	N34E20	76	60	12	14.0	+	220										
33	N34E20	28	20	10	1.0	+	120										
34	N32E9-11	76	58	10	11.0					1							
35	N32E9	21	21	36	4.0	+	810			2				1			
36	N32E7	30	21	14	2.3	+	60										
37	N34E7	37	33	10	48.0	+	40										
38	N32E5	53	51	5	8.7		150			2							
39	N30E13	27	20	5	.6		130										
40	N32E5	32	29	15	5.4	+	50			+							
41	N32E5	105	31	11	91.2	+	290	+	Fig. 11.3	+	1	3					
42	N26E13	33	32	145	3.4	+	321	+									
43	N26E13	20	20	13	1.9	+	900										

Table 11.1 (Continued)

Feature	Provenience	Length (cm)	Width (cm)	Depth (cm)	Volume (dm^3)	Flotation Sample	Botanical Density (gm/m^3)	Radiocarbon Sample	Botanical Identification	Fire-Cracked Rock	Utilized Lithics	Jasper	Black Flint	Chert	Ceramics*	Bone	Human Remains
45	N26E7	23	11	25	1.8	+	790										
46	N12E25	82	61	7	35.0	+	290			1			1		12-G		
47	N20E5	57	48	7	8.3	+	820	+									
48	N36E24	37	33	4	3.0	+	450	+	Fig. 12.3	+					1-SF		
49	N20E9	25	25	17	4.4	+	30										
50	N20E9	22	20	13	1.7	+	590										
51	N14E25	83	60	5	16.3	+	540			8				1	9-G		
52	N10E25	162	101	25	111.9	+	670	+	Fig. 11.7	18					182-G 14-CI	+	
53	N16E29	18	17	7	3.7	+	60					1					
54	N10E27	60	30	20	10.4	+	150										
55	N10E29	83	58	13	41.7	+	820	+				1			4-SH 1-G 1-CI	+	B6
56	N10E29	103	70	24	62.1	+	41	+			1		1	1	4-G	+	B3
57	N14E29	86	68	38	97.0	+	68	+				1		2	5-G	+	B4
58	N10E31	102	10	36	213.0	+	470			28				2			
59	N12E29	99	65	27	108.0	+	940	+		3	1	1	1		1-G	+	B5
60	N12E33	25	18	30	3.5	+	280										
61	N15E24	140	65	6	57.0	+	1100	+		6					1-CI 1-G	+	
62	N10E25	44	27	28	36.0							1	1			+	B7
65	N22E11	38	34	26	12.7	+	570								5-G		
66	N24E10	95	64	27	101.0	+	430						2			+	B8
67	N12E25	25	23	23	5.5	+	140										
68	S2-4E20	117	80	4	37.4	+	600	+		4				1	8-G	+	
69	S4E22	98	71	3	20.8	+	330	+						1	1-G		
70	S2E20	70	34	10	6.9	+	180			1							
71	S8E22	95	45	10	42.0	+	120										
72	S8E22	32	25	8	6.2	+	240										
73	N9E25	105	59	30	52.2			+								+	B9

* G = Grit Tempered
SH = Shell Tempered
SF = Shenks Ferry
CI = Clemson Island
+ Should be read "attribute present" or "sample taken."

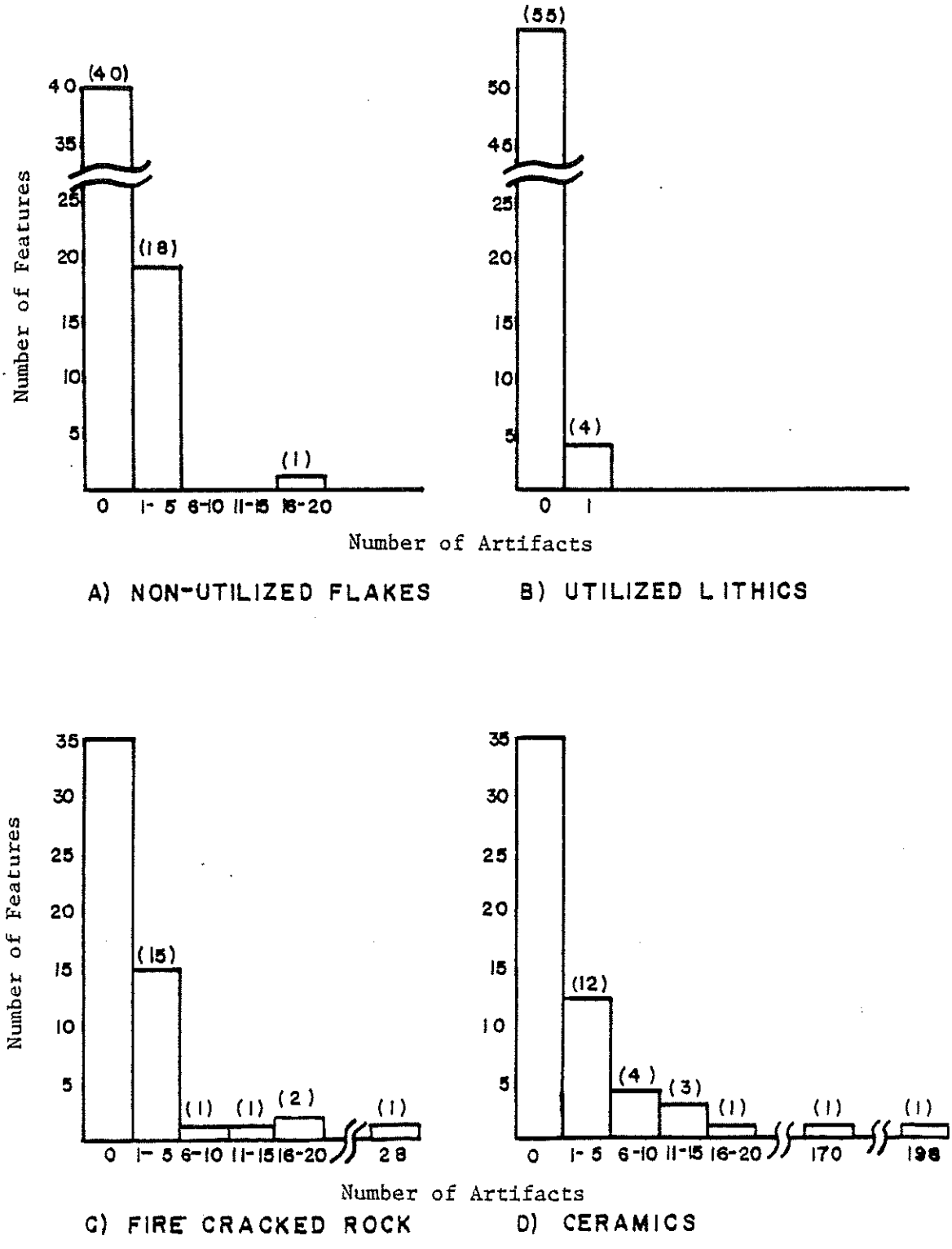


Figure 11.1: Artifact Contents of 59 Fisher Farm Features

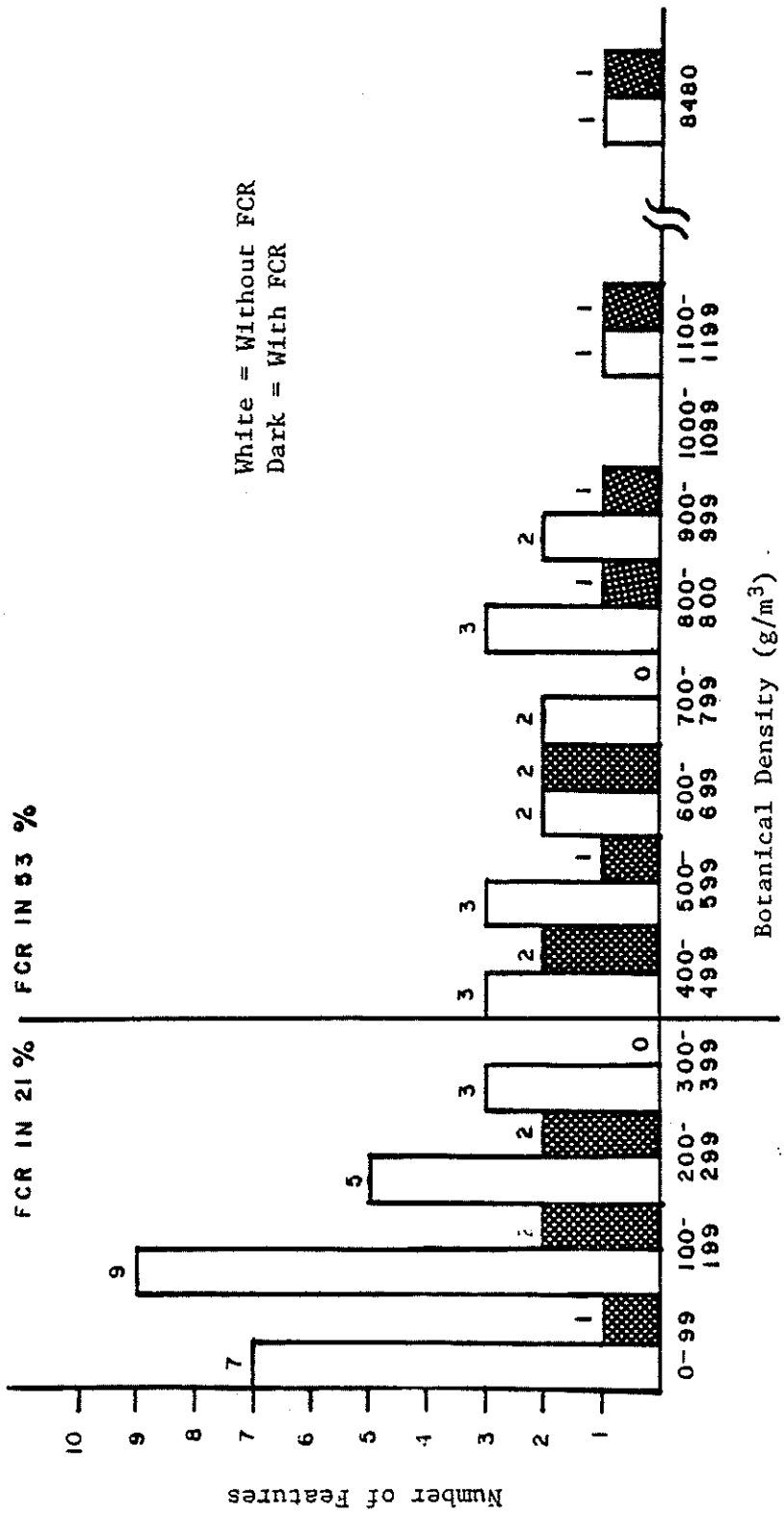


Figure 11.2: Association Threshold of Fire-Cracked Rock and Botanical Density

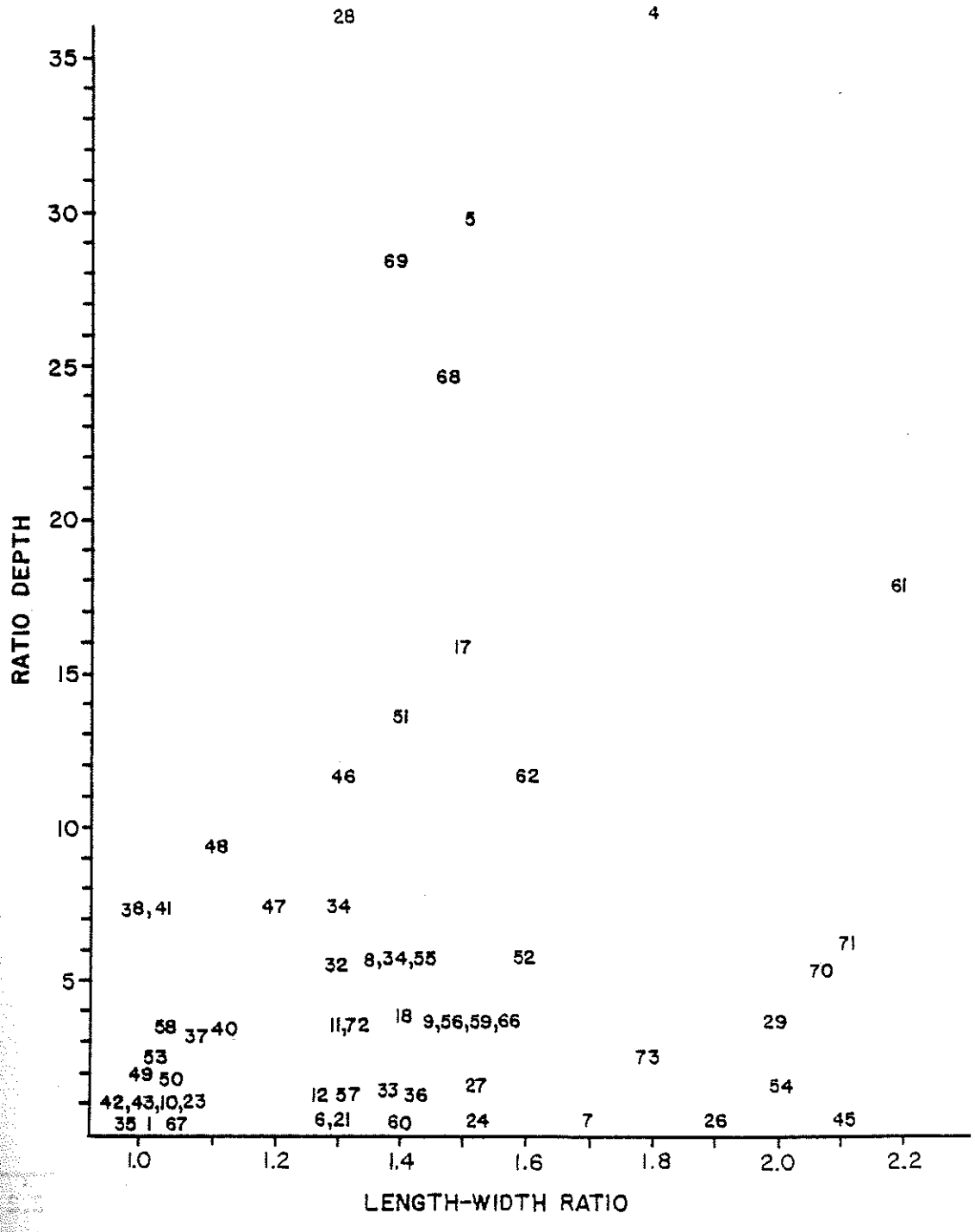


Figure 11.3: Scatterplot of 59 Fisher Farm Features

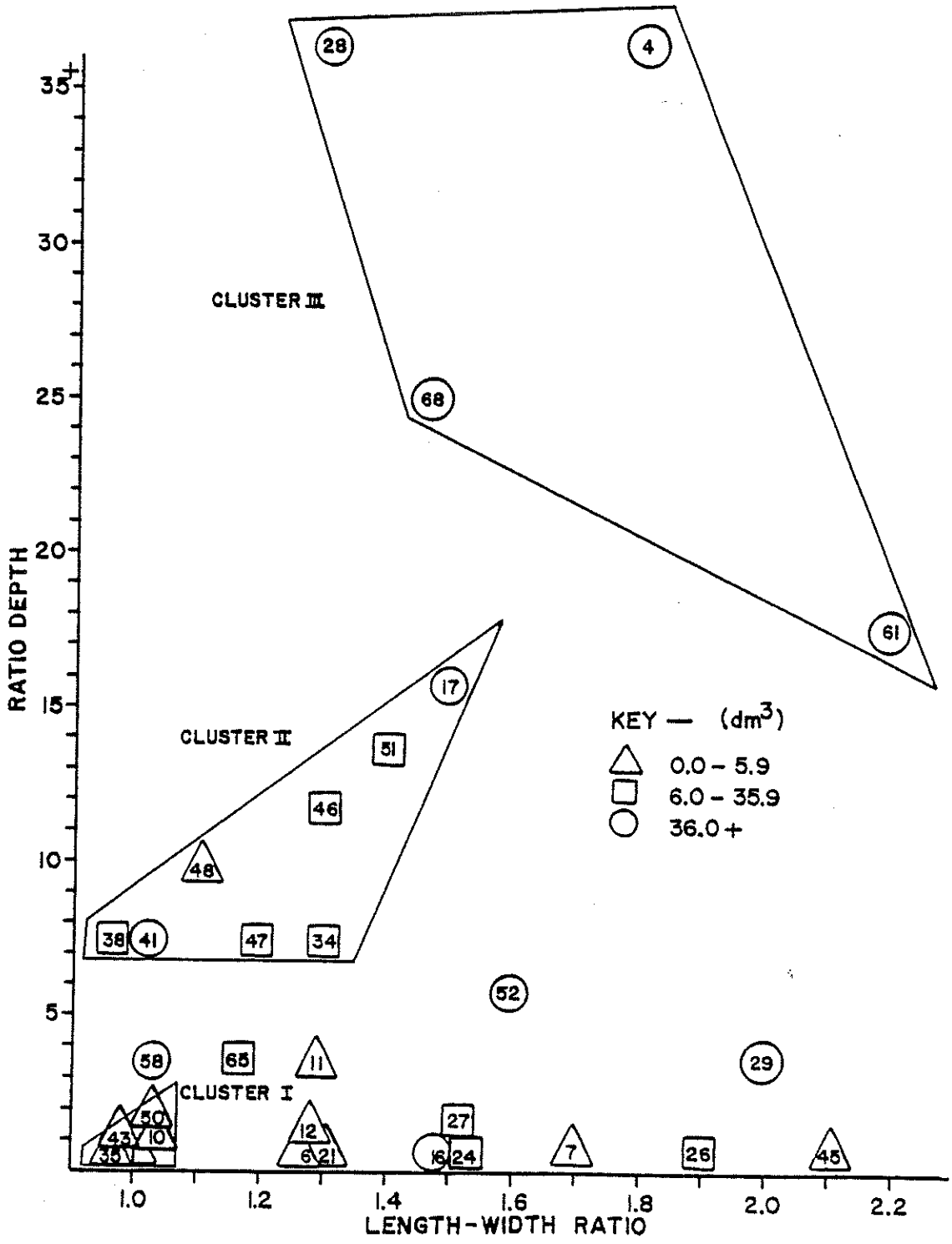


Figure 11.4: Scatterplot of the Fire-Associated Features

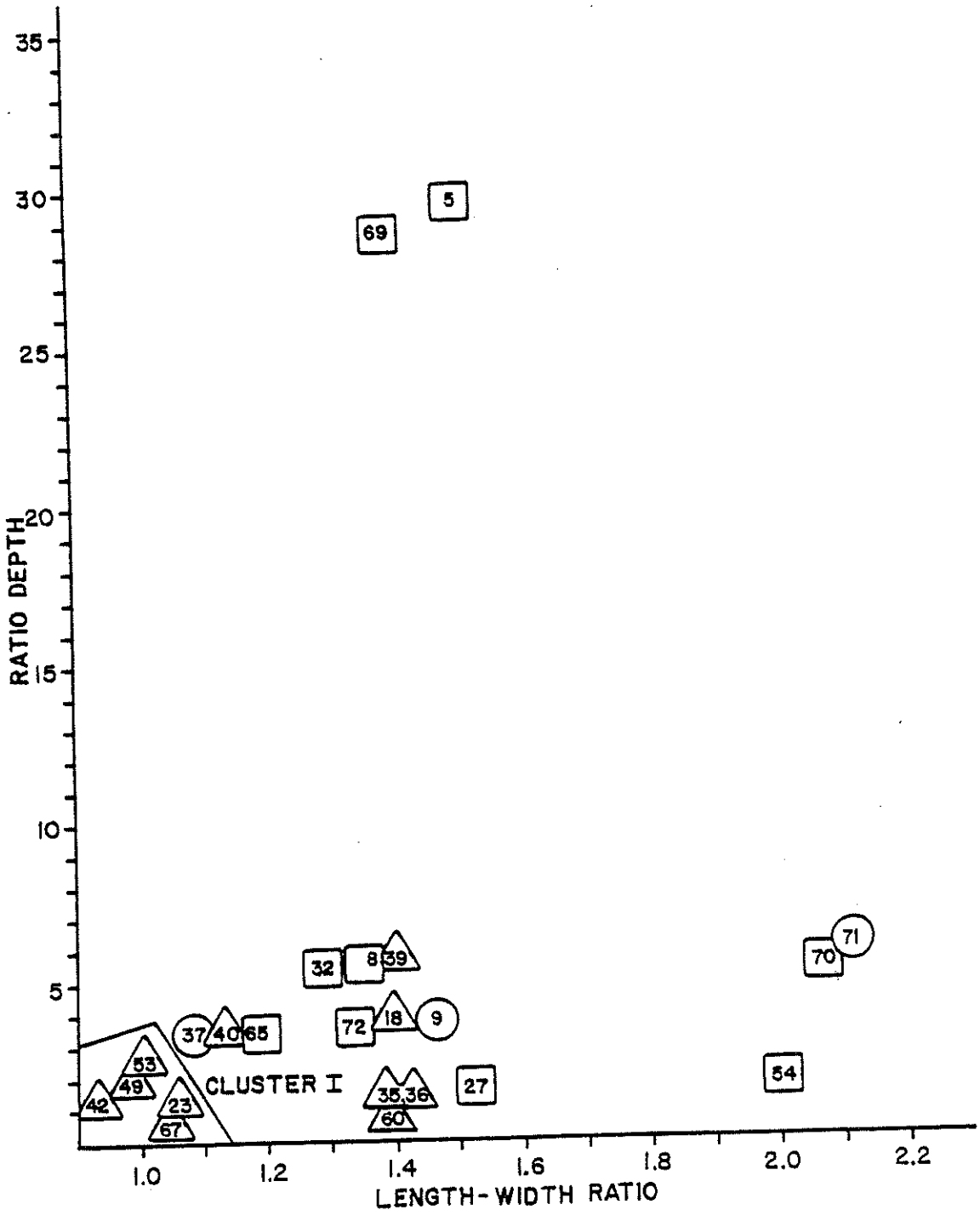


Figure 11.5: Scatterplot of the Features Not Associated with Fire

Table 11.2: Locations and Probable Functions of the 59 Fisher Farm Features Excavated in 1978

Probable Function	Feature Locations (Areas)					Off Terrace
	A	B	C	D	E	
Fire Associated						
Smudge Pits	35,40,50				1,10	
Hearths, Primarily Outdoor	34,38,41,47	46,51	48		17	
Smoking, Controlled Heat		61	28	68	4	
Domestic Heating, Cooking			7,21			
Limited Cooking					12	
Limited Cooking or Heating					11	
Roasting Pits		52,58		29		
Hide Smoking or Cooking	45,65		16,24,26		6	
Non-Fire Associated						
House Floor			8			
Caches, Other	42,49	53,67			23	
Midden ?			5	69		
Task Specific	39		18,27,32,33			
Storage, Small	36,40	60		70,72		
Storage, Large	37	54		71		9
Burials	66	55,56,57,59, 62,73				

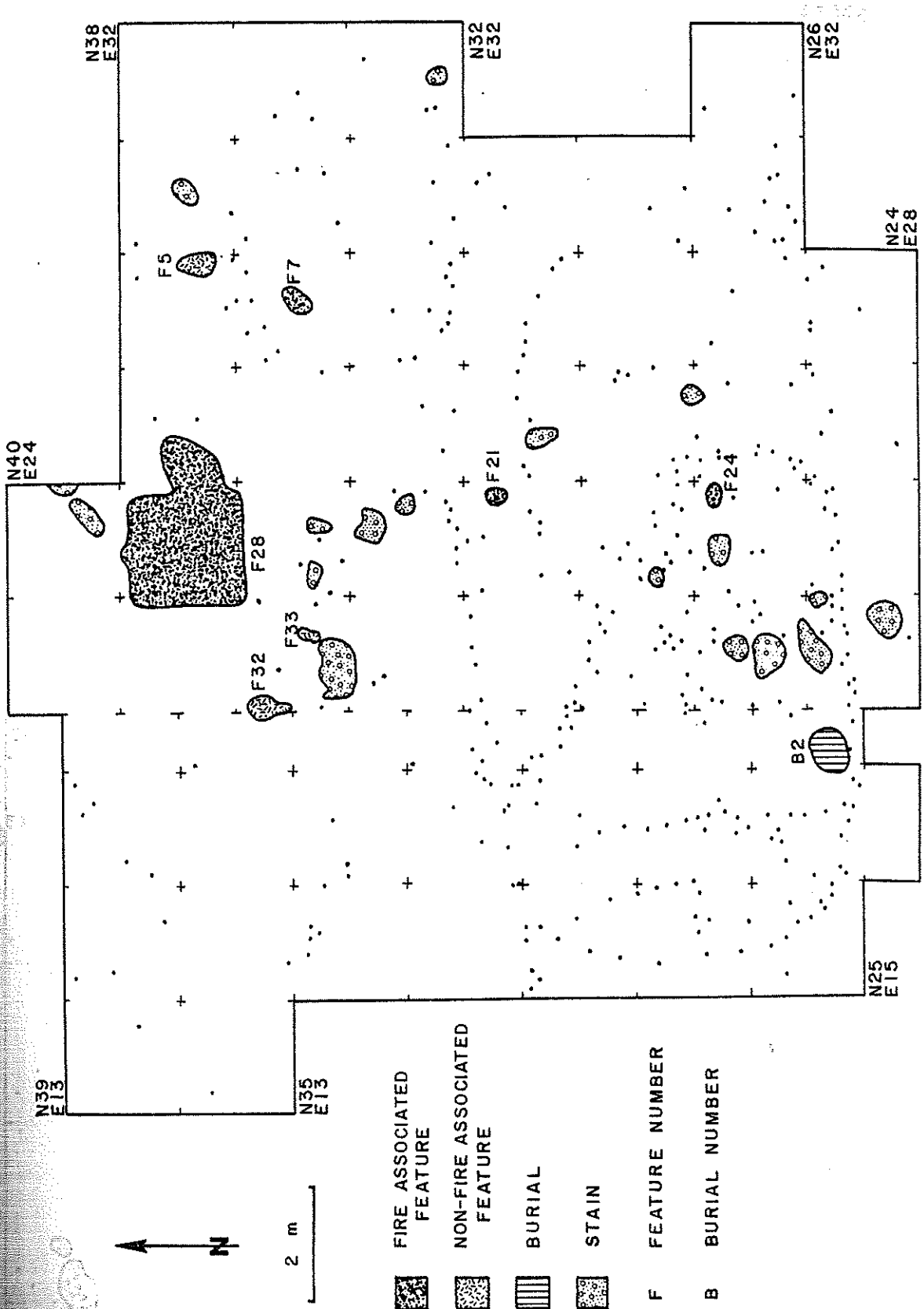


Figure 11.6: Features in Area C

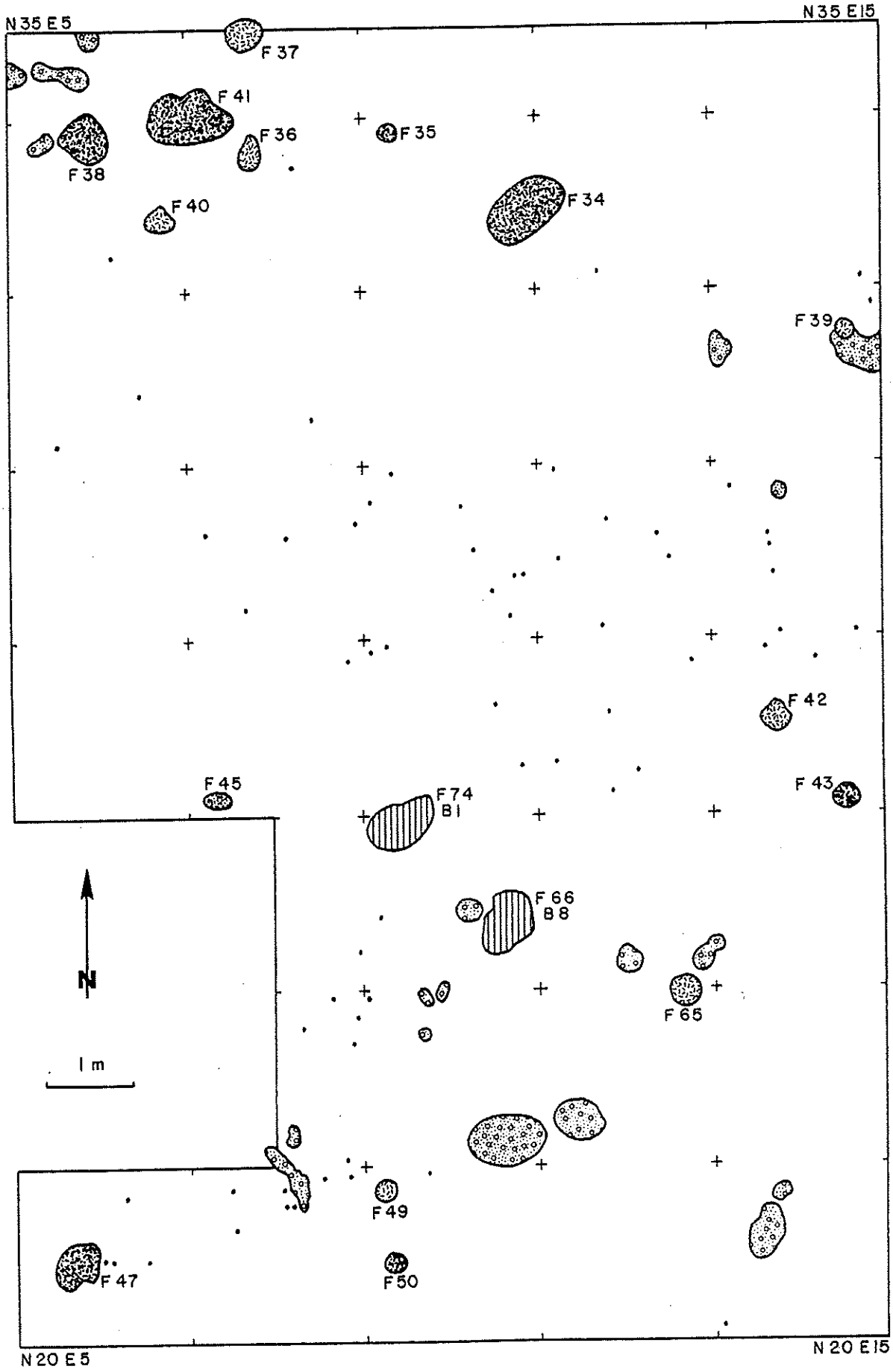


Figure 11.7: Features in Area A

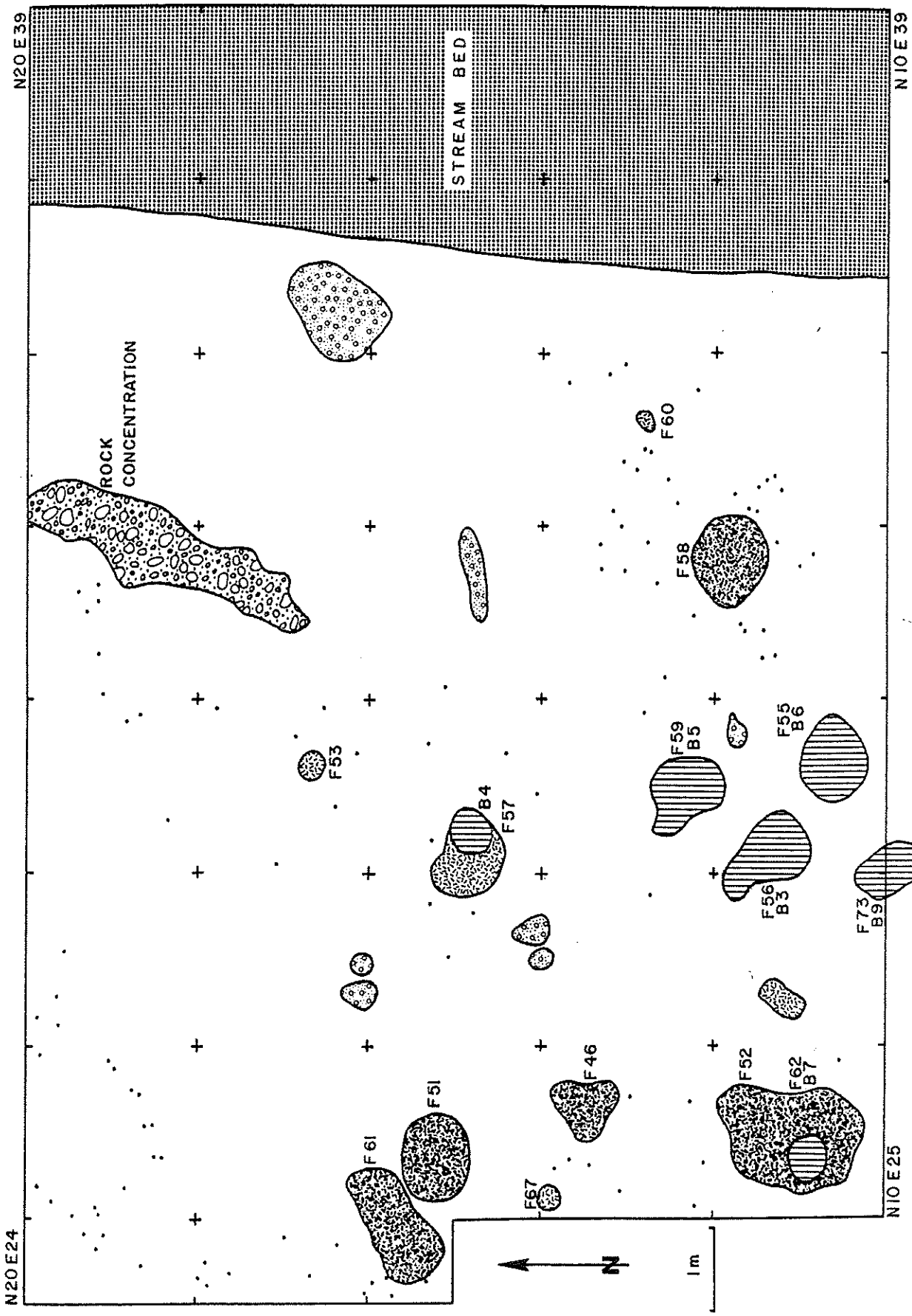


Figure 11.8: Features in Area B

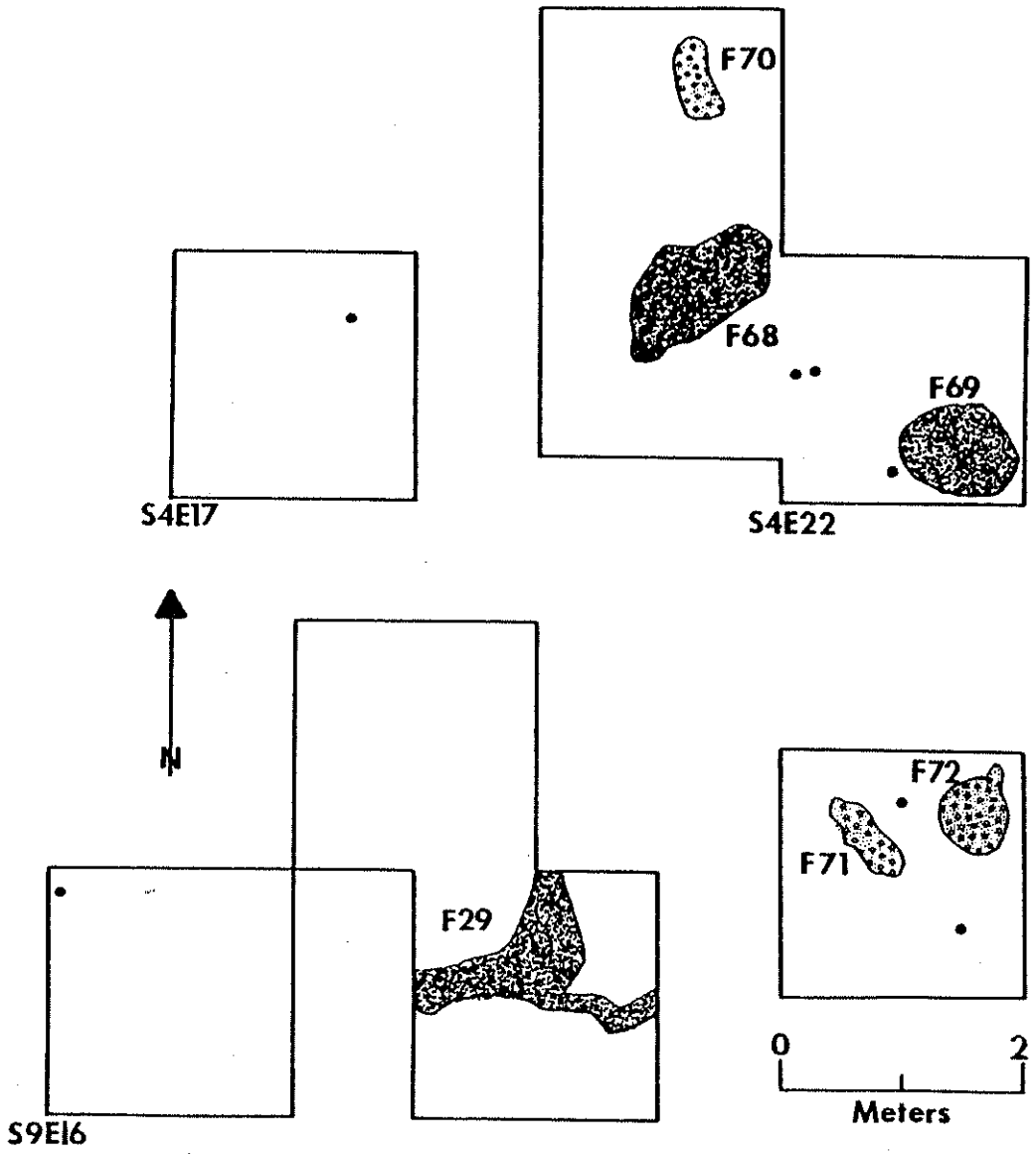


Figure 11.9: Features in Area D

Figure 11.9: Features in Area D

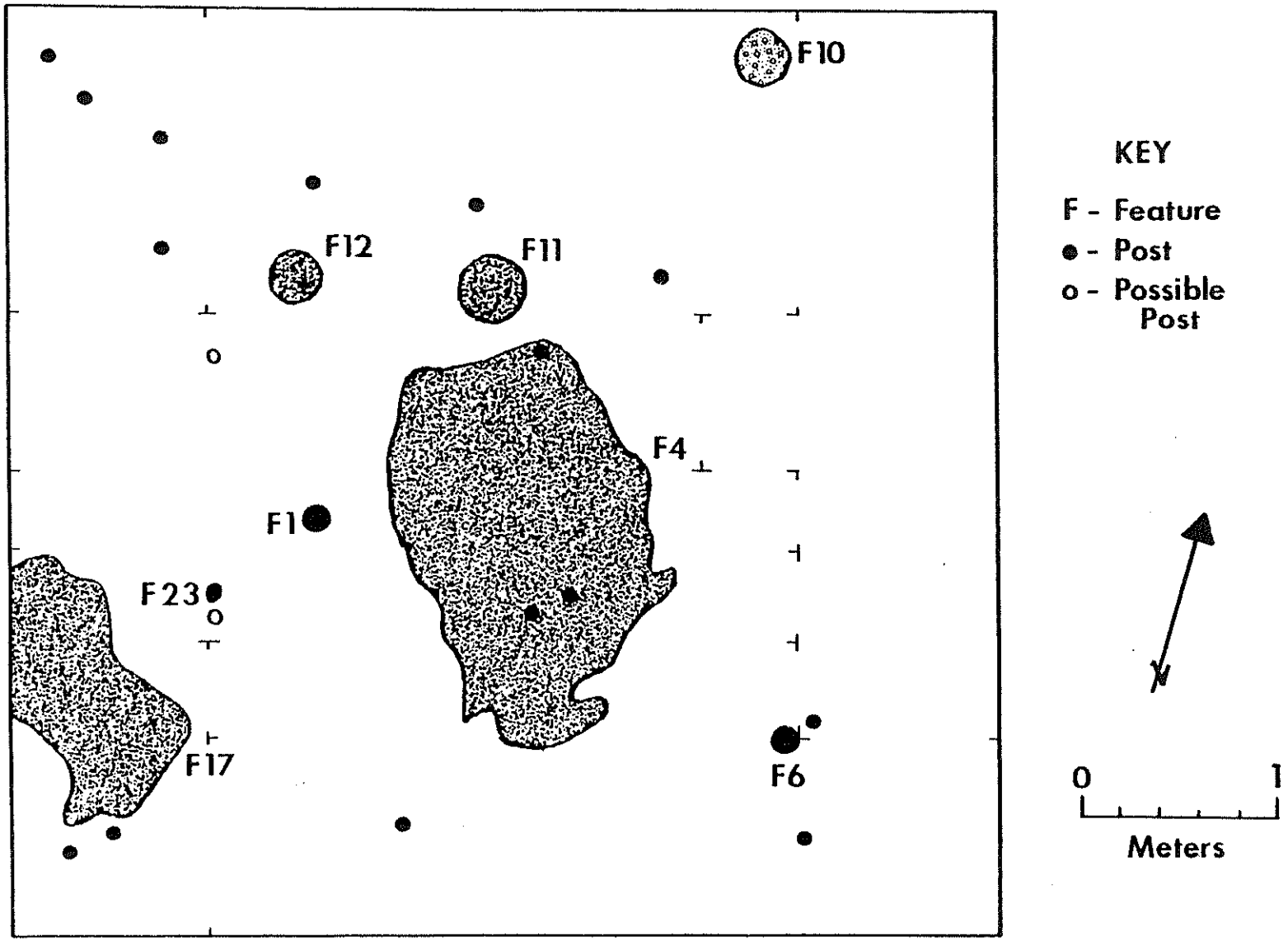


Figure 11.10: Features in Area E

A. FIRE-ASSOCIATED FEATURES

1. Cluster 1--Features 1, 10, 35, 43, and 50

These features are characterized by their round openings (the range in length and width is 13-25 cm) and proportionately deep profiles (ranging from 13-36 cm). Their overall volumes are quite small, from 0.9-4.0 dm^3. Stewart notes that "firepits which are small and deep are likely to be smudge pits for either pottery or hides" (1977:161). The ethnographic and archaeological reviews of organically rich, small, deep features by Binford (1967, 1972) and Munson (1968) which originally proposed these functional associations noted that such features tended to be located away from the principal living areas, that their shapes ranged from circular to oval, and that they were often filled with corn cobs, bark or other smokey fuels. While none of the contents of Cluster 1 have been analyzed, it is clear that concentrations of charred organic material are found in them and that they are away from the principal domestic zone in the central portion of Areas A and C (Figures 11.6 and 11.8).

This cluster represents only a subset of the features we will propose as smudge pits. More oval and elongated versions will be discussed below. It is interesting to note that of the two functions proposed by Binford and Munson, hide smoking may be more commonly associated with oval and elongated features of somewhat larger dimensions than we find in this cluster. Pottery-smudging pits, however, would seem to be necessarily circular and with orifice dimensions corresponding to those of the vessels being treated. We regard the vessel illustrated in Chapter 18 (Figure 18.10b) to be a common size for Late Woodland vessels in the Bald Eagle watershed, although there are some, like the Stewart pot found in Howard, that are considerably larger (Stewart 1933). The diameters at the mouth of each are 17.5 cm and 31.5 cm respectively; that is, approximately in the range of the feature diameters in this cluster.

2. Cluster 2--Features 17, 34, 38, 41, 46, 47, 48, and 51

These 8 features range from circular to oval (Length-Width Ratios from 1.0-1.5) and are both large and shallow. Their absolute dimensions are:

	MEAN	RANGE
Length	77.3 cm	37-125 cm
Width	53.1 cm	31-83 cm
Depth	6.9 cm	4-11 cm

Shallow, oval basins of this sort immediately suggest their use as hearths. Skinner's description of similar features among the Menomini suggests some interesting archaeological corollaries:

> In order to prevent flying sparks from setting fire to the house, an ever-present danger when the roofing of bark or mats is dry, a round basin-like pit is often dug in the floor to contain the fire. These holes, as observed by the writer, are about two and

> one-half to three feet in diameter, and six inches to a foot in depth. Sometimes stones are placed in them to act as supports for kettles....
>
> In some cases the fireplace is built up above the surface of the ground with small boulders. This is more commonly done when the fire is made outside, in warm weather, or when the camp is a temporary one.... In lodges in which no fireplace is dug, the reader should understand that the fire is made on the bare earth, with the occasional addition of several good-sized stones as supports for kettles (Skinner 1921:100).

If the features in Cluster 2 functioned as hearths we would expect them to contain:

1. fire-cracked rocks in small numbers,
2. botanical concentrations at the lower end of the "fire" distribution due to the high proportion of ash,
3. wood as the fuel rather than such smokey fuels as bark and grass.

All three of these attributes do indeed characterize this cluster. Fire-cracked rocks occur in 7 of the 8 features, in numbers ranging from 1-8. Botanical densities range from 150-820, with a mean of only 423. Finally, the identification of the floated contents of Feature 41 shows that the only aboriginal botanical material in it was wood (Table 11.3). The contents of Feature 48 were also analyzed but will not be discussed until Chapter 12. We regard Feature 48 to be a special purpose hearth related to the operation of a controlled heating facility used for smoking hides, meat, and drying foods and/or for ritual sweating.

Deleting Feature 48 temporarily, the recalculated mean dimensions of Cluster 2 are: length, 83 cm; width, 56 cm; and depth, 7.3 cm. The surface dimensions are in line with Skinner's description of Menomini hearths generally. However, the shallow depth of this cluster suggests their use as heat-irradiating facilities. As such, they would be more commonly expected outside of and away from domestic structures. If this pattern holds, then we need not be concerned about their being uncharacteristically shallow due to plow shaving.

Figures 11.6-11.10 show the distribution of Cluster 2 features and, as anticipated, there is some evidence of their being positioned away from the principal residential areas. We will therefore apply the generic term "hearths" to these features, knowing that the term embraces a number of functions related to intense lighting and/or heating.

Cluster 3--Features 4, 28, 61, and 68

The 4 features comprising this loosely defined cluster can be characterized as both large and quite shallow. Their individual dimensions are:

Table 11.3: Flotation Contents of Feature 41

Description	Weight (in gm)	Quantity	Burned/ Unburned	Percent of Total Weight
Rubus sp. blackberry	0.015	17	U	0.036
Acalypha rhomboidea three-seeded mercury	0.015	25	U	0.036
Viola sp. violet	0.085	85	U	0.202
Setaria sp. foxtail	0.008	9	U	0.019
Panicum capillare panic grass	+0.001	1	U	0.001
Unidentified Seeds	0.010	15	U	0.024
Charred Wood Chips	29.810	--	B	70.757
Burned Wood, Mod. Roots, Dust and Dirt	3.095	--	B/U	7.346
Modern Roots	3.495	--	---	8.296
Snail	0.001	3	---	0.002
Insect Parts	0.010	--	---	0.024
Flint Chips	0.990	4	---	2.350
Clay Balls	2.380	--	---	5.649
Stones	2.215	--	---	5.258

Feature	Length	Width	Depth
4	215 cm	120 cm	1-3 cm
28	298 cm	230 cm	7 cm (max)
61	140 cm	65 cm	6 cm
68	117 cm	80 cm	4 cm

Stewart indicates that such superficial heating facilities are ethnographically known to have been associated with campfires, fires for syrup manufacture, food drying and smoking, the sacrifice of dogs, bears, and humans, and divination (Stewart 1977:161), but an even greater number of prehistoric activities may have been connected with their use.

The possibility that Feature 28 served as a smoking/drying facility is explored in detail in the next chapter. Here we can say that layers of fuel connected with the generation of smoke were found filling the depression of a semi-subterranean structure that was clearly designed for controlling heat.

Feature 4 was similarly composed of layered grasses and wood chips. Also like Feature 28, maize, Polygonum, Chenopodium, and bone remains were found mixed with the burned fuel (Table 11.4). The heavy use of smoke producing grasses as fuel would appear to eliminate all the above ethnographic uses for the features except smoking and drying. Therefore, given its size, peripheral village location (Figure 11.10), and associated food remains, we will regard Feature 4 to be a drying/smoking facility. Without the clear shape and evidence for an enclosed superstructure like Feature 28, this feature must have been an open-air facility. Some combination of the several posts found in the area may well have served as a drying rack for foodstuffs during treatment.

Feature 61 also revealed fire-cracked rock and burned bone fragments in a concentrated matrix of charred botanical material. Unlike Features 4 and 28, this material has not been identified. Postmolds along the western edge of the feature may represent the remains of a scaffold or rack, but this is speculative. Given the density of organic material and the association of fire-cracked rock and bone with a shallow feature, we tentatively identify this feature, too, as primarily a smoke producing facility.

Feature 68, like the other features in this cluster, contained charred bone and fire-cracked rock. An alignment of posts for a small circular structure in this area predated the feature's construction. Considerable evidence for burning was seen in the zone surrounding the feature, indicative of the intense heat it produced.

These 4 features clearly reflect their use as heating facilities but their unusual size and dense concentrations of charred organic remains suggest their function was more than simply that of hearths. Some are associated with posts, while all contain fire-cracked rock, bone, and pottery. The clearest single functional association is that of smoking/drying, although that evidence is best for Features 4 and 28. Like the hearth category, these features are generally positioned some distance from the structure areas.

Table 11.4: Flotation Contents of Feature 4

Description	Weight (in gm)	Quantity	Burned/ Unburned	Percent of Total Weight
Zea mays corn	0.240	7	B	.208
Chenopodium sp.	0.007	15	B	.006
Polygonum sp. (lenticular)	0.003	4	B	.003
Acalypha rhomboidea three-seeded mercury	0.026	44	U	.022
Viola sp. violet	0.007	9	U	.006
Phytolacca americana pokeweed	0.005	1	U	.004
Physalis sp. ground cherry	0.011	26	U	.009
Setaria sp. foxtail	0.047	43	U	.041
Melilotus sp. sweet clover	0.002	4	U	.002
Rubus sp. blackberry	0.001	1	U	+.001
Ambrosia artemisiifolia common ragweed	0.002	1	U	.002
Unidentified Seeds	0.005	8	U	.004
Charred Wood Chips	48.470	--	B	42.017
Burned Grasses	13.560	--	B	11.754
Burned Grasses, Modern Roots, Dirt	25.595	--	B/U	22.187
Bone	0.025	3	B	.022
Modern Roots	7.060	--	U	6.120

Table 11.4 (Continued)

Description	Weight (in gm)	Quantity	Burned/ Unburned	Percent of Total Weight
Snails	0.002	5	U	.002
Insect Parts	0.075	--	U	.065
Ceramic Fragment	0.170	1	---	.147
Flint Debitage	0.345	9	---	.299
Clay Balls	19.670	--	---	17.051
Stone (crystal)	0.030	1	---	.026

The remaining fire-associated features at Fisher Farm, reordered in Table 11.5, fall into two major categories--small, deep facilities with fire-cracked rock, and generally larger, charcoal-rich features. The first category includes Features 7 and 21. Their oval shape and the presence of fire-cracked rock suggests their use as hearths, yet their deep profile and small size implies a well contained heating arrangement. Such a conservative design is expected in or around domestic structures where, depending on the structures' age and building material, they might be accidently ignited by sparks. As is seen in Figure 11.6, these 2 features do indeed occur immediately in the area of heaviest domestic activity at the site. Given their design it is probable they were used for heat and a limited amount of indoor cooking, more so than for light. A cluster of sherds found on a fragment of intact house floor (Feature 8) adjacent to Feature 7 supports this contention.

The second category is a diversified one in shape and probably in function. It can be divided into 4 somewhat distinctive morphological subsets. Feature 12 is a small, oval, medium depth feature with large amounts of woody fuel associated with it. This is the type of facility that one expects would commonly serve as a cooking facility for a limited number of people. The results of its flotation analysis tends to confirm this, since maize, Chenopodium, hickory nuts, and a number of bone fragments were all found in the feature fill (Table 11.6). Feature 11 may likewise be a somewhat larger version of Feature 12, although its unusual amount of debitage, beyond simply being a receptacle for village waste, may also relate to its function in stone tool manufacture.

Features 29, 52, and 58 are all large, basin-shaped facilities with concentrations of fire-cracked rock. Ritchie commonly refers to similar facilities in New York as "roasting pits" while Stewart regards them as large, stratified earth ovens. We believe the large number of sherds in 2 of these to also be related to their function since there is a great degree of consistency in their ceramic material and their numbers are unrelated to the size of the facility. If these features did serve as roasting facilities, then some evidence of what was roasted, and little else, would be expected in their fill. Flotation samples from Feature 29 and 52 have been analyzed and their contents clearly demonstrate that the roasting of Chenopodium took place in Feature 29 and the roasting of walnuts took place in both Features 29 and 52 (Table 11.7). Also as expected for roasting facilities, these 3 features are positioned some distance away from the principal domestic areas.

The final group of fire-related features are all oval, deep, small to medium in size, and have above average concentrations of botanical remains in their fill. Like Features 11 and 12, these would appear to be suitable for the preparation of meals for small groups of people, but the smoking of hides is certainly another possibility. Unfortunately, our best testing procedure, analyzed flotation samples, is not possible for these features as of publication. We can observe, however, that the distribution of these features is close to the principal residential area. This is the type of distribution we would expect if their purpose was that of small-scale cooking.

Table 11.5: Remaining Fire-Associated Features

Feature Number	Length-Width Ratio	Ratio Depth	Volume	Botanical Density	Fire-Cracked Rock	Chipped Stone Material	Ceramics	Bone
7	1.7	.7	3.0	?	Present	0	Present	0
21	1.3	.9	2.5	"Large chunks"	Present	0	0	0
12	1.3	2.1	5.0	"Bark and wood"	0	1	2	+
11	1.3	3.4	29.9	"Present"	3	16	14	+
29	2.0	3.0	57.5	?	15	3	172	0
52	1.6	5.3	111.9	670	18	0	196	+
58	1.0	2.8	1213.0	470	28	2	0	0
6	1.3	.9	27.3	"Charcoal laden"	1	0	0	0
16	1.5	.9	61.0	"Numerous pieces"	4	0	0	0
24	1.5	.8	16.4	"Throughout"	0	0	1	0
45	2.1	.7	1.9	790	0	0	0	0
26	1.9	.7	7.0	760	0	0	0	0
65	1.1	1.4	12.7	570	0	0	5	0

Table 11.6: Flotation Contents of Feature 12

Description	Weight (in gm)	Quantity	Burned/ Unburned	Percent of Total Weight
Carya sp. hickory	0.980	12	B	0.988
Zea mays. corn	0.065	1	B	0.065
Chenopodium sp.	+0.001	1	B	0.001
Physalis sp. ground cherry	+0.001	1	U	0.001
Viola sp. violet	0.065	75	U	0.065
Setaria sp. foxtail	0.002	2	U	0.002
Acalypha rhomboidea three-seeded mercury	0.004	6	U	0.004
"Grass seed"	0.001	2	U	0.001
Charred Wood Chips*	70.765	--	B	71.324
Burned Wood, Modern Roots, Dirt	26.735	--	B/U	26.946
Modern Roots	0.285	--	U	0.287
Bone Fragments	0.093	8	B	0.094
Snail	0.001	5	U	0.001
Insect Parts	0.002	--	---	0.002
Flint Chip	0.087	1	---	0.088
Clay Balls	0.130	--	---	0.131

*Note: This category contains a large amount of Charred Bark Fragments.

Table 11.7: Flotation Contents of Features 29 and 52

Description	Feature 29				Feature 52			
	Weight (in gm)	Quantity	Burned/ Unburned	Percent of Total Weight	Weight (in gm)	Quantity	Burned/ Unburned	Percent of Total Weight
Juglans sp. walnut	2.210	69	B	3.066	0.555	35	B	2.009
Chenopodium sp.	0.012	28	B	0.017	---	---	---	---
Rubus sp. blackberry	---	---	---	---	0.001	1	U	0.004
Rumex sp. dock or sorrel	0.001	1	U	0.001	---	---	---	---
Physalis sp. ground cherry	0.020	102	U	0.028	---	---	---	---
Brassica sp. mustard	---	---	---	---	0.002	4	U	0.007
Viola sp. violet	0.022	23	U	0.030	0.020	20	U	0.072
Acalypha rhomboidea three-seeded mercury	0.014	22	U	0.019	0.020	31	U	0.072
Setaria sp. foxtail	0.022	26	U	0.030	0.003	3	U	0.011
Plantago lanceolata	0.002	3	U	0.003	---	---	---	---
Unidentified Seeds	0.006	15	U	0.008	0.001	3	B/U	0.004
Charred Wood Chips	31.480	---	B	43.676	21.590	---	B	78.162
Burned Grasses	---	---	---	---	0.010	2	B	0.036
Burned Grasses, Burned Wood, Modern Roots, Dust, Dirt	6.720	---	B/U	9.323	2.450	---	B/U	8.870
Modern Roots	9.360	---	U	12.986	1.350	---	U	4.887
Snails	0.004	8	U	0.006	0.010	12	U	0.036
Insect Parts	0.045	---	---	0.062	0.010	---	---	0.036
Ceramic Fragment	---	---	---	---	0.120	1	---	4.344
Flint Chips	0.115	4	---	0.160	0.020	5	---	0.072
Clay Balls	21.945	---	---	30.447	0.110	---	---	0.398
Stones	0.100	3	---	0.139	1.350	---	---	4.887

B. NON-FIRE-ASSOCIATED FEATURES

The 29 non-fire-related features at Fisher Farm are difficult to evaluate functionally. There are a number of reasons for this. First, none of these features have had their flotation samples analyzed to date. Second, additional contents such as ceramics, debitage, and other materials are either entirely absent or occur in such low numbers that their implications elude us. Finally, since morphological characteristics are the basis for our functional hypotheses, that leaves only one remaining variable, spatial location, available to us for evaluating test implications. Unfortunately, ethnographic accounts traditionally say little about the spatial location of facilities not associated with structures.

The function of one non-fire-related feature is obvious. Feature 8 is the fragmentary house floor discussed above that surrounded Feature 7. Both features were found in the principal structure area. The survival of Feature 8 was coincidental, given that traces of all other structure floors had long since been destroyed by the plowing of Fisher Farm.

Cluster 1 of Figure 11.5 includes 5 features (23, 42, 49, 53, and 67), all of which have circular orifices, deep to moderate profiles, and small volumes. Stewart cites ethnographically documented facilities of similar form that were used in curing ceremonies, as caches, and as pot holders by northeastern groups, although other task-specific activities may also have used such features. One might suspect their use as caches would imply their being positioned near residences. Their distribution at Fisher Farm (Figures 11.7-11.8, and 11.10) implies a variety of functions for this category.

Features 5 and 69 are both large and very shallow features. Each had low botanical densities and a single artifact inclusion. We consider these to be either severely plow-disturbed features or, more probably, shallow pockets of incidental midden accumulation.

Five features have been grouped on the basis of their unusual sizes and shapes. Feature 39 is volumetrically the smallest feature found at the site, measuring only 27 x 20 x 5 cm. Features 18, 27, 32, and 33 are all low in botanical inclusions and, apart from some sherds, are devoid of cultural material. Feature 27 is sub-rectangular with a basin-shaped profile. Features 18 and 33 both consist of 2 joined pits forming an hourglass shape at the orifice. These facilities are felt to have been necessary parts of tasks that have left minimal artifactual trace. Whatever the nature of these tasks, it is clear from Figures 11.6 and 11.7 that their performance occurred in the immediate residential area.

Two final categories of features may have been used as storage facilities. Features 36, 40, 60, 70, and 72 are oval, with medium to deep profiles and small volumes. It is possible that they were simply the oval counterparts of Cluster 1, and that there was no functional distinction between them. The larger category, including Features 9, 37, 54, and 71 were probably caches for significant volumes of material. As Figures 11.7-11.8, and 11.9 indicate, they were usually placed some distance from the residential areas.

C. HUMAN BURIALS

With a single exception, the 9 burials excavated at Fisher Farm in 1976 and 1977 occur in 2 clusters away from the main area of domestic activity (Figures 11.6-11.8). As a group these features exhibit considerable variation in morphology, size, and contents. The volumes of Burials 3-9, excavated in 1977, range from 36-108 dm^3 while botanical density varies from 41-940 g/m^3. Fire-cracked rock and lithic debitage varies from 0-3 pieces and ceramics from 0-6 sherds per burial. An examination of Table 11.1 shows no significant covariation between any of these variables, implying to us that burial pits were expediently dug and were in part filled with refuse. No grave goods were directly associated with these burials.

D. STRUCTURES

A postmold-rich area containing only those features logically associated with domestic activities stretches across Areas A and C (Figures 11.6 and 11.7). There was no doubt in our minds during their excavation, nor is there any now in looking at the postmold configuration on these figures, that long sections of parabolically arranged postmolds were associated with single structures. However, sufficient "noise" exists in the several overlapping patterns and non-structure-related postmolds to prevent us from securely isolating any complete structure outlines. Ritchie (1973) has convincingly demonstrated a temporal trend in the Late Woodland architecture of New York from small, circular structures to large "longhouses." We believe this trend also holds for central and eastern Pennsylvania. Since several independent lines of evidence from Fisher Farm indicate that the terrace was occupied throughout this period, we suspect that the existing postmold pattern is a composite of a number of different geometric house forms.

E. A MODEL OF FEATURE-RELATED ACTIVITIES

With the information obtained from the analysis of the size, form, and contents of each feature and their spatial location, we can propose a general model for the distribution of activities at the Fisher Farm Site. Figure 11.11 schematically represents the distribution of each feature type in 3 "activity zones."

Zone I is characterized by small, deep hearths and ovens found within or adjacent to domestic structures. This area probably witnessed the most routine and frequent activities associated with daily life. The indoor hearths served as cooking fires and as sources of heat and light. Fires were small and self-contained in order to keep sparks and indoor smoke at a minimum.

Zone II is separate from but adjacent to the habitation area. Features are small to medium in size and are generally deeper than those of Zone I. Non-fire associated pits are indicative of small-scale storage, while fire associated features represent small-scale cooking. Special task features are also found in this zone.

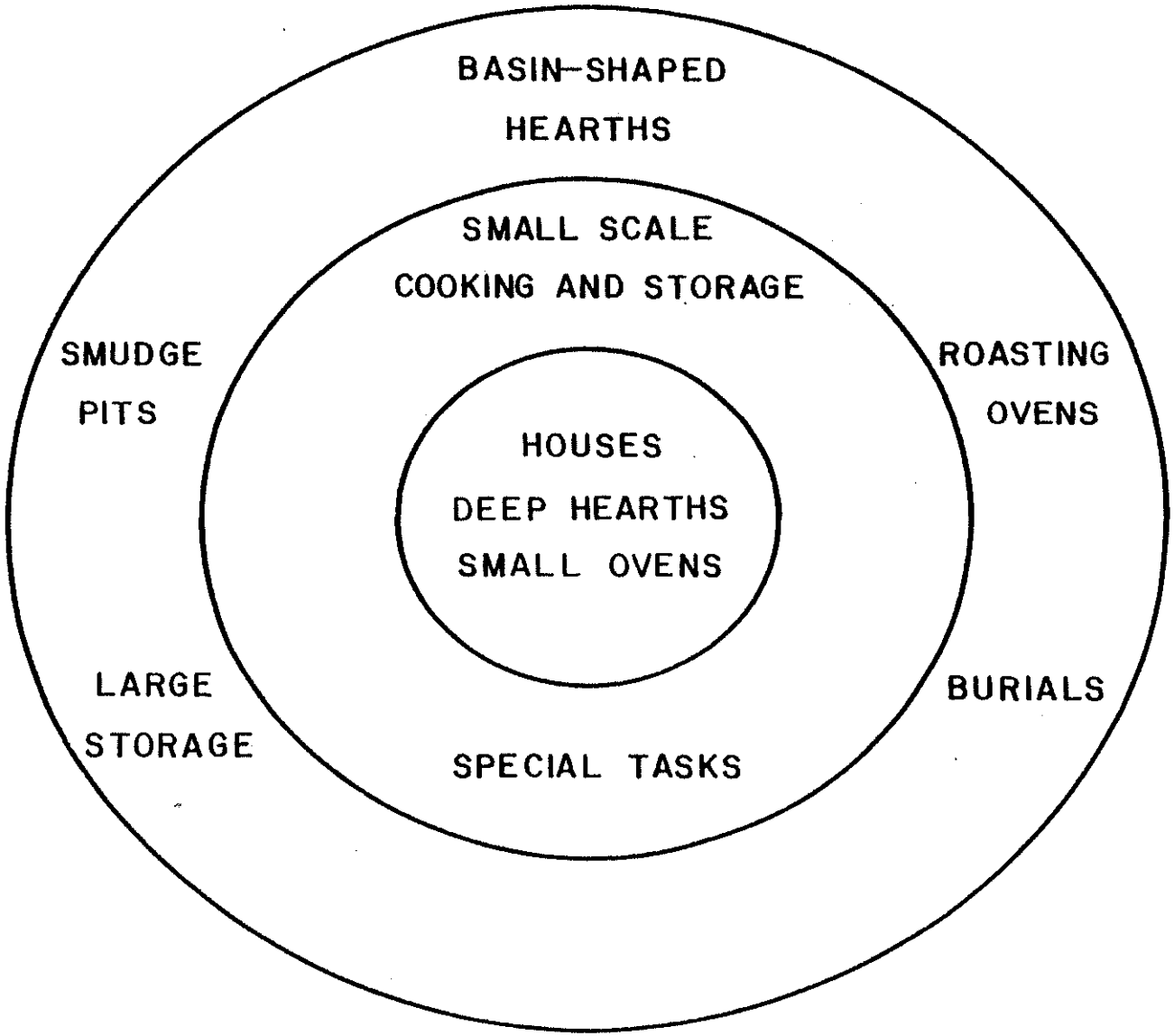


Figure 11.11: Activity Zone Model for Fisher Farm

In Zone III one finds smudge pits and basin-shaped hearths. Such features produce intense heat and/or large quantities of smoke and are probably associated with smoking and drying activities. Large storage pits, burials, and large roasting ovens also characterize this zone.

This pattern indicates that 3 variables were considered by the aboriginal inhabitants of Fisher Farm prior to the construction of any feature: size, frequency of use, and the amount of heat and smoke produced. Small, shallow features were preferred in or adjacent to houses over large, deep ones, presumably because they would be less likely to interfere with routine human traffic and activities. Frequently used features would also be preferentially located near areas of routine domestic activity. Finally, features designed for intense heating and/or smoking would be intentionally positioned away from domestic areas to avoid unwanted smoke and to minimize the accidental burning of structures.

The common sense nature of these generalizations and the clarity of the feature pattern that resulted from their application at Fisher Farm has two important implications. First, it reassures us that the methodology we used in assigning features to functional classes was an appropriate one. Second, it suggests to us a set of basic community design principles that should have wider application than simply Fisher Farm. We hypothesize that these same principles at least hold for all non-nucleated Late Woodland villages in the region. (Presumably concerns over the use of limited space in densely occupied and stockaded villages of this period would modify some or all of these considerations.) If this hypothesis is true, then the spatial principles discussed here can be used to help future excavators: 1) orient themselves with respect to other activity zones in the early stages of excavation, and 2) narrow the range of functional categories possible for spatially proximate features. These matters are of particular concern when only a limited portion of a site is being excavated and field strategies dictate small, scattered excavation units.

F. A REASSESSMENT OF PLOW ZONE INFERENCES

The results of the foregoing subsurface feature analysis provide independent data with which to evaluate the inferences concerning activity areas made in Chapter 9. These inferences were based on the spatial association of artifacts within the plow zone and a limited knowledge of feature size, distribution, and carbon content. Now that probable functions have been assigned to each feature, some modifications to these inferences are warranted.

The northwest corner of Area A was characterized as a processing/storage area on the basis of a cluster of 7 features (with and without significant carbon), 4 stains, and the association of high counts of bifacial tools in the plow zone. Of the 4 fire-associated features, 3 have been defined as shallow outdoor hearths used for intensive heat production. The fourth has been defined as a smudge pit. Two small and one large storage pit are also present. These data support the earlier contention that the cluster is a processing/storage area. We can qualify this further by stating that this area is probably associated with less

labor intensive subsistence or domestic tasks than are found in other portions of the site.

A zone of intensive processing is also present in the western one-third of Area B. High concentrations of all artifact classes were present in the plow zone, either directly above or close to this set of carbon-rich features. In addition to outdoor hearths this area contains 2 roasting pits, 2 caches, 1 smoke-producing facility, and a single large storage pit. Clearly a wide variety of activities, accompanied by intensive heat and smoke, were carried out here. The greater diversity of feature types, the higher botanical content, and the more remote position of this cluster from the structure area all suggest that more intensive processing was carried out here than in Area A.

The feature-stain cluster in the southern one-half of Area A, defined in Chapter 9 by high values for flint, jasper, lithic count, lithic weight, and low counts of bifacial tools within the plow zone, may be predominantly associated with the smudging of ceramics and/or the smoking of hides, although a variety of features are present. These consist of 2 smudge pits, a smoking or cooking facility, 2 cache/potholder facilities, and an outdoor hearth. This clustering of types is clearly different from that of the 2 feature clusters above. On the basis of these data we will go beyond our initial definition of the area and postulate it to have been largely used for hide working and/or ceramic preparation.

For the remaining 2 activity areas, the feature analysis does not require any modification of the initial inferences. Features 32 and 33 in the domestic activity area of Area C are non-fire features and were associated with special, but unspecified, tasks. Features 7 and 24 within the structure area were used for light cooking and heat generation and are compatible with interior use.

CHAPTER 12

THE SEMI-SUBTERRANEAN KEYHOLE STRUCTURE AT FISHER FARM--FEATURE 28

JAMES W. HATCH AND JOYCE DAUGIRDA

I. INTRODUCTION

The 1977 excavations at Fisher Farm uncovered a structure unique to the excavated portion of the site. The remains consisted of a roughly rectangular depression filled with organic and other debris as well as architectural elements of an associated superstructure. The formal attributes of the feature are comparable to many of those described for so-called "keyhole structures" (Smith 1976), "turtle-pits," and "teepee pits" (Dragoo and Lantz 1971, 1973, 1975) in Pennsylvania and New York. Although Smith prefers to interpret keyhole structures in this region as sweathouses, the remains of foodstuffs in seemingly primary context within some of them suggested to him their alternate or simultaneous use as drying/smoking facilities. Their architectural counterparts in the upper Ohio drainage, teepee pits and turtle pits, are known to contain concentrations of food remains as well as artifacts and they are routinely referred to as food storage/food preparation facilities.

Because a number of these structures have been found on Late Woodland sites and the determination of their function bears directly on the archaeological reconstruction of procurement strategies during this time, it is important to resolve this debate. With this in mind, we decided to completely excavate and float the rich organic contents of Feature 28. To date this feature remains the only one of its kind to have all of its contents saved and identified. As such, we feel it can contribute to the resolution of the functional debate.

II. FEATURE MORPHOLOGY

Feature 28 appears to be the remains of a domed or conical structure built over a shallow excavated depression (Figure 12.1). The feature was first discovered during the excavation of square N36E22. The dark, heavily carbonized remains filling the depression clearly demarcated the body and, to a lesser extent, the extension, from the surrounding orange subsoil. Given its position immediately below the active plowzone, it was assumed that the higher portions of it had been destroyed. It was obvious, however, that much of the structure remained intact, permitting an analysis of both its architectural details and its contents.

As the excavation of Feature 28 began, 4 quadrants were created to aid in the systematic removal of its organic-rich fill. Measuring along these lines, the maximum length of the feature, including both the body and extension is 2.20 m. Considering only the body, the feature is 2.25 m (east-west) and 2.13 m (north-south), again measuring along quadrant

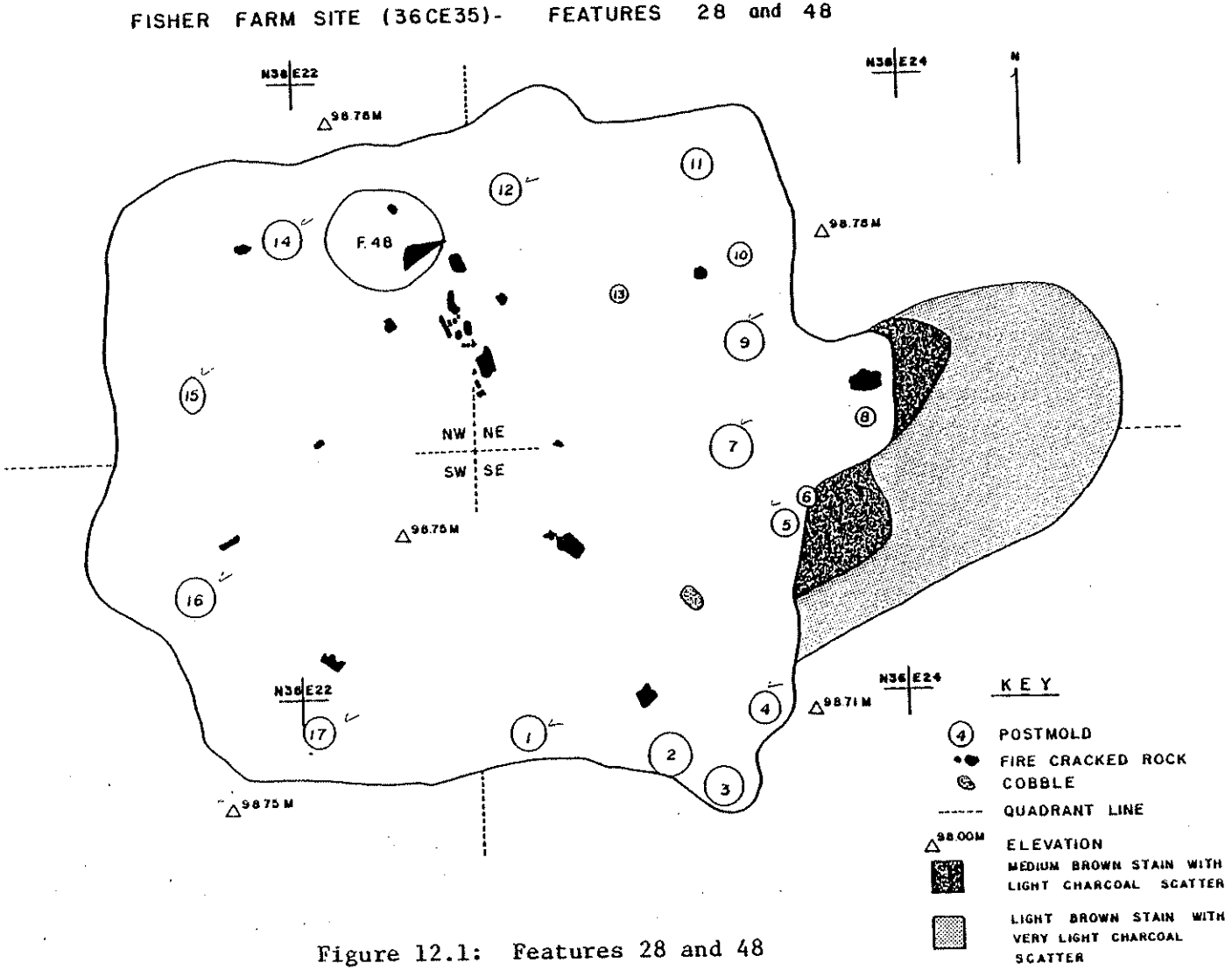


Figure 12.1: Features 28 and 48

lines. The width of the extension, measuring perpendicularly from the north edge, is approximately 0.83 m. The feature is oriented due east or, at most, a very few degrees north of east.

The profile of the depression is comparable to the idealized keyhole cross-section illustrated by Smith (1976) (Figure 12.2). While some of the better preserved examples of keyholes elsewhere in the area have an average depth of 30 cm, plow damage has effectively reduced the depth of Feature 28 by shaving its higher portions. Slight evidence existed for a raised step separating the body from the extension, a characteristic found in most keyholes.

Absolute elevations within the body are somewhat misleading, since the entire feature was built on a portion of the terrace with a slight southeasterly tilt. Over the width of the feature, the surface of the surrounding orange hardpan differs some 7 cm (Figure 12.1). However, elevations taken during the excavation in one of the deepest surviving portions of the feature showed a 7 cm difference between the uppermost portion of the organic layer and the base of the depression.

An interesting pattern is formed by the 17 postmolds found within Feature 28. All posts were located inside the body area. Ten of these postmolds (with average surface diameters of 11 cm and depths of 24 cm) were tilted at roughly 10° angles outward from the center of the body. The distribution of these 10 postmolds (Table 12.1 and Figure 12.3) formed a circle that no doubt comprised the principal support for the structure. The remaining 7 posts either 1) were related to the feature but not to the circular structural element, 2) were later architectural replacements or supports for the circular element, or 3) were in the feature by coincidence; that is, they pre- or post-dated its use.

A small burned clay hearth filled with ash (Feature 48) was found along the north wall of the body area. There is no question that the hearth was functionally a part of the structure; in fact, similar internal hearths or basins have been discovered in keyholes elsewhere (Smith 1976).

III. FEATURE CONTENTS

Five rectangular blocks of dark, organically rich fill were removed as control specimens from the body of Feature 28 (Figure 12.4). With the exception of a radiocarbon sample removed from one of the blocks, they remain intact today for future reference. Observations on the organic composition of their surfaces have been made, and all other material from the fill of the body area has been examined. Tables 12.2 and 12.3 summarize these findings. The items listed on Table 12.2 were three-dimensionally point provenienced and removed separately due to either their fragile nature or obvious interpretive value. The botanical items on this table are also included on Table 12.3 in their appropriate quadrant.

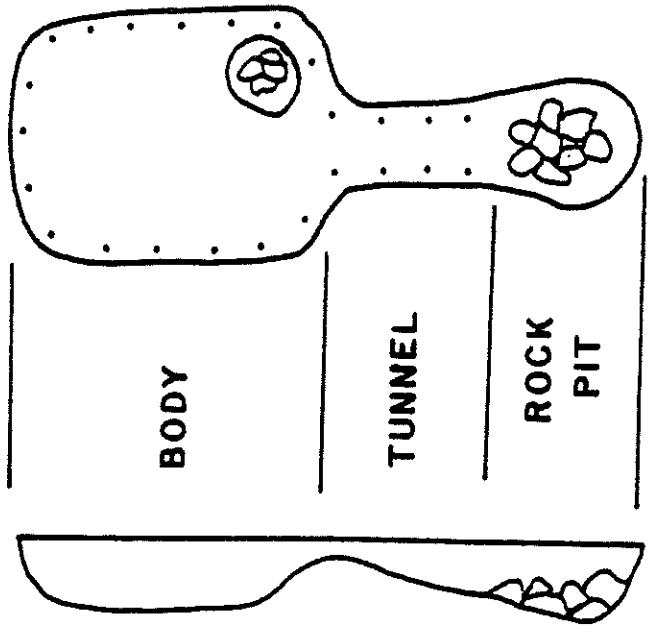


Figure 12.2: Profile of Idealized Keyhole (above) Versus Feature 28 (below)

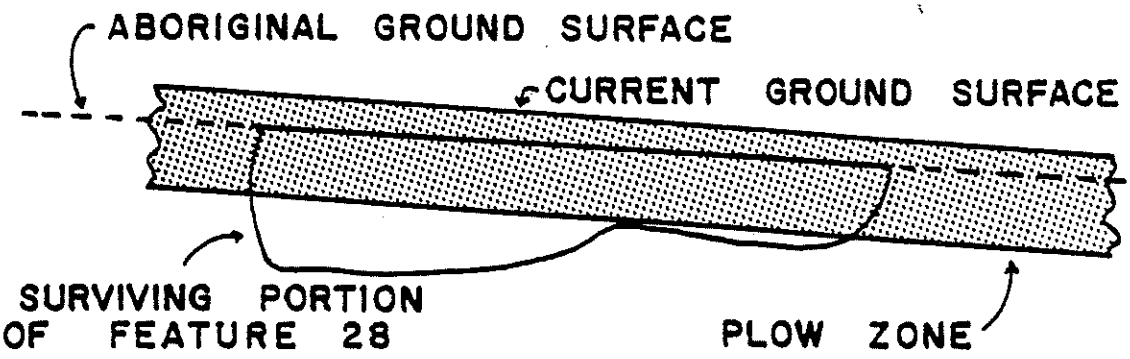


Table 12.1: Postmold Characteristics for Feature 28

Postmold Number	Diameter (cm)	Depth (cm)	Angled
1	11	13	X
2	15	rodent hollowed	
3	15	24	
4	10	24	X
5	8	30	X
6	6	16	
7	13	26	X
8	6	18	
9	12	23	X
10	8	6	
11	9	12	
12	11	24	X
13	5	1	
14	13	25	X
15	12	32	X
16	12	25	X
17	10	30	X

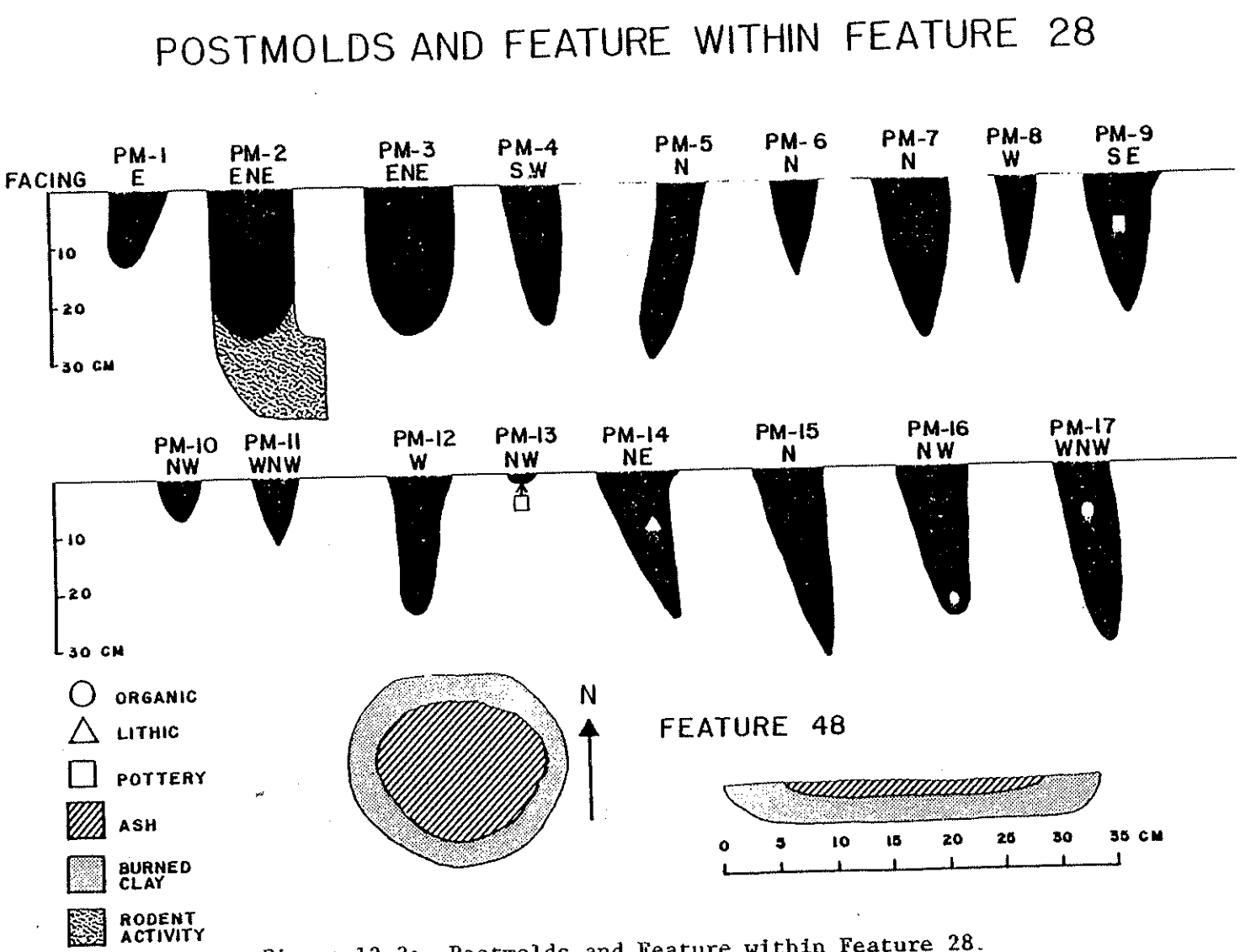


Figure 12.3: Postmolds and Feature within Feature 28.

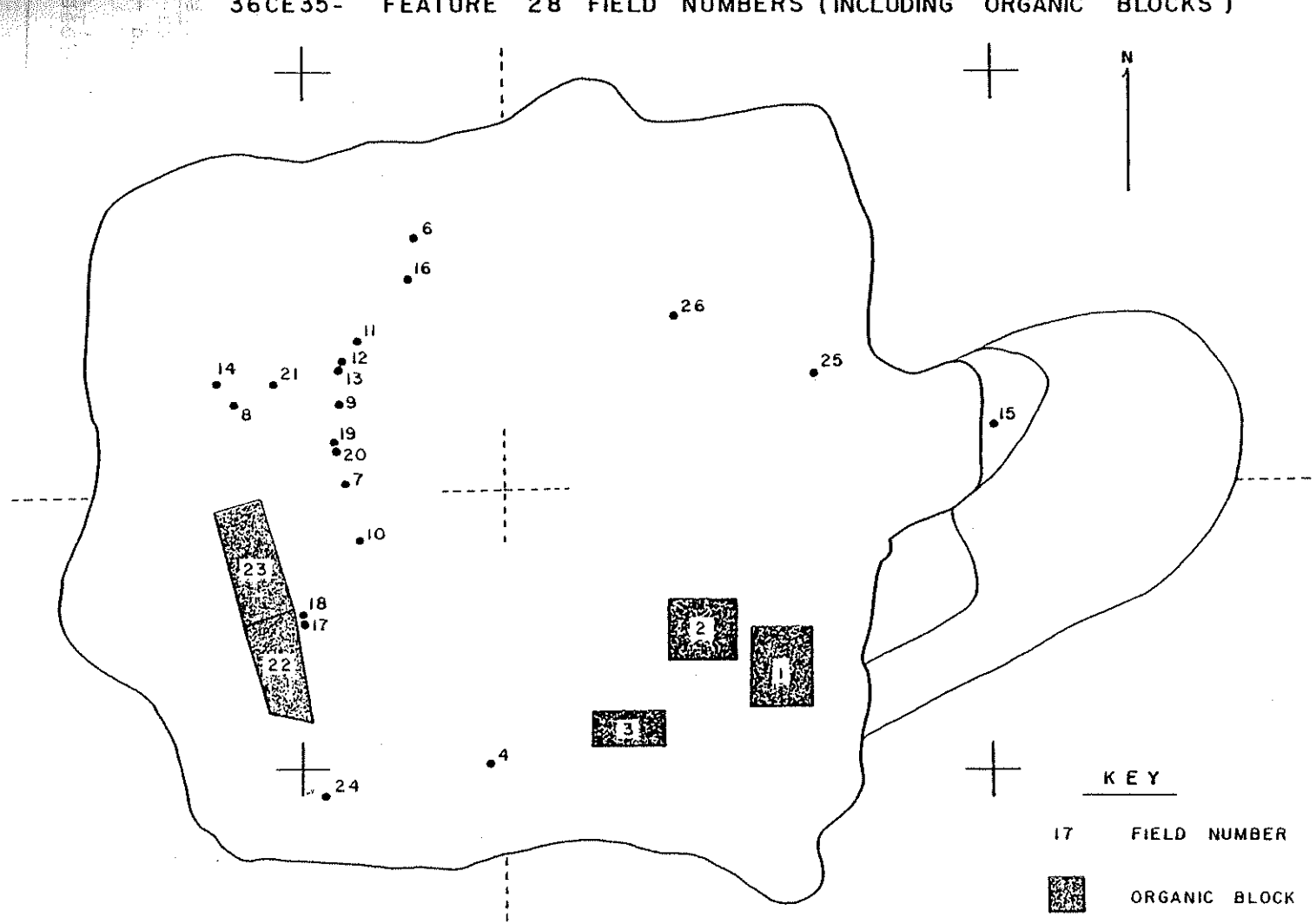


Figure 12.4: Locations of Field Numbers and Organic Blocks in Feature 28

Table 12.2: Field Number Provenience and Description--
Features 28 and 48

Field Number*	Provenience		Description
	Horizontal**	Vertical	
1		--	Block Organic Sample
2		--	Block Organic Sample
3		--	Block Organic Sample
4		--	Bark - unidentified
5	S.W. Quad--General	--	Shagbark Hickory Hull, Leaf Branch, Corn Cob
6		98.79	Rim Sherd - Shenks Ferry (see Figure 18.9 top, center)
7		98.74	2 Corn Kernels
8		98.79	Corn Stalk
9		98.75	Shagbark Hickory Hull
10		98.74	Body Sherd - grit tempered
11		98.80	Bone fragments - unidentified
12		98.76	Oak Seed
13		98.76	Body Sherd - grit tempered
14		98.79	2 Corn Kernels
15		--	Corn Kernel
16		98.75	Branch Fragment - 2 cm diameter
17		98.77	Marshgrass - horsetail "matting"
18		98.77	Marshgrass - cattail "matting"
19		98.76	Twig - 5 cm long, .6 cm diameter
20		98.76	Corn Cob, Corn Kernel
21		98.76	2 large wood fragments
22		--	Block Organic Sample
23		--	Block Organic Sample
24		98.69	Corn Kernel
25		--	Body Sherd - shell tempered - Postmold 9
26		--	Sherd - unidentifiable - Postmold 13

* See Figure 12.4.
** Unless otherwise indicated, see Figure 12.4.

Table 12.3: Botanical Remains in Feature 28 Quadrants and Feature 48

	NE Quad.	SE Quad.	SW Quad.	NW Quad.	Feature 48
SEEDS					
Zea mays corn	21[a] .530[b] B[c]	36 .580	98 1.700* B	16 .630 B	2 .070 B
Helianthus sp. sunflower	--	--	2 .006 B	--	--
Phaseolus sp. bean	--	--	1 .095 B	--	--
Curcurbita pepo pumpkin squash	--	--	1 .010 B	--	--
Polygonum sp.	160 .360 B	199 .470 B	322 .730 B	170 .386 B	3 .005 B
Chenopodium sp.	14 .004 B	48 .025 B	22 .020 B	32 .011 B	--
Physalis grandiflora ground cherry	1 ↓.001 U	--	1 ↓.001 B	--	--
Phytolacca americana pokeweed	2 .005 B(?)	2 .020 B	8 .065 B(?)	1 .001 B	--
Rubus blackberry	5 .005 U	23 .030 B/U	5 .005 U	8 .007 U	--
Ambrosia artemisiifolia common ragweed	--	--	5 .025 U	2 .003 U	--
Viola fimbriatuda violet	--	4 .010 U	6 .015 U	5 .005 U	--
Viola cutullata hooded violet	15 .020 U	24 .070 U	36 .095 U	41 .040 U	--

Table 12.3 (Continued)

	NE Quad.	SE Quad.	SW Quad.	NW Quad.	Feature 48
Setaria glauca yellow foxtail	1 +.001 U	--	2 .005 U	1 .001 U	--
Cyperus schweinitzii nut sedge	--	--	2 .005 U	--	--
Acalypha rhomboidea three-seeded mercury	25 .015 U	35 .020 U	56 .030 U	48 .025 U	--
Rumex dock or sorrel	--	--	1 +.001 U	1 +.001 U	--
Brassica kaber common mustard	--	--	1 +.001 U	--	--
Geum canadense white canada avens	2 .005 U	1 +.001 U	--	--	--
Cycloloma atriplicifolium winged pigweed	--	--	--	1 +.001 U	--
Oryzopsis sp. ricegrass	--	--	--	1 .001 U	--
Lactuca biennis lettuce	1 .003 U	--	--	1 +.001 U	--
Conium maculatum (?) poison hemlock	--	6 .005 U	--	4 .001 U	--
Unidentified seeds (burned, encrusted, and fragmented)	11 .008 B/U	2 +.001 U	-- .325 B/U	6 .005 B	--

Table 12.3 (Continued)

	NE Quad.	SE Quad.	SW Quad.	NW Quad.	Feature 48
OTHER BOTANICAL REMAINS					
Cornstalk fragment	--	--	--	1 .550 B	--
Corn Cobs	--	--	1 * B	1 * B	--
Nut hull fragments (probably hickory)	--	--	5 .075 B	--	--
Carya sp. hickory nut shell fragment	1 .020 B	6 .255 B	7 .430 B	13 1.095 B	--
Carya ovata shagbark hickory	--	--	1 * B	1 1.620 B	--
Quercus sp. oak	--	--	--	1 .015 B	--
Burned wood chips	-- 20.120 B	-- 10.970 B	-- 41.915 B	-- 41.080 B	-- 1.050 B
Burned pieces of wood	--	--	--	3 1.270 B	2 .050 B
Burned twig	--	--	--	1 .950 B	--
Burned grasses "marsh grass" and possible "horsetail" and "cattail"	-- .060 B	-- .970 B	-- 4.570* B	-- .280 B	-- --
Burned stem unidentified	--	--	1 .070 B	--	--

Table 12.3 (Continued)

	NE Quad.	SE Quad.	SW Quad.	NW Quad.	Feature 48
Burned leaf branch	--	--	1 * B	--	--
Burned wood and grasses	--	--	-- 4.030 B	--	--
Burned grasses and modern roots	--	--	-- 1.705 B/U	--	--
Burned grasses, modern roots, dust and dirt	-- 3.180 B/U	--	-- 5.510 B/U	-- 7.870 B/U	-- .430 B/U
Pine needles white pine (?)	--	--	--	--	-- .220 U
"Field Daisy" petals	--	--	24 .015 U	--	--
Modern roots, leaves, etc.	-- 1.800 U	-- 1.910 U	-- 3.150 U	-- 2.000 U	-- .300 U
Unknown Botanical Remains	--	--	5 .130 B	--	--

*Some samples were removed in block form and still remain in their clay matrix. Although specimens can be identified they cannot be weighed.

[a]Quantity.

[b]Weight in grams.

[c]Burned or Unburned.

A. BOTANICAL REMAINS

Although Table 12.3 lists all identified botanical specimens from Features 28 and 48, it is doubtful that all items are of aboriginal origin. Plow disturbance immediately above the fill of this structure along with frost cracking, insect activity, etc., has no doubt led to the occasional inclusion of more recent elements. To minimize the risk of including modern elements in this study, we have disregarded all unburned items. As is clear from the table, the majority of these items derived from weeds that flourish in seasonally abandoned agricultural fields--exactly the species of plants that populate Fisher Farm today and the types of elements we would expect to be intrusive in the feature. Ground cherry, pokeweed, and blackberry all showed variable evidence of burning and, although some were probably foodstuffs, they will be dismissed here.

Those elements that showed unmistakable evidence of burning and were therefore regarded as aboriginally associated with the feature can be divided into two groups--a food component and an architectural component. Eight types of food items were present: corn, sunflower, bean, squash, Polygonum, Chenopodium, hickory nut, and acorn. By weight, corn elements were the most important. One stalk fragment, 2 fragmentary cobs, and 173 individual kernels of corn were recovered. Hickory nut hull fragments were the next most important by weight. Those elements that could be identified by species were all shagbark hickory, a nutritious and common local variety (see Chapter 3). Polygonum seeds were third by weight, although most frequent in number. Chapter 14 discusses their potential and availability in some detail, as well as that of Chenopodium, the next most common food item. Squash, beans, sunflower, and acorns were all uncommon, but present. All of these items have long been known to have played important roles in the diet of northeastern prehistoric populations.

The architectural component comprises several categories of burned wood and grasses. Burned wood appeared in two forms--small wood chips, with the appearance of briquets, and larger, more intact branches. No elements suitable for structural beams were found, although such items are common in better-preserved keyhole and turtle pit structures elsewhere. It is possible that our briquets were burned and damaged beams, although we will offer an alternate hypothesis below. The grass also appeared in two forms--marsh grass and other, unidentified grass species. In the westernmost sections of the feature, where the fill of the depression was deepest and best preserved, the grass had the appearance of being aligned. Grass was seen to run parallel to the edge of the feature, while toward the center of the body it formed thin, perpendicular layers (Figure 12.5).

B. FAUNAL REMAINS

As has been discussed elsewhere in this report, bone was rarely preserved at Fisher Farm. The only fragments discovered were calcined and were usually associated with features exhibiting other evidence of fire. Two small fragments of bone were discovered at FN 11 in Feature 28

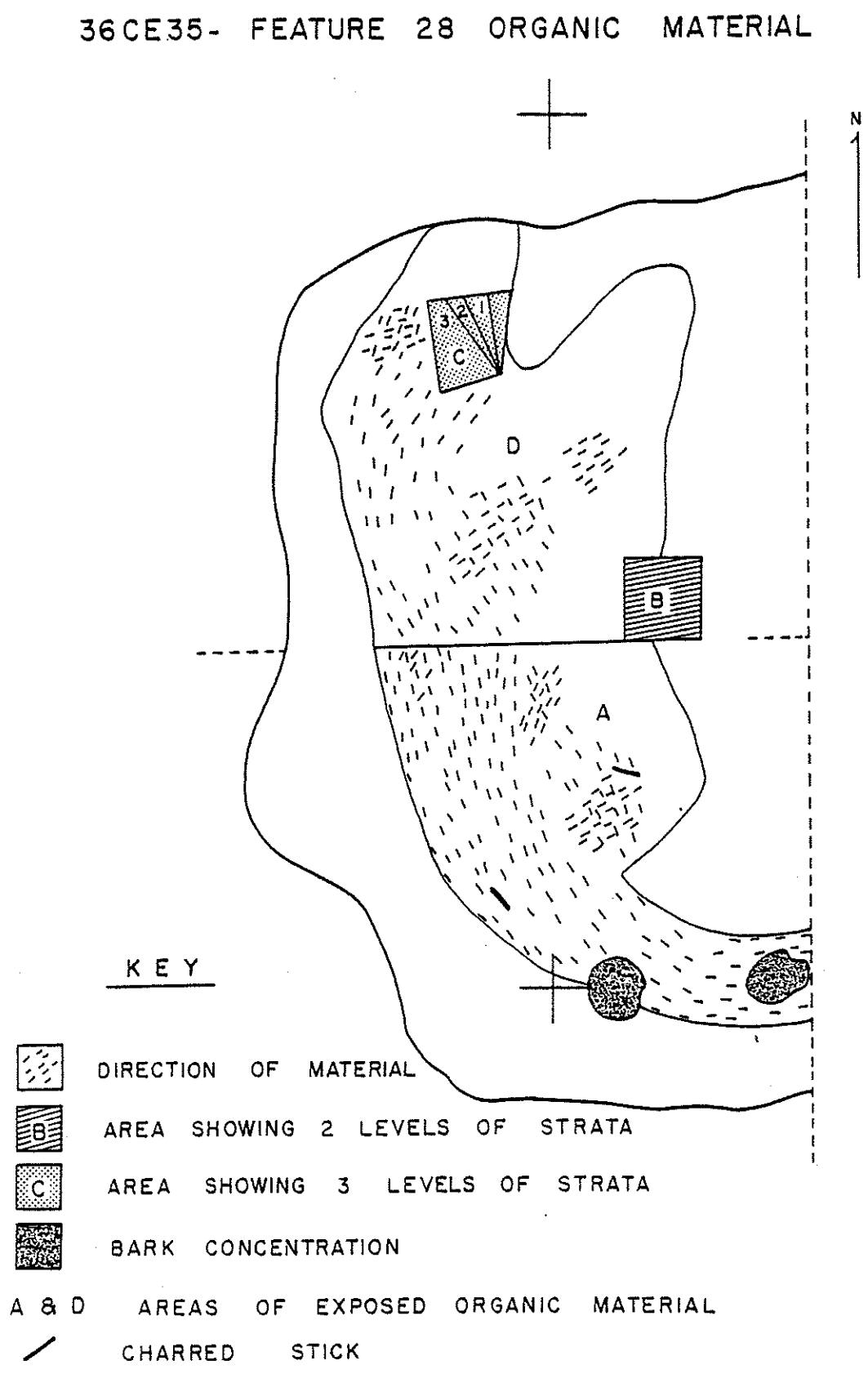


Figure 12.5: Patterning of Organic Material in the Western Half of Feature 28

(Table 12.2 and Figure 12.4). Both were too small to identify further.

C. CERAMICS

Five pottery sherds were associated with this structure; one in Feature 48 (FN 6), two in the fill of the body depression of Feature 28 (FN 10 and FN 13) and two in postmolds (FN 25 and FN 26).

The rim sherd in Feature 48 was the most important, given its context. Feature 48 was not discovered until all the fill from the northwest quadrant of Feature 28 had been removed, so there can be little doubt that the sherd, found lying immediately above the ash lens filling the hearth, was in primary context. Its typical Stewart Complex characteristics (see Chapter 18) were in complete agreement with the radiocarbon date of 1350±105 A.D. obtained from the body fill. The two additional body sherds from the fill were also grit tempered.

The two final sherds came from postmolds 9 and 13. It is doubtful that postmold 13 was, in fact, related to this feature. Its small size and isolated location suggests it may have existed prior to the digging of the body depression. The small size of the sherd in the postmold's fill precluded even temper identification. However, the sherd in postmold 9 was shell tempered. As discussed in Chapter 18, such sherds were predominately associated with the later phases of occupation at Fisher Farm. Its presence here was assumed to be a result of filling sometime after the uprooting of post 9. This action was associated with the destruction of Feature 28.

IV. THE FUNCTIONAL DEBATE

The functional aspects of Feature 28 and structures like it throughout Pennsylvania and New York can now be addressed. Up to now the accepted means of verification in the functional debate has simply been the inventorying of ethnographic analogs. Smith (1976), for example, apparently selects the sweathouse option over that of smoking/drying solely on the basis of his review of the ethnographic record. However compelling analogic arguments of function may be, there can be no doubt of the primacy archaeological characteristics must take in the decision-making process. In this particular debate, we again seem to have encountered a situation like that of the "smudge pits" and "hide smoking" controversy of Binford (1967, 1972) and Munson (1969), wherein alternate hypotheses regarding the same class of features were proposed and the researchers offered convincing evidence in support of each.

A. STRUCTURAL CONSIDERATIONS

Smith lists several features of keyhole structures that we believe hold for Feature 28.

1. External coverings of tightly woven grass thatch, sealed with an earth embankment at the base.

2. Long, narrow entryways, some with indications of an earthen sill at the body juncture.

3. Piles of fire-cracked rocks at the entrance (suspected for Feature 28 prior to plow disturbance).

4. Fire-cracked rock concentrations in the body of the structure.

5. Peripheral community placement (1976:11).

Given this list, there can be no doubt that these structures served as controlled heating facilities. The tightly woven or packed grass covering clearly prevented unregulated heat loss. The earthen embankment, in conjunction with the semi-subterranean interior, probably served as an effective seal against drafts at the base of the structure. The entryway sill acted as a barrier to heat loss from the body area. Fire-cracked rock clearly served as the heat source, with rock piles at the entryway both heating air as it moved into the body and serving as a source for additional heated stones for the interior. The location of these facilities away from the primary domestic areas was no doubt due to the danger of fire during their use.

The implications of 3 other characteristics of keyhole structures proposed by Smith are much more argumentative. Building off of the sweathouse notion, Smith regards the high incidence of burning in these structures to be ceremonial in nature, not the consequence of normal use. How one can test this assumption is not specified. He also suggests that the predominately eastward orientation of these structures has "possible ceremonial implications" (1976:11). Here we could alternatively propose that the regulation of heat in the body of these structures was dependent on air intake through the entryway and their orientation toward the east, away from the prevailing westerly wind directions, would facilitate this control. One could test the proposition that those keyholes with entryways oriented in other directions were responding to local air-flow patterns, rather than unexplained religious deviations.

Yet another problem concerns the use of the entryways. Several examples show supporting posts located in the middle of the entryway at the body juncture, blocking free access. Feature 28 is one such example (Figure 12.1, postmold 7) as is the Ramm Site keyhole illustrated by Smith (1976:5, Figure 5). In these cases some other entrance directly into the body must have existed.

B. CONTENT CONSIDERATIONS

The most serious problem with the sweathouse hypothesis is that of the structures' contents. Smith characterizes these features by their "absence of cultural debris" (1976:11). Reconsidering the keyholes on which his analysis was based, the seemingly comparable teepee and turtle pit features of western Pennsylvania, and Feature 28 at Fisher Farm, this statement is inaccurate. As stated earlier, Feature 28 is the only one of its kind to have been fully floated and analyzed. It is evident from our earlier discussion that substantial amounts of food remains were

discovered in it. These were distributed throughout the layers of grass and burned wood in the fill, not simply on top. Thus, we feel their context to be functionally relevant and not just one of secondary discard. For the Parker Site keyholes Smith (1973) describes fire-cracked rocks accompanied by, among other things, ceramics, grinding and pounding equipment (such as hammerstones and milling stones), and such foodstuffs as charred elk mandibles, corn kernels, and cobs. A series of well preserved turtle pits in Cattaraugus County, New York reported by Dragoo and Lantz (1971, 1973, 1975) similarly include charred corn and calcined bone along with stone tools and debitage, pottery, pounding and grinding equipment, and large quantities of fire-cracked rock. A single structure at 30 Ca 35 contained both mortar and pestle. The coherency of this material, especially the food remains and processing equipment, must be regarded as the expected assemblage for structures of this type. Although Feature 28 at Fisher Farm did not exhibit the tool assemblage common to the others, its high density of foodstuffs must be considered paradigmatic because of the flotation.

C. ETHNOGRAPHIC CONSIDERATIONS

A search through the ethnographic literature conducted independently by Smith (1976) and the authors shows that both ritual sweating and the smoking and drying of foodstuffs were quite common practices in aboriginal North America. Sweating was often carried out in casually made facilities--cavities in the sides of stream banks among the Narraganset, or blankets tossed over a framework of poles inside or outside the house among the Ojibwa. However, one type of facility found in isolated areas through the Southwest, Northwest, and Northeast bears a number of strikingly similar features to keyholes:

> The foundation of this structure may be quadrangular or round. Never did it lack the permanent, often depressed, fireplace approximately in the middle of the room, and the double entrance: a hole in the roof, as the main door, and a narrow opening in the level of the floor, connected with a perpendicular shaft or an inclined tunnel. The latter was used as a door only in special cases, at all other times only to bring in the wood for the fire or...as a ventilator (Krickeberg 1939:20-21).

In many of the same groups that practiced sweating, smoking in prepared facilities was also carried out. Three different structures are commonly described for the processing of meat--racks, smokehouses, and enclosed caches. Racks were primarily used for drying meat, that is, ridding the meat of excess moisture, volume, and weight. Sun drying was sometimes sufficient, although smokey fires were often built under the racks. The benefits of smoking, beyond those of drying, derive from both the impregnation of the meat with chemical preservatives that inhibit bacterial growth as well as the coating of the meat's surface with woody residues resistant to insect infestation (Desrosier 1970:264). Considerable time seems to have been necessary to properly smoke meat over

outdoor fires. Smokehouses were employed when time was not so available (when the group was on the move or the weather was variable) or when long periods of storage were necessary before consumption and a thorough preservation was crucial. Outdoor drying was often supplemented by indoor smoking. Among the Northern Saulteaux of eastern Canada, Skinner reports:

> When traveling and there is no time to cure meat thoroughly, a grill of poles is built and the fire made under it, but this does not cure meat well. Sometimes meat is smoked on a scaffold or grill, built over the fireplace beneath the smoke hole. This is especially the case in the two-fire lodges (1912:133).

Both techniques were regularly used by the Hare of northeastern Canada:

> Frames for drying fish and smoke houses are built in the camps when the Indians are on the move to collect food, for the curing of meat and fish (Hurlbert 1962:33).

The Tlingit of British Columbia are said to have protected drying meat from the rain and direct sun with green branches but in wet weather may have finished the job of drying over an indoor fire (Krause 1956:121). However, Olsen tells us that "in front of each house, near the waters edge, was a smokehouse...." (1967).

Compared to sweathouses, very few architectural descriptions of smokehouses are available in the ethnographic literature. This may stem from an early ethnographic preoccupation with activities connected with personal ritual or ceremony and a corresponding de-emphasis of common economic pursuits. We do find, however, Olsen's (1967) comment that in 1933 the Tlingit smokehouses "...were the only buildings constructed in the old manner with posts, beams, and adzed planks."

Storage facilities for processed food were even more variable, ranging from deep subterranean caches to tree top scaffolds. Yet occasionally these too took on forms analogous to keyhole structures. The Micmac, for example, had "...an oblong structure, susadi, in which wood was kept and meat hung, (which) was occasionally built adjoining the wigwam at the entrance...." (Wallis and Wallis 1955:60). Also, Swanton's citation of Lederer describes the Eno of North Carolina as having storehouses. "To each house belongs a little hovel made like an oven, where they lay up their corn and mast, and keep it dry" (Swanton 1946:380).

D. DISCUSSION

We, of course, should not preclude the possibility of multiple functions for these structures. Krickeberg reminds us that "the bath frequently takes place in houses which are also used for other purposes. Thus, for instance, in Northwestern California, among the Yurok and Hupa, it takes place in the house which serves the men and grown youths for work, relaxation, sleep, or social intercourse" (1939:20). The important point

here is the complementary design elements of Feature 28, and keyhole structures generally, to either sweathouses or smokehouses, and the strong possibility that either could also have served as storage facilities for processed food and processing equipment.

We do need to consider one final piece of evidence from Feature 28, however. During the excavation of its fill, tightly compressed strata were seen in several of the better preserved sections. One area in the northwest quadrant exhibited the particularly clear separation of three strata (Figure 12.4). A block sample of this area was removed and shown to Dr. Carl Keener, Associate Professor of Biology at The Pennsylvania State University. His informal report was provided to us prior to the senior author's discussion with him of the alternate hypotheses concerning the use of the structure.

Keener identified the three layers of botanical material as primarily consisting (from bottom to top) of 1) layered grasses (unidentified), 2) wood chips, and 3) layered marsh grass. In association with heated sandstone rocks, Keener proposed this stratigraphy to be a prepared bed for the generation of heat and smoke. The first layer of grass and the wood chips were seen by him to generate a great deal of heat but, if left alone, would soon ignite and burn out of control. The uppermost layer of marsh grass was seen as the dampening agent. Marsh grass is known for its high silica content, and a layer would insure that neither it, nor the more flammable materials below, would readily ignite. Clearly such an arrangement would not be used on the floor of a sweathouse.

The important question here is whether these strata represent intentional layers on the aboriginal floor or a single layer of grass on the floor of a facility whose structural supports (our wood chips) and external cover (marsh grass) burned and collapsed inside. This is impossible to answer for Feature 28 and difficult to answer from the existing information of similar excavated features. Smith's description of the Parker Site keyholes describes several superimposed layers of charred marsh grass (1973), while Dragoo and Lantz have encountered between 2 and 6 strata in the turtle pits of southwestern New York. Some of these latter strata clearly represent post-structure fill; however, relevant structural layers are always found below. We propose that a careful reanalysis of existing feature information should be undertaken. Additionally, we propose that flotation should be carried out on all future discoveries of this sort along with the removal of reference stratigraphic blocks.

V. A CULTURAL FRAME OF REFERENCE FOR KEYHOLES AND TURTLE PITS

Most of the features discussed in this chapter have been discovered in northern Pennsylvania and southern New York in an area extending from the North Branch to the Allegheny River. Incorporating both glaciated and unglaciated components of the Allegheny Plateau, this area was regarded in colonial times as superior hunting territory for deer, elk, and many other species. Given the existing evidence for growing Late

Woodland populations and increasing tribal interaction in this area, its regular exploitation in late prehistoric times must be assumed. Herbstritt's recent survey and excavation of rock shelters in portions of the Allegheny Plateau (1977) has located numerous Late Woodland hunting camps, while his discovery of large, late Late Woodland palisaded villages with keyhole structures located in high upland settings suggests significant population pressure during this episode. Intensive deer and elk exploitation in the form of collective drives, stalking, deadfalls, and traps, so common in the ethnographic records of northeastern and Great Lakes groups, should also be expected here.

If the careful reexamination of internal stratigraphy and food remains of keyhole structures, teepee pits, and similar features in Pennsylvania and New York substantiates the smoking hypothesis, then it is this model of Late Woodland exploitation which we propose to account for their presence. Fall and early winter hunts in this area may well have yielded more food than was immediately needed. Processing such food in anticipation of late winter and spring shortages would have required thorough smoking operations, and in this area of highly unpredictable snowfall and rainfall patterns, such operations may have necessitated their being carried out in special smoking facilities.

CHAPTER 13

AN ANALYSIS OF THE HUMAN REMAINS FROM THE FISHER FARM SITE

DIANE E. SICKERT

I. INTRODUCTION AND METHODOLOGY

Nine burials, all believed to be associated with the Late Woodland occupation, were excavated during the 1976 and 1977 field seasons. The shallowness of the graves, the acidic soil conditions, and the extreme ranges in termperature and moisture through the year all contributed to their poor state of preservation. Several of the burials excavated at Fisher Farm possessed stains and bone fragments indicating the original position of the body. However, the majority of diagnosable remains consisted of tooth crowns. Because they are the hardest tissue in the body, teeth can provide valuable morphological information. The information obtainable from the study of teeth relates to age, sex, genetic affinities, diet, and pathologies.

According to Mann, "the best indicators of age are unerupted tooth development, tooth eruption, root closure and tooth wear" (1975:50). Tooth wear includes both occlusal and contact wear between teeth, abrasives in the diet, the natural movement of the jaw and teeth, and the use of the teeth and jaws as aids to tools or as tools themselves. The teeth from this site could not be analyzed for root closure, due to the absence of everything but the crowns. However, the other three indicators of age were examined. The observed molar wear was compared to Brothwell's age correlations and molar cusp wear of pre-medieval British burials (in Bass 1971:239). Variation in bilateral wear was noted in an attempt to diagnose chewing habits. Asymmetric bilateral wear was examined since it often indicates the presence of pathological disorders or anomalous habits of chewing which limit or prevent the use of a portion of the chewing area. The teeth were also examined for dental caries, since hypotheses can often be generated as to the cariogenic factors causing them. The occurrence of shovel-shaped morphology on the incisors was also checked. Characteristic of American Indian dentitions, the function of this trait is to strengthen the incisor teeth (Carbonell 1963). The molars were checked for the presence of Carabelli's cusp, [a trait in which the lateral borders of the incisors curve lingually giving the tooth a shovel-shaped appearance (Dahlberg 1951)]. A general discussion of these observations will appear later in this chapter.

Several problems exist in drawing conclusions from the above types of observations. First, the development and eruption of teeth are related to processes of skeletal growth and development. Here, considerable idiosyncratic variation may be seen in a population. Second, some aboriginal American dentitions reportedly have rapid or otherwise peculiar molar wear patterns. Morris (1966) found that the later molars in Indian dentitions wear faster than the first molars. This result contradicts

Mann's conclusion that "...in humans considerable time passes between the eruption of successive molars and this is reflected in the differences in wear between the first, second, and third permanent molars" (Mann 1975:30). With this in mind, one must be careful in applying Brothwell's age assignments according to wear patterns. Their use here has been limited to relative ages, to get an idea of the approximate age composition of the population at Fisher Farm. Third, one must be aware that the diet of many aboriginal Indian groups was very gritty and their teeth often wore rather quickly. Also, differential wear may occur when attritional stress is not uniform over the dental arches (Molnar 1971:187). This again calls for the careful application of Brothwell's estimates to aboriginal populations. Fourth, after a certain age, it is very difficult to estimate dental wear. Stewart (in Mann 1975:51) notes that accurate estimation is difficult for individuals over 30 years of age. It is for this reason, and the fact that an absolute age cannot be assigned, that Mann has proposed the following guidelines for aging (Mann 1975:150):

Infant--before M1 erupts

Juvenile--before M2 erupts

Adolescent--before M3 erupts

Adult 1--equals M3 erupted, but little or no wear

Adult 2--equals stage 2 wear

Adult 3 or mature adult--dentine pits exposed on M3

Both absolute and relative estimates will be used here.

The sexing of an individual is normally based on the cranium, pelvis, femur, calcaneus, and talus, depending on the state of preservation. However, teeth can also be used in analyses of sex. Ditch (1972) states that there are significant differences in tooth size between the sexes, with the teeth of females usually being smaller and those of males being larger and longer.

As stated earlier, the only human material suitable for analysis from Fisher Farm were teeth. Recent work on the sexing of skeletal material by using formulae based on tooth size has shown that substantial samples are required before equations unique to that population can be formulated. Unfortunately, the sample from Fisher Farm was too small to justify their derivation here. For this research two previously published sets of formulae were applied, one developed by Ditch and Rose (1972) and the other by Owsley (1975). However, relative tooth size continued to be used because only one burial allowed the exact combination of tooth measurements required by the formulae. The measurement techniques used are as follows:

Mesio-distal (M-D)--Taken along the plane bisecting the occlusal surface of each tooth with end points located at the wear contact facets. Canines and incisors were measured at the mesial and distal crests of curvature.

Bucco-lingual (B-D)--Taken perpendicular to the plane of the occlusal surface, with end points located at the crown midpoint. Incisors and canine measurements were taken on the cemento-enamel junction.

Measurements were taken on all teeth regardless of wear. Mean values were first calculated for each side of each tooth. Next a range and mean were calculated for each set of teeth. Finally, tooth measurements were compared with other reported Indian groups.

II. BURIAL DESCRIPTIONS

A. BURIAL 1

This burial was found during the 1976 field season in N26E4. A stain in the eastern portion of the square was noticed on the surface of Level 2, 28 cm from the surface. The fill of the pit was mottled until bone material appeared, at which time the soil changed to a very hard packed clay. The pit fill contained a few incidental, village, and refuse artifacts including fire-cracked rock. Thirteen teeth and tooth fragments were found in addition to three long bone fragments. The latter were strengthened in the field with a solution of Elmers Glue diluted with water but the fragmentary nature of these bones made analysis unproductive.

The burial pit was 35 cm deep from the surface of the feature to its deepest point. The dimensions were taken in a north-south and east-west direction. The maximum length (east-west) was 66.5 cm and the maximum width (north-south) was 50 cm. The position of the body could not be determined.

The roots and dentine of all teeth were missing and tooth crowns were very fragile. The teeth remaining were the left PM_2, M_1, PM^1, M^1, C, and the right M^1, PM^2, M_2, M_1. Two of the lower teeth, PM_2 and M_1, were broken. Other teeth included an upper incisor with only the labial surface, a canine (lower left) with a broken lingual surface, two unusually shaped molars, and a broken molar fragment. Other tooth fragments were found in the hard clay but analysis of these was impossible.

No dental caries was seen on any of these teeth. Shovel-shaping is unknown for this individual due to the absence of incisors. The molar cusp pattern of the maxillary left and right M^1's was 4-, for the mandibular M_1 it was +5, and for the M_2 it was +4.

The fragmentary upper incisor showed a wear facet along the midpoint of the distal surface, a feature noted by Wheeler (1962). A great deal of wear was seen on the distal surface of the upper canine which followed the curved shape of this tooth and which also occluded with the PM^1. A great deal of wear was also present along the midpoint of the mesial surface of the left M^1. Wear on the distal surface was not as pronounced. The right PM^2 exhibited slight wear on both surfaces. The left M_1 had some wear on its distal surface whereas the right M_1 had a very faint wear facet on its distal surface. The lower right M_2 showed no wear on either surface. Given the fact that there was a larger wear facet on the mesial surfaces of the first molars than on the distal, that the second premolar exhibited only a slight amount of wear on both surfaces, and that a M_2 had erupted, an age of about 14 years can be assigned this individual.

The age of an individual can also be estimated by looking at the degree of occlusal wear on the teeth. In addition, bilateral wear, degree of wear from the median, and the type of bite can also be determined. The cusp of the upper left canine was worn, with more wear of the mesial third. Both the lingual and buccal cusps of the left PM^1 showed some wear. The right PM^2 displayed very little wear. The upper right M^1 displayed more wear on its lingual cusps. The protocone was worn on either side of its ridge and there was wear on the central fossa. The hypocone was reduced with some wear along the entire length of the cusp. Both buccal cusps, the paracone, and the metacone displayed very little to no wear. However, the left M^1 displayed more wear on all its cusps. There was considerably more wear on the lingual cusps, the protocone, and the hypocone. The left lower PM_2 showed very little wear. The same was true of the right M_2. The buccal cusps of the lower right M_1 displayed more wear than the lingual cusps, the hypoconulid, and the entoconid, all of which displayed only slight wear. The mesial side also displayed more wear than the distal. There was wear on the buccal and mesial surfaces of the protoconid. According to Brothwell's chart of molar wear in pre-medieval British skulls, this individual is younger than 17 years of age and is an adolescent according to Mann's typology (1975:150).

When the wear of these teeth was looked at in terms of degree of wear from the median, we found more wear on the first molars than on the premolars and more wear on the first molars than on the second. This agrees with the fact that the first molars erupt before the premolars and the second molars.

The degree of bilateral wear on the first molars indicates that this individual was chewing more on the left side of the mouth. The degree of wear indicate this individual had an overbite. When the upper M^1 occludes with the lower M_1, the wear pattern indicates that the lingual surface of the upper M^1 occluded with the buccal surface of the lower M_1.

The sex of this individual cannot be computed with the formulae mentioned earlier due to the lack of bucco-lingual measurements for the canines. However, the teeth are extremely large so it is hypothesized to be a male.

As was mentioned earlier, two unusual teeth were associated with this burial. They are undiagnosable due to the unusual molar cusp pattern which had affected tooth shape. One tooth had four cusps, one of which was centrally located on the buccal surface. There were no cusps at either the mesial or distal ends. Directly opposite the central cusp was a very small cusp. On either side of this was a cusp. The central cusp bisected this molar and was higher than the two cusps on the lingual side. No wear facets were seen on this tooth. There was very little occlusal wear on the central cusp. Because there was no wear other than that very small section on the central cusp and no contact facets, it is hypothesized that this tooth was erupting at the time of death.

The other unusual tooth had six cusps and was probably a lower molar, although its side was questionable. There was a large cusp on the buccal

surface and two small cusps opposite it on the lingual surface. There were smaller cusps to the left and right of these. There appeared to be no wear facets and no occlusal wear.

B. BURIAL 2

This burial was also discovered in 1976. It was found in Level 2 of square N26E15 and consisted of nothing more than a stain. The burial was classified as such due to the similarities in pit size and shape with that of Burial 1. Some sherds and lithic debris were recovered, especially in the top layers of the grave. The orientation and burial dimensions were impossible to determine. The maximum dimensions of the pit were 74 cm in length and 34 cm in width.

C. BURIAL 3

The first burial unearthed during the 1977 field season was found in Level 2 of square N10E29. The pit fill consisted of light brown mottled clay and charcoal flecks. One piece of fire-cracked rock was recovered. The skeletal material found in this feature (56) consisted of articulated portions of the left and right legs, skull fragments, and three deciduous molars. The leg and cranial bones were badly preserved, so analysis of these was impossible.

The dimensions of the grave were 53 cm in width (north-south) and 101 cm in length (east-west). The skeleton was on its left side in a semi-flexed position. Anatomically meaningful stains were seen in the area of the spinal column and the thoracic region.

The diagnostic skeletal material was comprised of three polished deciduous molars: the maxillary right dm^2, and the mandibular right dm_1 and left dm_1. Several lesions of dental caries were observed in the molars. On the right dm_1, a rather large cavity was situated along the developmental groove in the central pit. Two small carious lesions were in the left dm_1. One was in the mesial pit and a very small cary was in the distal pit. The presence or absence of the shovel-shaped incisor is unknown.

The contact facets between the molars were very pronounced on the mesial sides. On the right upper dm^2, the mesial side displayed a large wear facet almost as long as the side itself. It was centered and quite wide. There was no facet on the distal side of the dm^2. The lower dm_1 also displayed a large wear facet on the mesial side. It was centered and very pronounced. A slight facet was observed on the distal side near the gumline. The lower right dm_1 had a smaller facet than the left dm_1 on the mesial side, but it was still very pronounced. There was no facet on the distal surface.

The occlusal wear seen on the deciduous molars was significant. The cusps of the right dm^2 were smooth, not pointed, with more wear on the distal side. The lingual aspect of the right dm_1 was very worn,

especially at the distal end. This was also where the carious lesion was observed. The buccal cusps on this tooth were not seriously worn. The left dm_1 also had very smooth surfaces on the cusps. There was more wear on the distal side than on the mesial and slightly more on the lingual aspect. When the wear is looked at bilaterally, there was much more wear on the mesial side of the right dm_1 than on the left dm_1. However, the wear seen on the distal aspects of both teeth was greater than the wear on the mesial sides.

The amount of wear on the dm_1 made analyses of the cusp pattern and number of cusps impossible. The dm^2 was a five-cusped molar.

This individual is hypothesized to be around 5 years of age for several reasons. First, the teeth displayed significant wear and dental caries were present, indicating that the deciduous molars had been functioning for some years. Second, according to dentition and eruption patterns, the permanent first molars erupt between 5-7 years of age. Since the first molars were deciduous and by the age of 7 a child should have all four first permanent molars, the probability of the child being between 6-7 is not great. Mann (1975:150) would assign the relative age of "infant" to this individual.

The sex of the child could not be determined.

D. BURIAL 4

This highly disturbed burial was found during the 1977 field season in Level 2 of squares N14E27 and N14E29. Much of the grave and skeleton were destroyed by a later intrusive pit. As a result neither the grave dimensions nor the body's original position are known. The head was pointing in an easterly direction.

The osteological material consisted of a portion of a cranium and crowns of the upper right I^2, C, PM^2, M^2, M^3, the left upper I^2, C, PM^2, M^1, M^2, M^3, a right lower M_2, and a broken and extremely worn lower PM. The lower PM could not be diagnosed as to side or position. A central left I_1 was too badly broken to be measured. The presence of shovel-shaping is indicated, but reduced due to extreme occlusal wear. No extra cusps were seen on any of the molars. The molar cusp patterns represented are: a +3 on the M^2s, a 4- on the left M^1 (the cusps for this tooth are extremely worn but the pattern could be diagnosed by the grooves), and a +4 on the right M_2. The M_3s have 4 cusps but the pattern is undeterminable due to peculiar fissures.

Several carious lesions were observed. There were three caries on the left M^1; one in the central pit, a small one in the central fossa adjacent to the central pit, and one in the center of the buccal surface below the buccal developmental groove. The left M^2 also had a small one starting on the mesial half of the protocone. The right PM^2 had a lesion in the center of the lingual cusp. The right M_2 had several caries. One was located in the distal contact facet. Another was starting in the

buccal developmental groove on the buccal surface (seen from the inside of the crown). The others were on the occlusal surface; a large one was in the metaconid (mesial-lingual) cusp, a small one was starting in the protoconid (mesial-buccal) cusp, and another very small one was starting in a groove on the distal occlusal surface.

The contact facets were generally pronounced. The right M^2 had two clear facets along the midline, one mesial and one distal. The right PM^2 had a larger facet on the mesial surface than on the distal. The distal wear facet of the right C was rather large and on the lower third of the tooth. The mesial facet was not as pronounced and was in the middle third. The distal facet on the I^2 was slight, as was the mesial. This same type of wear was also seen on the left I^2 although the mesial side displayed slightly more wear. The mesial and distal facets on the left C were pronounced and had a more labial position. Large wear facets were observed on all the molars. The mesial surfaces were all worn on the bulb of the buccal cusp. The distal surfaces were not as worn as the mesial and the facets were observed close to the gumline. The lower PM had a very pronounced facet on one side, close to the gumline, and a slightly less noticeable facet on the other side. The M^3s displayed rather large contact facets on their mesial surfaces, on the bulb, and close to the gumline.

The degree of occlusal wear on this individual was the greatest within this population. Both the left and right I^2s were very worn and the dentine was exposed. The occlusal surfaces of these teeth were slightly sloped (with the mesial side being lower). The canines displayed similar wear, and much dentine would have been exposed. The occlusal surface was steeply sloped, with the distal end being lower. Almost all the lingual surface was worn on the right canine. The left lingual surface had broken off. The right PM^2 had very worn cusps, being almost flat except on the higher buccal cusp ridge. This gave the tooth a lingually sloping occlusal surface. The lower PM was worn flat which accounts for why it was undiagnosed as to side and position. On the left M^1, the cusps were worn down nearly to the grooves with only the ridges of the cusps remaining high. The distal aspect of the left M^2 displayed more wear than on the mesial-buccal cusps. The ridges were high with the cusps themselves rather worn. The wear observed on the right M^2 was very similar, with slightly more on the distal surface. However, this tooth was not as worn as the M^1. The right M^3 displayed wear along the lingual and distal cusp ridge. A great deal of wear was on a small section of the ridge on the mesial surface. The left M^3 had more wear on the disto-buccal cusp. The lingual-mesial cusp also had a high degree of wear. There was very little wear on the buccal-mesial cusp.

The occlusal wear, when observed bilaterally, was similar on both sides of the mouth. As to degree of wear from the median point, the canines and incisors had similar degrees of wear between the left and right sides. The canines and premolars were extremely worn. The M^1 displayed more wear than the M^2 and M^3.

The age of this individual has been estimated to be 35 years or slightly older. The presence of the third molars with occlusal wear indicated

that this person was older than a young adult (that is, between 30-40 years of age). The degree of wear on the teeth, especially the molars, is very similar to the degree of wear that Brothwell predicts for a 35 year old individual (in Bass 1971:239). In addition, when this individual is compared to Burial 9, the degree of wear is more pronounced in this specimen. Burial 9 age has been hypothesized to be within the 30-35 year group, or belonging to the Adult 2 group defined by Mann (1975: 50).

Sex could not be determined with the formulae mentioned earlier due to the absence of the lower canine. However, these teeth were rather small when compared to the large teeth found in Burials 1 and 8. It is therefore hypothesized that this individual was a female.

E. BURIAL 5

During the 1977 field season, this burial was discovered in Level 2 of square N12E39. The burial pit contained mottled, light brown clay and abundant charcoal flecks. The pit itself, Feature 59, was bell shaped in vertical profile. Its basal dimensions were 99 cm in maximum length (northwest-southeast) by 65 cm in maximum width (northeast-southwest). The body was in a semi-flexed position on its left side and oriented north-northeast. The artifacts associated with the feature fill included a potsherd, a flint flake, a red jasper flake, and 3 fire-cracked rocks, all as incidental inclusions.

The several fragments of cranial and long bones could not be diagnosed. However, 4 teeth were recovered which could be analyzed; a right PM_2 and M^3, and left C_1 and PM_2. The presence of the shovel-shaped incisor is unknown for this individual. The existence of extra cusps on the molars is also unknown.

The right PM_2 was very worn on the occlusal surface. The wear facets were pronounced and there was no evidence of any dental caries. The left PM_2 also had very pronounced wear facets and a very worn occlusal surface. However, there was more wear on the distal aspect and in the center of the tooth. A large carious lesion was also observed in the center of the tooth.

The left lower canine also displayed a great deal of wear. The contact facets were quite pronounced and positioned in the middle to upper third of the tooth. Occlusally, the tooth was very worn and the dentine would have been exposed. A large hole in the center of the occlusal surface indicated this--it was not due to the formation of a carious lesion. A small lesion was forming however, on the same distal surface as the wear facet.

The right M^3 was not as worn as the other teeth in the burial. The three main cusps were still pronounced. However, a carious lesion was forming in the central pit. A slight wear facet was observed on the mesial surface.

The age of this individual cannot be estimated following Brothwell due to the lack of additional molars. However, when the right M^3 is compared to the M^3s of Burial 2, it appears that Burial 5 was somewhat younger. Also, the teeth are more yellow than in Burial 2. I therefore hypothesize that this person was between 25-30 years of age at the time of death. Because of the dentine exposure in the right M^3, this individual is classified as a mature adult following Mann (1975:150).

Sex has been hypothesized as female because of the small size of the teeth when compared with others in this population.

F. BURIAL 6

This burial is the southernmost of a cluster of four burials that occurred in a 6 m x 4 m area. It was found in Level 2 of square N10E29 during the 1977 field season and was assigned feature number 55. There was a unique ash concentration in two areas of the burial and several dark stains similar to those in Burials 3 and 5. The latter probably resulted from the decay of internal organs or organic accompaniments. Two of these stains had red ocher associated with them. Artifacts found in the pit fill consisted of one red jasper flake and one piece of chert. The burial pit had a maximum length of 85 cm (east-west) and a maximum width (north-south) of 37 cm. The body was lying on its left side.

Twenty-three teeth were recovered from this burial. They include: right upper I^2, C, PM^1, PM^2, M^1, M^2; right lower I_1, I_2, C, PM_2, M_1, M_2; left upper I^2, C, PM^1, PM^2, M^1, M^2; and left lower I_2, C, PM_2, M_1, and M_2. All M^3s were unerupted. There were no supernumerary teeth and no extra cusps. Shovel-shaped incisors were present as well as a few very small carious lesions on the occlusal surfaces of the first molars. The teeth had a yellowish color and showed very little wear. The molar cusp patterns were as follows: M_1s, Y5; M_2s, +4; M^1s, 4-; and M^2s, +3.

Contact wear facets were not pronounced on the molars and very few, if any, could be seen on the other teeth. Several teeth had no wear facets, including the right PM^1, C^1, and C_1, and left C^1, PM^1, PM^2, C_1, and PM_2. All the M2s showed slight wear on their mesial surfaces and none on their distal surfaces. The right M^1 had a slight wear facet near the gumline off of the hypocone. The mesial surface displayed greater wear over a larger area. The left M^1 was very similiar to the right, the only difference being that the facet on the mesial surface was slightly smaller. The lower Mls were also similar. The right PM^2 displayed no wear facet on the mesial surface and only a small one on the distal. The lower right PM_2 had facets on both sides but they too were slight. The upper I^2s displayed slight contact facets on their mesial surfaces and none on their distal surfaces. The opposite is true of the lower I_2s, where the distal surfaces displayed slight wear along the midline and the mesial surfaces showed no wear at all. The lower I_1 had a slight contact facet on its mesial surface and nothing on the distal side.

Very little occlusal wear was seen on the molars. The M^2s had little wear on the protocone ridge. The M^1s had more wear. The lingual surface

was worn, and the buccal cusps also showed some wear. The protocone was somewhat flattened and the hypocone sloped distally. The premolars showed no wear. Both the canines and the incisors displayed wear; the upper incisors were flattened (the right more so than the left). The lower M_2s had very little wear on the lingual surface. Most of the wear was seen on the M_1s with the majority of it on the buccal surface and on the cusps. There was more wear on the left I_2 then on the right I_2.

This individual was an adolescent and was younger than 17, more probably about 13 years of age at death. Brothwell's chart starts molar wear at 17 years and this individual does not show as much as Brothwell's initial stage. The absence of the third molars indicates that this individual had not reached the adult stage as defined by Mann (1971:150). Also, the second molars erupt between the years of 12-14 and very little wear is present on these teeth. Because of the large number of teeth recovered for this individual, the sexing formulae referenced earlier could be applied. All but one indicated this burial to be female. These teeth are much smaller than Burials 1 and 8, which were hypothesized to be male individuals.

G. BURIAL 7

This burial was found in N10E25 during the 1977 season and was assigned feature number 62. However, most of this burial was destroyed aboriginally when a hearth (Feature 52) was dug into it. Therefore, only a small portion of the burial pit remained. No artifacts were found and only a few small pieces of bone survived. The material was very fragmentary and could not be analyzed.

That Feature 62 did indeed represent a human burial was suggested by the fact that four definite interments were located within a radius of 2.5 m.

H. BURIAL 8

This burial was found during the 1977 field season in N24E10. The burial pit was given feature number 66. The pit fill was a medium brown loam mottled with orange clay and charcoal flecks. Stains appeared in both the cranial and chest areas, and were very dark grey in color. At the northeast end of the pit were two stains, possibly disintegrated leg bones. In the central area of the northern half of the pit were more decomposed bones, probably arm bones and ribs. The fragmentary nature of these bones made analysis impossible. Some evidence of the skull was also recovered, but this too was fragmentary. The other osteological material found were teeth; four crowns, a broken premolar, and an unusually shaped tooth.

This individual was on its left side in a semiflexed position. The dimensions of the burial pit were 95 cm in maximum length (east-west) and 64 cm in maximum width (north-south). Also found in the grave were 6 artifacts; 2 flint flakes and 4 small sherds. Like the other material

associated with burials at Fisher Farm, these artifacts appear as incidental inclusions in the pit fill.

The recovered teeth consisted of the right upper M^1 and M^2, the left upper M^1 and M^2, an extremely worn and broken PM, and an unusually shaped molar. No distinguishable mandibular teeth were found. The presence of the shovel-shaped incisor is unknown due to the lack of central incisors. One carious lesion was seen in the unusually shaped molar. It was located in the distal oblique groove between the metacone and the hypocone. The unusual thing about this molar is that it looked like an upper right M^1, only larger. It had a 4- molar cusp pattern. The left M^2 also had four cusps and an unusual teardrop shape, with the widest part on the buccal side. The right M^1 had a molar cusp pattern of 4-. Other molar cusp patterns included a +3 on the right M^2 and a 4- on the left M^1.

The contact facets in this individual were very slight with none occurring on the distal side of the second molars. The first molars had a slight contact facet on their distal side towards the gumline. The mesial side of the left M^2 had some wear present towards the lingual surface due to the irregular shape of the teeth. The odd molar was broken on the mesial side but there appeared to be more wear than on the other molars.

The right M^1 displayed occlusal wear on all four cusps; however it was not pronounced. The lingual surface (the protocone and the hypocone) displayed more wear than the buccal and the distal-buccal cusp, while the metacone, displayed more wear than the paracone. The left M^1 also had wear on all four cusps with more wear seen on the distal cusps, the metacone and the hypocone, which were flattened. The distal part of the protocone (toward the distal oblique groove) and the hypocone were worn lingually. The right M^2 showed wear on the protocone and only very slight wear on the paracone and the metacone. The left M^2 showed more wear on the distal and lingual surfaces with the outer edges of the crown flattened. The broken PM was very worn. It was flattened all the way across the tooth. The odd molar displayed more wear than the others, especially on the protocone where it is very pronounced.

Examining the wear beyond the mesial point, the M^1s had slightly more wear than the M^2s, especially on the distal and lingual surfaces. The M^1s displayed similar bilateral wear. The M^2s displayed more wear on the protocone, with the right side showing a greater amount than the left.

The age of this individual has been estimated to be about 15-16 years of age following Brothwell (in Bass 1971:239). The sex of this adolescent has been hypothesized as male due to the similarity in size of the molars to Burial 1.

I. BURIAL 9

Also discovered during the 1977 field season were some undiagonistic bone fragments and an upper left M^2. These were found in N9E28 in

Feature 73. This feature was bell shaped, containing a dark brown loose fill. The pit fill contained a high percentage of decayed organic material and charcoal flecks. The dimensions for this feature were 1.05 m (north-south) and 0.59 m (east-west).

The diagnosable skeletal material consisted of an upper left M^2 crown with a -3 molar cusp pattern. There were two large wear facets on both the mesial and distal sides, the largest being on the mesial side. There was much more occlusal wear on the lingual side, in the protocone. The paracone and the metacone did not exhibit much wear. Dental caries were present. The larger of the lesions was situated in the central groove of the central pit. Two smaller carious lesions were in the smaller grooves on either side of the central lesion. The presence of shovel-shaped incisors is unknown.

This individual is believed older than 20 years because of the large wear facet on the distal side, indicating that the M^3 had been exposed for some time. Following Brothwell's tooth wear diagram (in Bass 1971:239), this person was in the 25-35 year age group. According to Mann (1975:150), this individual belongs in the Adult 2 category.

The sex of this adult could not be determined.

III. CONCLUSIONS

During the first two field seasons at Fisher Farm, 9 burials were uncovered. All of the graves were bell- or oval-shaped in vertical profile and most had flat bottoms. Fire-cracked rock, burnt clay, flakes, and sherds were found in many of the burial pits, probably resulting from the casual filling of graves with household debris or soil derived from midden areas.

Seven of the 9 burials (Burials 1, 3, 4, 5, 6, 8, and 9) contained material that was diagnosable; that is, the presence of tooth crowns as compared to highly fragmented and decayed bone. Even the crowns were fragile due to the absence of roots and dentine. A total of 61 tooth crowns were recovered from these burials. Three were deciduous molars--all coming from Burial 3, a child of about 5 years of age. A significant amount of wear was present on these molars, but this is not uncommon for deciduous teeth in preliterate human groups (Hunt 1960:247).

Three adolescent dentitions were also present (Burials 1, 6, and 8). Age estimates for these burials were based on the absence of the third molars and the amount of wear, both on the occlusal surfaces and between the teeth. Of particular interest were the second premolars and the second molars, since these teeth erupt between 11-14 years of age. Burial 8 displayed the most wear of the three. Occlusal wear was noted on the M2s but the greatest wear appeared on the broken PM, which was worn flat. The facets between the molars were only slightly worn. Somewhat more occlusal wear was noted on the second molars of Burial 6, but not on the premolars. Burial 1 had more contact wear than Burial 6. The

ages of these adolescents were hypothesized to be about 13 years old for Burial 6, about 14 years old for Burial 1, and about 16 years for Burial 8.

Carious lesions were observed on the occlusal surfaces of all the first molars in Burial 6 and one lesion was noted in a second molar in Burial 8. No dental caries was found in any of the teeth of Burial 1. In terms of tooth size, both Burial 1 and 8 had very large teeth when compared to Burial 6, which was computed as a female by use of the sex determination formulae. Even though sex diagnosis based on teeth is an uncertain exercise, the teeth of females are usually smaller and those of males are larger and longer (Ditch and Rose 1972:61). Therefore, Burials 1 and 8 were hypothesized to have been males.

The remaining burials (Burials 4, 5, and 9), were adults ranging from 25-35 years of age, with Burial 4 being the oldest. The criteria for these estimates were the degree of wear and the presence of the third molars. A great deal of occlusal wear and exposure of dentine was observed. The maximum wear occurred in Burial 4, where even the distal cusps on the third molars were quite worn. The third molar in Burial 5 was not as worn, but a carious lesion was observed in the central pit. Other carious lesions were observed on several teeth in Burials 4 and 5. In terms of sex, both Burial 4 and 5 were hypothesized to be females because of the small size of the teeth when compared to the teeth of Burial 1 and 8. Burial 9 could not be sexed.

The 61 teeth were also examined for the presence or absence of shovel-shaped incisors and Carabelli's cusps. Shovelling was observed in 2 of the burials (Burial 4 and 6). Carabelli's cusps were not found on any of the molars, in apparent agreement with Dahlberg's conclusion that they are infrequent in American Indian populations (1951:169).

Molar cusp patterns from this sample were compared to several other Indian populations. On the whole, most populations have a Y5 pattern on the first mandibular molars and a +4 on the second molars. The +4 is the most specialized or advanced cusp pattern. The Fisher Farm population had an equal prevalence of both Y5 and +5 for the first molars and +4 for the second molars. As far as the maxillary teeth are concerned, most populations have a high frequency of four well-developed cusps on the first molars. However, the hypocone or distolingual cusp is unstable and in some populations is reduced or completely lost (Dahlberg 1951:164). In this sample, the hypocone is reduced on the first molars, resulting in a 4- arrangement, and is totally absent on the second molar, resulting in a 3 cusp pattern.

Not only were the above molar cusp patterns somewhat different from the norm, but this population also had a high frequency of aberrant molar teeth. Eight percent of the 61 tooth crowns found had unusual shapes. Burial 1 had 2 such molars, one with 4 cusps arranged in such a way that there were no cusps at either the mesial or distal ends, and the other with 6 cusps. Burial 8 had one unusually large molar which looked like a M^1. It also had 2 4-cusped, tear-drop shaped second molars with the widest portion on the buccal side. It was first thought that some of

these teeth might have resulted from syphilitic conditions, but with further analysis this could not be supported. Tooth sizes for Fisher Farm individuals are well within the ranges of other reported Indian groups.

Of the 7 burials that actually yielded diagnosable material, 1 was an infant, 3 were adolescents, and 3 were adults. Such a high proportion of sub-adult mortality is not at all unexpected for primitive, shifting agriculturalists. The significant amount of wear on the teeth also indicated that much grit was present in the diet. This can largely be attributed to the grinding of foodstuffs with stone tools and to the fact that teeth were probably used as tools on a variety of occasions.

CHAPTER 14

THE ECONOMICS OF WEED SEED SUBSISTENCE IN THE RIDGE AND VALLEY PROVINCE OF CENTRAL PENNSYLVANIA

JOSEPH A. BAKER

I. INTRODUCTION

A recurring feature in the botanical remains of many archaeological sites in eastern North America is the appearance of the seeds and pollen of a number of weedy, seed-bearing genera. These genera share a similar habitat and occur in contexts suggestive of a role in the subsistence strategies of populations from the Archaic Period to Contact. The existing evidence comes from a wide geographic area encompassing most of the eastern United States and, with the current emphasis on the flotation of soil samples, the data are becoming increasingly available.

This paper is an attempt to address two interrelated questions concerning the paleoethnobotany of these plants--their energetic/economic potential and their place in the overall scheme of subsistence. In considering these problems the author drew upon three sources of information: 1) the existing archaeological literature on the subject, 2) a field study conducted by the author involving the controlled sampling and harvesting of representative stands of the genera involved, and 3) the appropriate botanical and agricultural literature. Since the field study and much of the data gathered from the literature deals with the particular assemblage of species and habitats common to the Ridge and Valley area of Centre and Huntingdon counties Pennsylvania, any conclusions drawn from this study are most pertinent to the immediate region. However, due to the fact that many of the same species are represented in Archaic and Woodland components throughout eastern North America, the data may prove to have implications for a wider geographic and ecological area.

II. THE LOCAL ASSEMBLAGE

Before addressing the questions of economic potential and associated procurement systems, local representatives of the genera involved in the study will be discussed generally with respect to their morphology and habitat preferences. The scale of occurrence used in the following discussion was adopted from Westerfeld (1961, in Deam 1940).

Abundant--A plant growing in large quantities throughout the area wherever its habitat occurs.

Common--A plant growing throughout the area wherever its habitat occurs, but which may be in limited numbers in some localities.

Frequent--A plant growing throughout the area on most of its habitats but occurring in small numbers in some localities.

Occasional--A plant which may or may not be present even though the habitat and other conditions appear favorable. Of casual occurrence.

Infrequent--A plant definitely limited in its distribution, usually because of specific habitat requirements.

Rare--A plant with a very limited distribution, the record often resting on one or two collections.

Locally Abundant--A plant infrequent in its distribution, but forming colonies of considerable extent in localized areas.

A. GENUS CHENOPODIUM (LAMB'S QUARTERS, GOOSEFOOT)

Chenopodium is a diverse, world-wide genus of which some twenty species occur in the eastern United States and Canada. The genus favors a heavily disturbed waste habitat but exhibits adaptations to a variety of moisture and soil conditions. All of the species in the Centre and Huntingdon County area are annual weeds which appear in late April or May. The plants flower from late June to October, producing ripe seeds during the latter month. The various species exhibit a wide range of subtle morphological differences which can make species-specific field identifications difficult. The primary genus specific diagnostics are the dentated, somewhat lanceolated leaf configuration, and the characteristic flower clusters at the termini of the branches and the central stalk.

One of the local chenopod species, C. botrys, is an adventive from Europe. Also known as Jerusalem Oak, C. botrys is a somewhat small species attaining a maximum height of about 60 cm. It is erect and either simple or multibranched. It has a distinctive pungent odor and its leaf configuration does bear a resemblance to that of some oaks. It is infrequent in this area, occuring in waste places and roadsides.

C. album (Common Lamb's Quarters)--C. album is a species with a wide distribution in both the New and Old Worlds. The plant is fully erect, usually multibranched, and commonly a meter or so in height, with compact seed clusters. New World plants are probably derived from native and introduced sources. Occurrence is frequent in waste places, gardens, roadsides, etc.

C. ambrosioides (Mexican Tea, Wormseed)--An erect, multibranched or bushy species with highly serrated leaves, this species typically reaches one meter in height. It secretes a volatile oil which has a powerful, pungent odor. The seed clusters are more dense than those of C. album. The plant is a native of Mesoamerica. Its local occurrence is rare except in urban settings, where it may become abundant in waste places.

C. berlandieri (Berlandier's Goosefoot)--An erect, multibranched plant, C. berlandieri grows to about one and a half meters in height. The branches are slender and arched and the flowers are similar to those of C. album. The plant is of rare occurrence in this area and is much more widely distributed in the southern and western United States. The species' habitat is dry waste places.

C. hybridum--This is an erect and simple species which grows to about 1.5 m with a broadly ovate to triangular leaf shape and a single flower cluster at the terminus of the stalk. The species occurs infrequently in moist wooded areas.

B. GENUS AMARANTHUS (PIGWEED, REDROOT)

Amaranthus is also a very widespread genus, containing some 50 species. Eleven of these occur in the northeast United States and eastern Canada. All amaranths in Centre and Huntingdon Counties, with the exception of A. Powellii, are of near world-wide distribution and are thought to have reached this area from Mesoamerica. Amaranths favor highly disturbed waste habitats such as recently abandoned or ill-kept gardens or disturbed roadsides. Local species appear in late April or May and flower from July to October, with the seeds ripening from mid-September to October. Most amaranths are very tall plants, characterized by their ovate leaf configuration and dense, often very large, spike-shaped seed clusters.

A. graecizans (Tumbleweed)--This is an erect plant with slender ascending branches, rather diminutive flower clusters, and small rounded leaves. A. graecizans usually adopts a bushy configuration, about a meter in height and in girth. The plant is locally infrequent, appearing in the dry disturbed zones common to the western United States.

A. hybridus (Slender Pigweed)--This is an erect, often multibranched species reaching a maximum size of 2 m. It has the characteristic ovate shaped leaves and slender, often drooping flower spikes of its genus. It is locally frequent, occurring in many disturbed habitats and waste areas.

A. spinosus (Spiny Amaranth)--Spiny Pigweed is erect and multibranched, reaching about a meter in height. It is characterized by stiff, slender flower clusters bristling with sharp spines. It is of rare occurence here, growing in disturbed waste places.

A. retroflexus (Common Pigweed)--This is the most frequently occurring of the local species of amaranths. It is tall, erect, and usually multibranched, frequently reaching two or more meters in height. The spikes are stiff and very dense. The stems are covered with minute hairs and are also rough to the touch. This species is of common occurrence and favors gardens and other disturbed areas.

A. powellii--This species is similar in most respects to A. retroflexus except for some differences in flower configuration. A. powellii is locally infrequent, preferring disturbed habitats, but has a wide distribution in the western United States.

C. GENUS POLYGONUM (SMARTWEED, KNOTWEED, WILD BUCKWHEAT)

There are about 150 species of Polygonum which occur in the New World alone, of which 16 occur in the Centre and Huntingdon County area. The genus may be said to favor disturbed habitats, but it exhibits a number of

species adaptations to various environments. P. coccinium is an aquatic species, for example, while P. bistorta is an alpine plant. In addition to the wide range of habitat preferences, the genus varies in configuration and morphology. Erect, branching, bushy, prostrate, and climbing species all occur. Foliage and floral configurations differ as well. Perhaps the only good diagnostic for the field identification of genus members is the presence of multiple knots or joints on the stems and branches of all species. Locally plants appear in late April to late May and flower between mid-June and October. By late September through October the plants produce ripe seeds.

P. arifolium, P. cespitosum, and P. cristatum--All three species are extremely rare locally.

P. cuspidatum (Japanese Knotweed) and P. periscaria (Lady's Thumb)--Both species originate from outside the New World. P. cuspidatum is an erect to prostrate perennial with broad, triangular leaves and large, numerous flower clusters. The plant is of Japanese origin and occasionally appears in abandoned habitation areas. P. periscaria, while similar in many respects to the native species P. lapithifolium and P. pensylvanicum, is a smaller species (growing to 80 cm) and has denser seed clusters. Dark blotches sometimes appear on the leaves. The plant is adventive from Europe and is frequent in the area.

P. hydropiper (Water Pepper) and P. hydropiperoides (Mild Water Pepper)--Both species are semi-aquatic and of frequent local occurrence. In terms of subsistence applications, both plants are basically condiments and are quite hot to the taste. P. hydropiperoides is the taller of the two and has larger leaves. Both species have white flowers, though mild water pepper displays occasional pink blossoms. Both are erect or spreading plants and favor waterlogged conditions.

P. lapithifolium--P. lapithifolium is usually erect and multi-branched with elongated lanceolate shaped leaves and numerous pink flower clusters. The species reaches a height of 1.5 m and occurs infrequently in this area in marshy or wet environments.

P. pensylvanicum (Pennsylvania Smartweed)--This species closely resembles P. lapithifolium with the exception of size and habitat. P. pensylvanicum prefers dry and rich disturbed soils and reaches a height of 2 m. It occurs frequently in Centre and Huntingdon Counties.

P. punctatum (Water Smartweed)--An erect or ascending species, P. punctatum exhibits narrow lanceolate leaves and long, sparse flower clusters of a white or greenish color. P. punctatum occurs in water or waterlogged ground.

P. sagittatum (Arrow-leaved Tearthumb)--P. sagittatum is a vining plant of variable size which derives its common name from the distinctive arrow-shaped leaf configuration. Other characteristics are the minute pink flowers and hairy stem. It occurs frequently in marshy areas.

P. scandens--This species is a perennial vining variety with broad, oval leaves and pink flower clusters. It is frequent in this area and its habitat is moist woods, thickets and roadsides.

D. GENUS AMBROSIA, SPECIES TRIFIDA (GIANT RAGWEED)

The genus Ambrosia, distributed only in the New World before contact, is now widespread. A. trifida occurs throughout the United States and Canada. It is a plant of waste places and roadsides, frequently occurring in poorly drained soil. Locally the plant appears by mid-May and flowers from August through September. Seeds ripen any time from mid-September to late October. The plant is erect, multibranched, and often very large. Specimens over 3 m in height are not uncommon. The most obvious diagnostic, aside from its large size, is the three-lobed leaf configuration. The spindly flowers with substantial seed clusters near their bases are also characteristic. The species occurs frequently in this area.

III. HABITAT CONSIDERATIONS

A preference for disturbed habitats may be seen in all the above mentioned species. As such, their occurence in the climax vegetation that covered a large portion of the prehistoric eastern United States must have been extremely limited. The necessary disturbed habitat largely results as a consequence of such natural forces as fire, flooding, ice heaving or storm damage, as well as from human activities.

Intentional burning of forest cover and second growth to clear land for agricultural or hunting purposes was practiced by many aboriginal groups in eastern North America (Day 1952). It was observed and recorded by early visitors to the New England and Middle Atlantic areas and there are indications that the practice had been going on for some time prior to Contact. Quantitative, diachronic information on the impact and frequency of use of fire in the prehistoric East is, of course, not available. It is reasonable to suppose, however, that growth in the number of hunting and gathering populations through time holds the potential for an increase in disturbed zones. With the adoption of slash and burn agriculture one might also expect a jump in the incidence of such habitat, especially in valley bottoms which, due to the frequent replenishment and arability of the soil, are prime agricultural land and weed habitat.

To a degree the existing archaeological information from the East supports this notion. Populations did rise in both size and density in many areas during the Archaic and weed seeds are a demonstrated food source near the end of this period. The seeds are also found with the remains of later agricultural peoples who, through their subsistence activities, maintained a constant supply of disturbed soil. If as Day (1953) asserts, fire was a widely employed tool of prehistoric populations in this area, then the argument for its playing a major role in the rise of weed seeds as a subsistance item may be a good one.

Under certain conditions flooding can produce large tracts of suitable habitat for weedy plants. Large alluvial valleys hold the potential for excellent weed habitat and, after flooding, seed bearing weeds might be expected to floresce wherever post flood drainage is sufficient. Flooding along smaller, secondary or tertiary streams which flow into major valley bottoms might not be as significant, since such water courses frequently lack both rich soils and the disruptive impact of flooding events. This makes the Midwest Riverine area, with its large and regularly inundated river basins, an excellent area for the exploitation of weed seeds as a wild food source and it is from this area that many of our earliest dates for weed seeds as subsistence items originate.

Ice heaving, or the alteration of soil structure through the freezing and thawing of water retained in the ground, and blowdowns of vegetation from storm damage also create disturbed areas. Neither produce very extensive areas of habitat as these types of disturbances tend to be rather localized. In addition, both produce somewhat specialized environments. Ice heaving usually occurs in poorly drained areas which would only support aquatic or water-loving species. Large blowdowns often occur in forested areas when trees and large branches topple and pull down other trees and vegetation. The surrounding area remains forested, however, and any colonizing species would have to be adapted to the low amount of sunlight and the thin, acidic soils frequently found in upland forest zones.

Human activities can result in the creation of significant weed habitat. Intentional burning, agricultural activities, deposition of midden, building activities, mining, timbering and other forces insure that wherever sedentary or semi-sedentary human groups are found, weedy plants usually appear in some quantity. With the possible exception of large-scale annual flooding or natural burning, no other force will produce habitat so regularly and to such a great extent.

Although weedy species may be present in a sparsely populated area they might not represent a dependable, concentrated food source until human activities create dependable, concentrated habitats. One can imagine mobile hunting and gathering groups living in a lightly populated area, making occasional use of weed seeds as they appear. As population sizes and densities, and consequently weedy habitats, increase, heavier use is made of the now more available food source. There is a tremendous variety of possible strategies for such a food source, ranging from the collection of wild stands to intensive cultivation, with every gradation between these two points. It is probable that these strategies underwent a good deal of transition through time and over space as population trajectories and lifeways changed. The next section considers the current archaeological models regarding when and how this food source was integrated into the framework of subsistence in the eastern United States.

IV. THE ARCHAEOLOGY OF WEED SEED SUBSISTENCE

Early dates for weed seeds in subsistence contexts come from a number of sites (see Struever and Vickery 1973 for a comprehensive review).

Although the dating is considered questionable, Ozark Bluff Dweller sites have yielded the remains of Chenopodium, Amaranthus, Polygonum, and Ambrosia trifida in subsistence contexts. These remains are felt to be Early Woodland, deposited before 150 B.C. At the Newt Kash Hollow site both Chenopodium and Iva appear in more reliable association with radiocarbon dates of 650 ± 300 B.C. and 700 ± 300 B.C. In the Salts Cave vestibule, Kentucky, charred seeds of Chenopodium appeared in levels associated with radiocarbon dates of 710 ± 100 B.C. and 990 ± 120 B.C. (Watson 1974b).

There are some much less direct indications that weed seeds may have appeared as a food source somewhat earlier than the Late Archaic or Early Woodland dates suggested by the data above. Chenopodium pollen appears in the Salts Cave vestibule with pollen of other food plants several layers beneath the earliest seed discovery. There are no associated cultural materials or radiocarbon dates, however (Schoenwetter 1974). It may also be noteworthy that grinding equipment is found on many Archaic sites which temporally precede those mentioned above. It may be the case that seed-bearing weeds were utilized along with other botanical products of the various environments exploited by these early Archaic populations.

To summarize, while there is evidence for the use of plant foods during the Archaic Period, the actual appearance of Amaranths, Chenopods, and other weedy plants does not occur until Late Archaic or Early Woodland archaeological contexts.

The predominant lines of archaeological interpretation concerning weed seed subsistence derive from Gilmore's (1931) and Jones' (1936) examination of macrobotanical remains from the Ozark Bluff Dweller and Newt Kash Hollow sites. Although Linton (1924) had earlier suggested the possibility of a diversified eastern North American agricultural complex, Gilmore and Jones were the first to articulate the theory with specific archaeological data. Their work was summarized by Quimby (1946) who discussed some of its problems, notably the use of seed size as an indicator of cultivation and the association of known cultigens with the remains of weed seeds. General discussions dealing with the cultivation of weedy genera have been published by Fowler (1957, 1971), Yarnell (1965), and Struever and Vickery (1973), among others. Basically all of these arguments support the notion of the propagation of weeds for food. Their positions differ, however, regarding the degree of active cultivation practiced aboriginally and the bases for establishing cultigen status in various species.

Gilmore's theory was largely based on the remains of Chenopodium from the Ozark Bluff Dweller sites. Due to the large size of the seeds and what he regarded as a resemblance to domesticated Central and South American varieties (Quinoa and Canihua), Gilmore suggested that the Chenopodium recovered from the Ozark sites was a cultivated variety. However, Gilmore's argument has a number of problems. Not only is the exact stratigraphic position of the specimens in doubt, but a recent reexamination of the Ozark Chenopods by Asch and Asch (1977) raised the possibility that the seeds are not a cultivated variety at all, resembling instead a modern weedy species (C. bushianum).

Gilmore's study served as an important early work, however, and as such much attention has been paid to seed size as a diagnostic of human agricultural manipulation (Yarnell 1965; Streuver and Vickery 1973; Struever 1962; Black 1963; and others). Arguments involving seed size often run as follows: A number of archaeological sites have produced weed seeds morphologically similar to modern specimens with the exception of size, the archaeological seeds being significantly larger. The assumption is made that human populations had selected for larger seeds among wild species and were actively cultivating these plants as domesticates. With the additional evidence that some species (notably Iva) are found archaeologically out of their geographic and habitat ranges and that there is a morphological homogeneity of some archaeological collections of seeds (for example, sunflower), one can make a case for at least some degree of human manipulation (Yarnell 1965).

Critics have argued that the use of size as a diagnostic of domesticity may be inappropriate given the possibility that the large archaeological seeds resulted from wild specimens growing under the optimal habitat conditions produced by human activities. It is more probable, however, that the encouragement of weedy plants, even in rich soils, will produce larger plants and more seeds as a reaction to improved habitat, but not larger seeds (Muensher 1955; Yarnell 1965). Unusually large or uniform seeds, while probably indicative of the selection of choice seeds for planting, might well be insensitive to manipulation involving weeding, thinning, watering, and even fertilizing. Such practices could yield seed populations that are indistinguishable from seeds gathered from unmodified stands.

While it seems probable that demonstrably large and uniform seeds indicate some degree of subsistence oriented human manipulation, it is still unclear how the resource strategies involving these plants evolved. Some authors contend that the route to this morphological differentiation was a sort of "benign neglect" wherein weedy species were allowed to populate the disturbed habitats of existing cultivated gardens. Agriculturalists, taking advantage of the heavy floresence of the plants in garden areas, harvested them along with the domestic crops. The subsequent selection and planting of choice seeds converted the wild species into true domesticates.

This model may well be an accurate one for major portions of the East, but it ignores the mutually competitive nature of the weedy genera and other cultigens. More seriously, the model does not account for their domesticate status prior to the introduction of tropical cultigens as other authors insist.

The neglect of gardens is not the only possible route to domesticity for these plants. It is quite possible that they first floresced in middens or other disturbed areas and were harvested in the fall along with other gathered resources. The selection of seeds and full domesticity would follow sometime after. Such a scheme would be feasible for a previously agricultural group and for hunters and gatherers as well. An agricultural group would have the option of encouraging weed growth in fallow fields and garden borders and domesticating them in these settings.

The idea of encouragement versus domestication leads to one of the central problems of interpretation involving weed seeds and their position in the subsistence strategies of prehistoric eastern North America. Streuver and Vickery refer to a "simple mudflat horticulture" (1973:1214). Yarnell calls cultivation any situation wherein "...man acts as an agent, selecting against other plants and, in doing so, alters the balance of competition for survival in favor of weeds and cultigens" (1965:81). Watson calls Iva and Helianthus "cultivated" and defines Salts Cave chenopods as "...at least an encouraged weed..." (1974b:234). The emerging picture is one in which most authors agree that weedy plants were manipulated by human groups but few agree on the nature and degree of manipulation involved. Thus the specific subsistence position of the weedy genera is presently lost in a multitude of options. Furthermore, most of these models were developed from data representing the physiographic and cultural domain of the Midwest Riverine area. Subsistence strategies of agricultural or hunting and gathering populations living in the Middle Atlantic, New England, Great Lakes, or Southeast areas might be expected to be quite different from those of the Midwest.

Any resolution to this problem must be based on a diachronic modelling of subsistence strategies in energetic terms. Such models must be regionally specific in terms of both the archaeological and plant ecosystems. The remainder of this paper will present preliminary data necessary for such model building in the Ridge and Valley province of Pennsylvania. It is hoped that ultimately these data will be so incorporated and the resulting model tested against the archaeological data from this region.

V. THE FIELD SURVEY AND WEED SEED ECONOMICS

The determination of the exact subsistence role of weed seeds not only requires an examination of archaeologically derived macrobotanical specimens, but also a thorough understanding of local environmental systems and of the local archaeology. An accurate control and interpretation of the archaeological and environmental data bearing on weedy plants in the local area is beyond the scope of this study. The differential availability of species, model procurement systems, and the nutritional values associated with this food source are only partially known and the local archaeological trajectory is only beginning to emerge.

In an initial attempt to collect relevant data, a survey of local plants was conducted with the aim of quantifying the differential productivity and availability of weed species in a variety of habitats. This effort was divided between two survey methods and areas. First, a selective survey was conducted of some of the numerous stands of weedy plants in Centre County's various waste area habitats. This survey was designed to sample a cross-section of the local weedy seed bearing community in a number of different settings. It was assumed that by closely examining the population characteristics of weed stands growing in settings with different degrees of disturbance, the results would provide a general picture of species-specific responses to prehistoric habitat variation and its manipulation.

A second, comprehensive survey in a relatively undeveloped area in Huntingdon County was also conducted. Here an attempt was made to inventory all weedy seed-bearing plants growing in the variety of ecozones typical of the Ridge and Valley physiographic province. The particular area chosen was believed to be similar to the lightly populated, low disturbance environment that most likely prevailed in the Archaic Period in Pennsylvania, after the establishment of the post-Pleistocene floral community and before the larger populations and more extensive soil disturbance of the Woodland Period. As such, these results would serve as a control for the impact of natural agents that promote weedy habitat in the local area.

A. THE COMPREHENSIVE SURVEY

The Stone Valley Field School and Experiment Forest, a University owned refuge area located about 10 miles southwest of State College, was systematically surveyed for weedy species by the author and Mr. Charles McCullough. Mr. McCullough is an instructor in survival techniques at The Pennsylvania State University and an authority on wild food plants. The survey area includes representatives of nearly the entire spectrum of local ecotypes, from climax hemlock and upland forest to wet meadows and marshes. Most of the soil disturbance is produced by flooding from University Lake, Shavers Creek, and various small water courses, as well as by ice heaving and storm damage. Fire is not common in this section of Pennsylvania.

The survey took two days. On the first day Mr. McCullough and the author surveyed the entire perimeter of the lake shore as well as 400 m of the edge of Shavers Creek until it entered a heavy forest cover of rhododendron and hemlock. Later the author surveyed approximately 2 km along the main access road. On the second day, working alone, the author surveyed the shore of Hutchinson's Pond and about 200 m of its drainage stream as well as about 2 km^2 of cleared land to the northeast. These surveys were conducted as carefully as possible and nearly all of the potential habitat areas were explored.

Table 14.1 presents the results of this survey and indicates the scarcity of seed-bearing species in these settings. P. hydropiper and P. hydropiperoides, while sought after as condiments, are quite hot and, to persons of normal constitution, do not represent a staple food source. P. sagittatum is a very low yield plant (the flower being approximately 0.5 cm long) and occurs in low densities near the lakes and streams. P. periscaria, an adventive from Europe, was represented in the survey by a single roadside collection. The Chenopodium was quite small, limited to the roadside, and consisted of a single stand. Of course in a year of extensive flooding one would expect florescences of pioneer weeds in the heavily disturbed flood zones, but extensive flooding is neither frequent nor regular in this area.

The Stone Valley survey suggests that the environment in this area, before the rise of sedentary human populations and their active creation of habitat, was not a good one for seed-bearing weeds. In such an

Table 14.1: Plant Stands and Average Plant Size--Stone Valley Survey

Genus/ species	Number of stands, habitat occupied, approximate size of stands	Average plant size
Chenopodium album (?)	1 stand, roadside, 4 m^2	12 cm
Amaranthus retroflexus	--	--
Ambrosia trifida	--	--
Polygonum hydropiperoides hydropiper	distributed continuously around lake and stream, 1 or 2 per m^2	about 50 cm
periscaria	1 plant, roadside, 8 cm^2	11.3 cm

environment, without annual flooding or other large scale natural disturbances, these plants would constitute a scanty and undependable resource. In the midst of a profusion of other types of wild plant foods, including hickory, acorns, and viburnum, it is doubtful whether weedy species would have played a significant economic role.

B. THE SELECTIVE SURVEY

The Centre County survey selectively examined a number of plant stands growing in artifically disturbed habitats. By controlling for species, degree of disturbance, and immediate habitat conditions, the differential productivity and yield of each stand could be assessed and the impact of disturbed conditions on productivity measured.

When a stand was located it received an identification number and certain information was recorded, including the location coordinates, genus or genera represented, associated flora, associated topography, elevation, slope, degree of soil disturbance, soil description, approximate spatial density of plants, average size of plants, dimensions of the stand, direction and amount of exposure to sunlight, and the conditions of soil drainage. Seventeen stands, including 6 of Chenopodium (possibly C. album), 3 of A. retroflexus, 3 of A. trifida, and 5 of P. pensylvanicum, were harvested with a beating stick or by hand beating onto a 6' x 8' plastic sheet. The seeds and chaff were then air dried and winnowed, and the seeds were weighed.

Table 14.2 summarizes the results of the selective survey with respect to estimates of caloric production. Estimates were calculated at 10% water from the formula

$$4.1(P+C) + 9.3F = \text{Cal per } 100 \text{ g},$$

where P=percent of protein, C=percent of total carbohydrates or nitrogen free extract plus fibre, and F=percent of fat.

It is immediately apparent from Table 14.2 that all plants have rather attractive caloric values. It should be noted that the value for Giant Ragweed is probably high. It was calculated from figures for A. artemisifolia or Common Ragweed, its closest relative. The seed coat of these species is very thick and coarse and was accounted for in the chemical analysis as fibre. No doubt much of the coat is indigestible. The seed is rather high in fat, however, (about 20% at 10% water) and thus the value may not be too far in error. Also apparent from the table are the uniformly low bulk yields per plant. These are partially compensated for by the rather high densities, higher in fact than one can successfully achieve with domesticated plants and still derive respectable returns.

These values, coupled with the low investment of energy necessary for the collection and processing of the resources, are no doubt the basis for their attractiveness prehistorically (see Table 14.3). According to a number of authors, Iroquois and Delaware groups relegated gardening and gathering activities to women (Newcomb 1956; Bennett 1955). The expenditures for weedy plants in Table 14.3 were therefore calculated for

Table 14.2: Yield and Density Values--Centre County Survey

Genus/ species	Average bulk yield per plant	Average caloric yield per 100 gm (at 10% H_2O)	Average density
Chenopodium album (?)	17.8 gm/plant	388.77 Cal./100 gm	7 plants/m^2
Amaranthus retroflexus	4.0 gm/plant	362.4 Cal./100 gm	8 plants/m^2
Ambrosia trifida	2.5 gm/plant	415.8 Cal./100 gm	11 plants/m^2
Polygonum pensylvanicum	1.24 gm/plant	373.07 Cal./100 gm	27 plants/m^2

Table 14.3: Comparative Energy Investment for Collecting and Processing--Maize versus Weed Seeds*

Activity	Expenditure	
	Maize	Weed Seeds
Tree Cutting with Stone Ax	8.4 Kcal/minute	0
Planting with Digging Stick	3.6 Kcal/minute	0
Weeding	6.6 Kcal/minute	0
Harvesting with Hand or Beating Stick	4.6 Kcal/minute	4.6 Kcal/minute
Gathering and Storage	3.0 Kcal/minute	3.0 Kcal/minute
Preparation (Grinding)	6.0 Kcal/minute	6.0 Kcal/minute

*Energy Expenditures are approximations derived from Durnin and Passmore (1967), Newcomb (1956) and Saraydar and Shimada (1973). Harvesting estimate based on threshing by traditional European technique. Gathering estimate based on walking with a 10 kg load. Grinding estimate based on general heavy labor involving use of arms.

females and represent the energy involved in collecting naturally occurring stands.

The most obvious feature of Table 14.3 is the low energetic investment required by these plants as compared to a domesticated resource. As a "camp follower" no thinning, watering, fertilizing, planting, or hoeing would be necessary to achieve significant stands. The input of energy is quite similar to that for a spatially proximate gathered resource. The expenditure for domesticates given in Table 14.3 is that of swidden maize agriculture. The values for land clearance, planting, and weeding derive from Saraydar and Shimada (1973) and represent the energy costs involved in using a stone ax for tree cutting, planting with a pointed stick, and hand weeding. They do not indicate whether these values are based on male or female labor. The remaining values are based on female labor only (Durnin and Passmore 1967).

The relationship between habitat and yield in the harvested stands of weeds is represented in Table 14.4. The author was unable to locate any species of Amaranthus or A. trifida in lightly disturbed environments in approximately 2.5 months of surveying, bearing strong witness to their preference for disturbed areas. It is possible that fertilizers in garden soils may have inflated some of the figures. However, all the garden areas were spottily fertilized with manure only and this was not even done on a regular basis.

Three trends are clear from this table. First, there is a positive correlation between the degree of disturbance and average plant size. The "maximum averages" presented here represent the larger average value in those cases when two stands were examined. Sizes in this table are not a function of age, since all plants dealt with in this survey sprouted in the early spring of 1978. Second, the average seed yield per plant is also positively correlated with the degree of disturbance. The only apparent discrepancy, A. trifida, is probably due to small sample size. Third, average densities of plants per m^2 are positively correlated with the degree of disturbance except for Chenopodium, where the opposite holds true. The cause of this reversal is the sheer physical size of the Chenopodium plants. The development and bushiness of chenopods in highly disturbed soils is such that it is not possible for them to grow more densely in a unit this size.

This table reinforces botanical and archaeological interpretations of these plants as "camp followers" or pioneers of disturbed zones and, while differential soil fertility is important, it indicates that as the degree of disturbance increases so does the potential yield.

A final table (Table 14.5) considers the caloric productivity per unit area of each species in each disturbance habitat. In the case of Chenopodium and Polygonum, the two plants for which all disturbance conditions could be measured, the caloric yield increased 11- and 19-fold, respectively, as the degree of disturbance increased. The impact of this change is so great that at least one genera, Chenopodium, is seen to rival the energetic yield of maize. If we keep in mind the earlier discussion of the small energy investment with respect to the weedy plants, then the comparative

Table 14.4: Plant Harvest Statistics

Genus/ species	Habitat conditions	Number of stands harvested	Maximum average plant density	Maximum average height	Maximum average yield per plant
Chenopodium album (?)	Highly disturbed	2	$4/m^2$	164 cm	52.4 gm
	Moderately disturbed	2	$7/m^2$	110 cm	8.5 gm
	Lightly disturbed	2	$9/m^2$	90 cm	2.2 gm
Amaranthus retroflexus	Highly disturbed	2	$15/m^2$	140 cm	6.0 gm
	Moderately disturbed	1	$5/m^2$	78 cm	4.9 gm
	Lightly disturbed	0	--	--	--
Ambrosia trifida	Highly disturbed	1	$11/m^2$	324 cm	2.9 gm
	Moderately disturbed	2	$6/m^2$	250 cm	2.9 gm
	Lightly disturbed	0	--	--	--
Polygonum pensylvanicum	Highly disturbed	2	$70/m^2$	120 cm	1.8 gm
	Moderately disturbed	2	$23/m^2$	80 cm	1.6 gm
	Lightly disturbed	1	$5/m^2$	27 cm	1.3 gm

Table 14.5: Comparative Caloric Values by Species and Habitat

		Yield/ Plant (gm)	Density/ m^2	Gm/m^2	Kcal/ 100 gm	Caloric Yield/ m^2
Chenopodium album (?)	Highly Disturbed	52.4	4	209.6	388.77	814.86
	Moderately Disturbed	8.5	7	59.5	388.77	231.32
	Lightly Disturbed	2.2	9	19.8	388.77	76.98
Amaranthus retroflexus	Highly Disturbed	6.0	15	90.0	362.4	326.16
	Moderately Disturbed	4.9	5	24.5	362.4	88.79
	Lightly Disturbed	--	--	--	362.4	--
Ambrosia trifida	Highly Disturbed	2.9	11	31.9	415.8	132.64
	Moderately Disturbed	2.9	6	15.6	415.8	64.86
	Lightly Disturbed	--	--	--	415.8	--
Polygonum pensylvanicum	Highly Disturbed	1.8	70	126.0	373.07	470.07
	Moderately Disturbed	1.6	23	36.8	373.07	137.29
	Lightly Disturbed	1.3	5	6.5	373.07	24.25
Zea mays				212.25	386.5	820.35

	$Kcal/m^2$	Species/Maize
Zea mays	820.35	1.00
Chenopodium album - Highly Disturbed	814.86	.99
Polygonum pensylvanicum - Highly Disturbed	470.07	.57
Amaranthus retroflexus - Highly Disturbed	326.16	.40
Chenopodium album - Moderately Disturbed	231.32	.28
Polygonum pensylvanicum - Moderately Disturbed	137.29	.17
Ambrosia trifida - Highly Disturbed	132.64	.16
Amaranthus retroflexus - Moderately Disturbed	88.79	.11
Chenopodium album - Lightly Disturbed	76.98	.09
Ambrosia trifida - Moderately Disturbed	64.86	.08
Polygonum pensylvanicum - Lightly Disturbed	24.25	.03

input/output ratios of several of these plants, when compared to maize, becomes even more impressive.

VI. CONCLUSIONS

Returning to the original objectives of this study, a number of observations can be made.

Quite clearly weed seeds are a viable, energetically attractive food resource, demanding a low input of energy when compared to a domesticate and producing respectable yields. All indications suggest that the resource would not be nearly as viable for a small, mobile group as it would be for a settled, dense population, especially an agricultural one. While this resource can provide spatially proximate and concentrated returns of foodstuffs like a domesticated crop, the recovery of the resource involves activity levels and energy expenditures similar to those necessary for non-domesticates. Thus the idea that these plants represented neither a domesticated nor a gathered resource, but something in between, is not without merit.

Whatever the exact subsistence position of weed seeds, there is still much to learn about them. The problems of differential yield and total energetic value need to be examined further, perhaps through simulated garden plots wherein the impact of weeding, watering, hoeing, and other activities can be precisely measured. As mentioned before, most of the ethnobotanical work done with these plants originates in the Midwest Riverine area and may not be applicable to the other physiographic provinces of eastern North America.

Answers to these and other questions are of primary importance to the accurate interpretation of the subsistence position of these genera. It is hoped that this paper will initiate a series of regionally based control experiments which will ultimately account for the position of these genera in the shifting economic strategies of eastern North America.

CHAPTER 15

GEOMORPHOLOGICAL AND PEDOLOGICAL ANALYSES AT FISHER FARM

JEFFERY J. GRYTA, WILLIAM J. WALTMAN, AND JAMES W. HATCH

I. INTRODUCTION

At the earliest inspection of the Fisher Farm Site in the spring of 1976, the distribution of surface material was seen to primarily conform to the top of a terrace elevated approximately 1 m above the adjacent floodplain. The intensive surface collections of both 1976 and 1977 confirmed this initial impression. The gradual downward slope to the east and south produced progressively lighter densities of artifacts at the lower elevations and the concentrations of fire-cracked rock and non-artifact sandstone rubble extending NE-SW along the slope seemed to denote a boundary feature.

Two excavations positioned off of the terrace, in 1976 and early in 1977, only reinforced these impressions. The 1976 units exposed a 60 cm deep pit, Feature 9, which was interpreted as a trash pit located at the periphery of the village. A 5 cm lens of dark, organically rich soil extending to the east and south was thought to represent a thin veneer of refuse associated with the upper, outflaring portions of the feature. The reexcavation of Feature 9 in 1977 and the opening of contiguous areas revealed that the feature was positioned immediately adjacent to the edge of the terrace and, to the east, the sterile alluvial stratigraphy thought to be associated with the rest of the floodplain was found.

However, as the 1977 season was ending, Area B was opened (Figure 11.8). The eastern half of this area extended off of the level part of the terrace and down the terrace slope. Our plan at this eastern end was to crosscut the sandstone boulder concentration visible from the surface and define its extent as well as to test the idea that a string of trash pits similar to Feature 9 might exist adjacent to the lowest terrace edge. If a series did exist, the 10 m width of Area B was presumed great enough to detect it.

As the eastern half of Area B was excavated, the loose concentration of rock on the surface was seen to originate from a pavement-like band of sandstone boulders and pebbles. The pavement horizontally separated two distinct soil types, a sterile orange hardpan to the west and a dark, organically rich loam to the east. The orange hardpan was obviously a continuation of the same material underlying the plow zone in all other portions of the site. The dark loam was a surprise. It was darker and more organically rich than the upper level of Feature 9. Compared to other discoveries at Fisher Farm it most closely resembled some of the carbon rich pits of the village proper. Yet Area B had revealed an unbroken expanse of the material 3 m wide, E-W, and 10 m long. What was thought might be a series of discontinuous pits now appeared to be a single large feature paralleling the edge of the village.

The make up of the rock pavement and its juxtaposition with the terrace edge immediately argued for the feature being a filled-in stream channel. The pavement was largely comprised of non-artifact, water-worn sandstone material. Smaller pebbles were tightly packed around the boulders in a similar fashion to the gravel bars lining the modern channel of Bald Eagle Creek 160 m to the south. Excavations were concentrated along the E38 line. The orange hardpan was seen to dip under the rock pavement and continue to the east at an approximately 20° slope. By the E39.2 line the hardpan terrace material was 85 cm below the original surface of the slope and 60 cm below the bottom of the plow zone. Within the 60 cm of intact fill, above the hardpan, 8 strata could be easily recognized, all with organic, ceramic, and lithic material associated. A preliminary seriation of the ceramics from the exploratory trenches revealed a Clemson Island, Shenks Ferry, shell-tempered continuum, and supported the notion of a nominally disturbed, chronologically sensitive stratigraphic sequence of village refuse. A decision was made to return to Fisher Farm for the 1978 season, concentrating on this area and capitalizing on the stratigraphic control that was so elusive elsewhere on the site.

The excavations of the stratified area in 1978 necessarily focused on a number of geomorphological and pedological problems. To assess the chronologic integrity of the stratigraphic profile from an archaeological viewpoint, it was imperative that the conditions surrounding the area's formation and filling in be known in as much detail as possible. It was assumed that temporal or environmental changes affecting the internal filling process would be detected by examining soil structure and documenting the formation of horizons. Ideally these observations would compliment and expand the more traditional archaeological designations of strata. This chapter presents the results of field efforts made in 1978 to define the structure and evolution of the stratified channel area as a separate entity from the terrace and the surrounding floodplain. The environmental and archaeological conclusions based on the area's contents will be presented in Chapters 16-19.

II. TOPOGRAPHIC SETTING AND METHODOLOGY

Bald Eagle Valley represents a transition zone between the Ridge and Valley and the Allegheny Plateau physiographic provinces. Bedrock underlying the floodplain of Bald Eagle Creek consists of limestone (Helderberg Formation) and shale (Hamilton Group). The terrace on which the Fisher Farm Site is located rises up from the floodplain approximately 160 m north of the current channel of Bald Eagle Creek. The slopes of the terrace are gentle 3% grades. The highest flood water from hurricane Agnes in 1972 failed to submerge the terrace. The filled, stratified depression or stream channel is located between the floodplain and terrace (Figure 15.1).

In its modern position, Bald Eagle Creek's southern bank dissects the colluvial slopes of Bald Eagle Mountain. Floodplain sediments are derived from the acid sandstones and shales of these colluvial slopes.

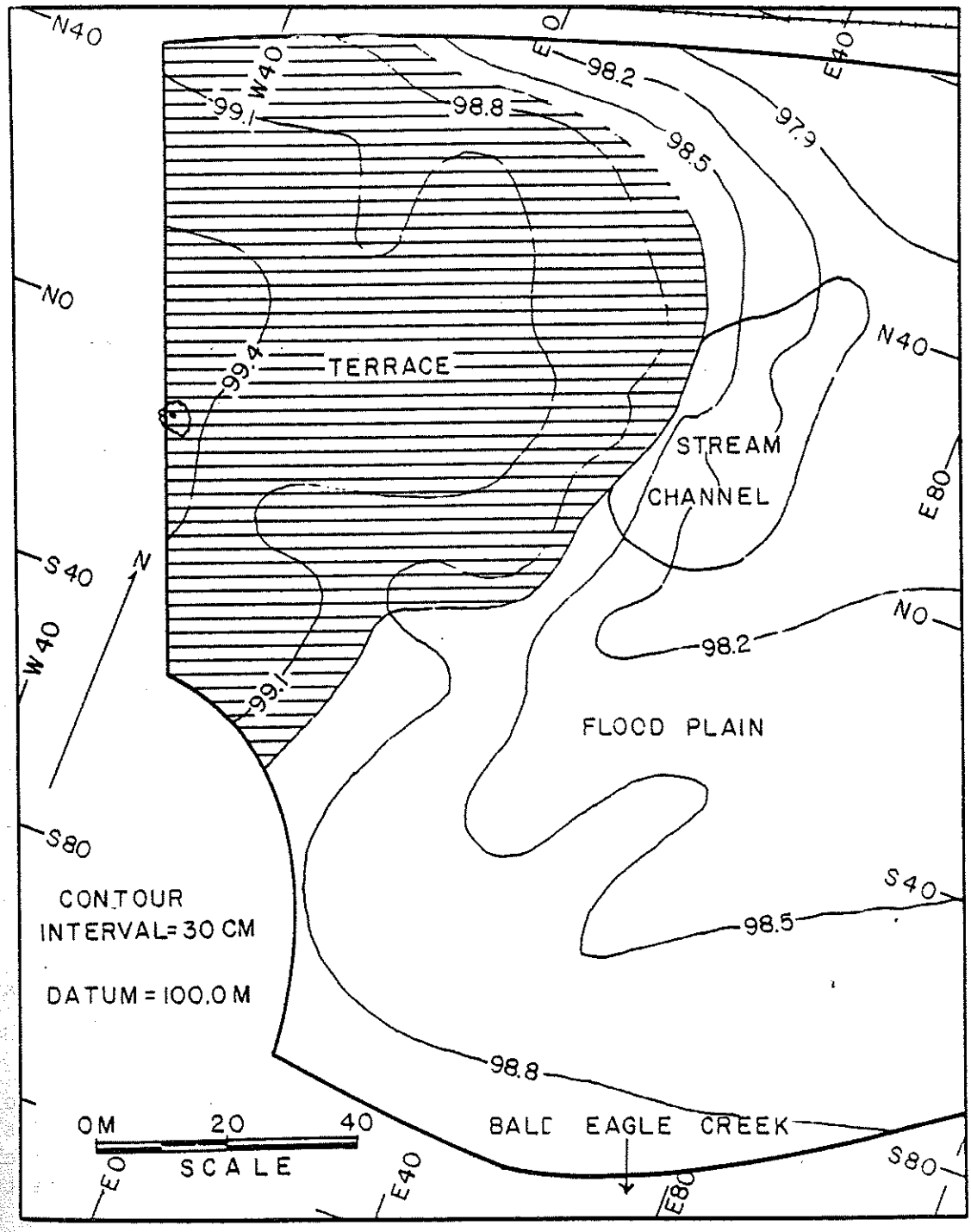


Figure 15.1: Location of the Terrace, Stream Channel, and Floodplain Formations

In order to study the terrace, filled stream channel and floodplain areas, detailed descriptions of the morphologically different soil units were needed. The field techniques used to collect this information included a series of 19 hand auger tests positioned at various locations (Figure 15.2). Auger profiles readily permitted separation of the soil units on the basis of color and texture. Collectively the profiles were drawn as a fence diagram, showing the spatial distribution and contact surfaces of all soils. This diagram provided a 3-dimensional perspective of the entire study area and helped define the horizontal and vertical boundaries of the filled stream channel. After recognizing surficial trends, detailed soil profile descriptions were made of the walls of selected archaeological trenches in the stream deposits and auger holes on the terrace. Soil profiles were described according to the morphologic properties of soil texture, structure, color, and consistence (USDA 1951). A Munsell Color Chart was used to match moist soil colors and pH was determined by colorimetric dyes with a Cornell Lime Test Kit.

III. AUGER TEST RESULTS

Soil profile descriptions corresponding to the 19 auger tests are presented in Table 15.1. The internal uniformity of the profiles taken from the terrace and floodplain highlight the uniqueness of the stratified deposits in the stream channel.

The terrace soil has a well-expressed argillic horizon, and soil colors of 2.5 YR to 5 YR with fairly high chromas. On the terrace slopes the B21 horizon contains many stones ranging from 7-25 cm in size. The freshly chipped surfaces of these sandstone cobbles exhibit "weathering rinds" or zones of iron oxidation (Peltier 1949). Weathering rinds are uncommon and more poorly developed in Wisconsinan age materials. Many of these cobbles are in fact similar to Peltier's description of rinds from the weathering rinds of Illinoian age cobbles: 1) a tan-colored surface zone, 2) a dark-brown zone, 3) a brick-red or pink zone, and 4) a buff-colored zone of slight alteration overlying unaltered rock (1949). It is therefore possible that this terrace is pre-Wisconsinan in age.

In the center of the terrace and across the floodplain, coarse gravels and cobbles occurred at an average depth of 117 cm. However, within the filled stream channel only minor pieces of gravel were found while augering to a depth of 310 cm. Apparently, the gravel zone was removed from this localized area during stream channel formation.

These data permit a tentative reconstruction of the formation of the terrace, stream channel, and modern floodplain feature. The earliest known sedimentological event in the study area is recorded in a thick accumulation of gravel. These gravels represent channel lag deposits laid down during one or several lateral migrations of Bald Eagle Creek. Similar gravel deposits are also known to occur in the nearby Halfmoon Creek floodplain. They are believed to be Pleistocene in age and directly overlie the bedrock of the valley floor. The clast size of the Halfmoon Creek gravels is similar to that of the colluvium deposited in Halfmoon Valley

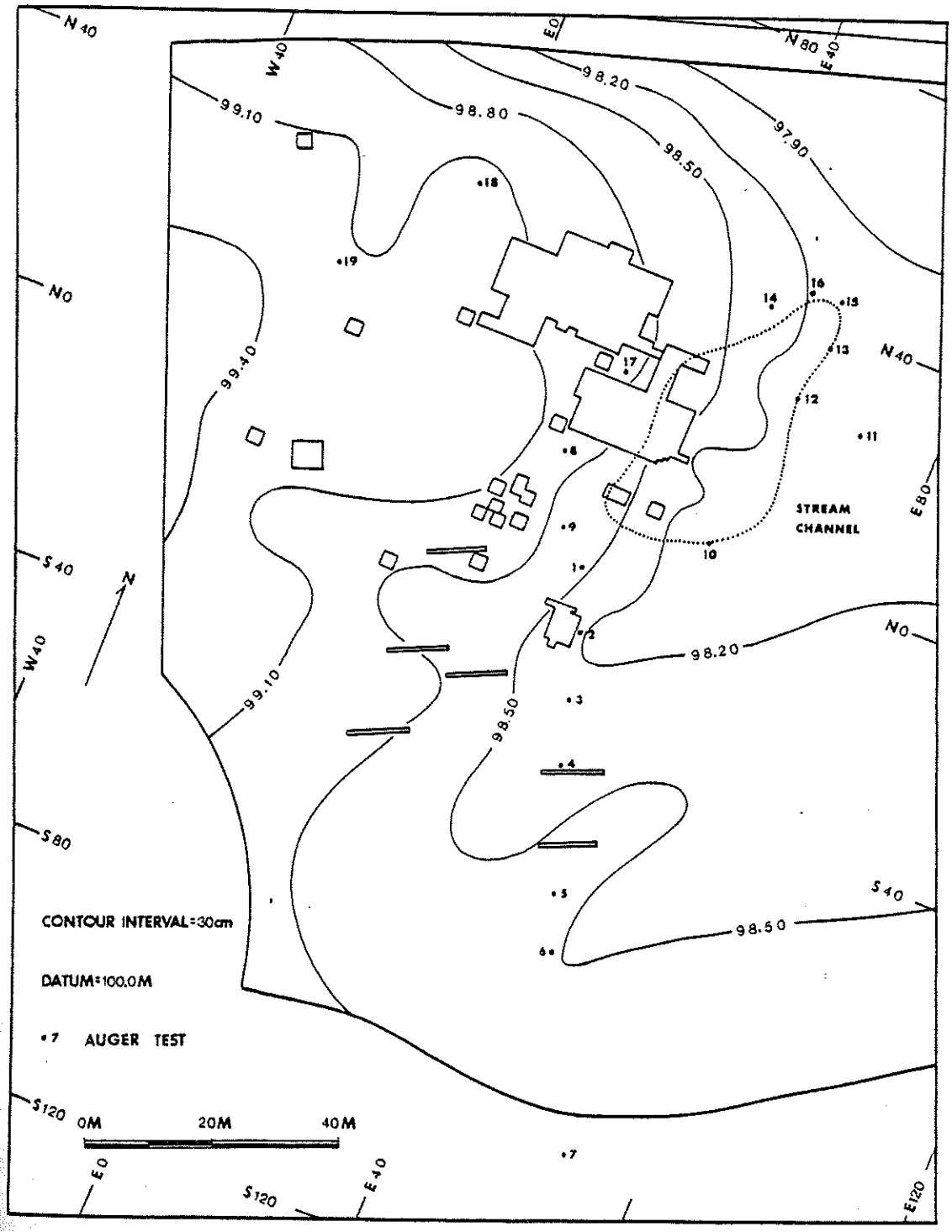


Figure 15.2: Location of the 19 Auger Tests--1978

Table 15.1: Soil Profiles from Auger Tests

Key to Augered Samples			
	Horizon	Depth (in cm)	Description
1.	Ap	0-20	silt loam
	B21	20-46	loam
	B22	46-76	heavy loam
	C1	76-	gravelly sandy loam
2.	Ap	0-30	
	B2	30-46	heavy loam
	B31		
	B32	46-107	sandy loam
	B33		
	C1	107-122	loamy sand
	IIC2	122-	gravel
3.	Ap	0-46	silt loam
	B2	46-66	loam
	B3	66-91	sandy loam
	C1	91-122	loamy sand
	IIC2	122-	gravel
4.	Ap	0-18	
	B1	18-48	silt loam
	B21	48-58	heavy loam
	B22	58-74	heavy loam; mottled, charcoal
	C1	74-102	loamy sand; mottled, firm
	C2	102-	loamy sand; mottled, firm
5.	Ap	0-46	
	B2	46-81	loam
	B3	81-102	sandy loam; many distinct mottles
	C1	102-122	loamy sand; many prominent mottles
	C2	122-152	gravelly loamy sand; gleyed
6.	Ap	0-30	
	B2	30-66	loam
	B3	66-112	sandy loam
	C1	112-122	loamy sand
	C2	122-	gravel
7.	Ap	0-36	
	B2	36-71	heavy loam
	B3	71-102	sandy loam
	C1	102-117	loamy sand
	C2	117-	gravel

Table 15.1 (Continued)

Key to Augered Samples			
	Horizon	Depth (in cm)	Description
8.	Ap1	0-20	
	Ap2	20-46	
	B1	46-58	
	B21	58-76	loam
	B22	76-84	heavy loam
	C	84-	gravel
9.	Ap1	0-20	
	Ap2	20-41	
	B1	41-56	loam
	B2	56-66	heavy loam
	B3	66-76	sandy loam
	C	76-	gravel
10.	Ap1	(similar to 11)	
	Ap2		
	B1		
	B2		
	B3		
	C		
11.	Ap	0-30	
	B2	30-58	loam
	C1	58-76	sandy loam
	C2	76-91	loamy sand
	C3	91-	gravel
12.	Ap1	0-23	silt loam; weak to moderate subangular blocky
	Ap2	23-46	silt loam; strong crumb
	B1	46-58	silt loam
	B2	58-71	silt loam
	A1b	71-91	silt loam
	B1b	91-107	silt loam; faint mottles
	B2b	107-142	silty clay loam; prominent mottles; moderate subangular blocky (?)
13.	Ap	0-38	
	B2	38-53	silt loam
	A1b	53-74	silt loam
	B2b	74-89	silt loam
	B31b	89-107	sandy loam
	B32b	107-119	sandy loam
	C1	119-	loamy sand

Table 15.1 (Continued)

Key to Augered Samples			
	Horizon	Depth (in cm)	Description
14.	Ap	0-30	silt loam
	B2	30-46	loam
	B3	46-61	sandy loam
	C	61-	gravel
15.	Similar to 13		
16.	Similar to 13		
17.	Ap	0-30	
	B1	30-36	heavy silt loam
	B21t	36-53	silty clay loam
	B22t	53-63	clay loam; very plastic, very sticky
	B23t	63-76	clay loam
	B24	76-91	silty clay loam
	C	91-	
18.	Similar to 19		
19.	Ap	0-23	dark brown (7.5 YR 3/2) heavy silt loam with strong medium crumb structure, friable when moist, slightly sticky and slightly plastic when wet, pH 6.0, abrupt smooth boundary.
	B21	23-43	dark reddish brown (5 YR 3/4) silty clay loam with moderate medium angular blocky structure, friable when moist, sticky and plastic when wet, pH 5.8, abrupt smooth boundary, few thin clay films on ped faces.
	B22t	43-63	dark reddish brown (2.5 YR 3/4) clay loam with strong medium angular blocky structure, firm when moist, very sticky and very plastic when wet, pH 5.6, gradual smooth (?) boundary, many thick clay films on ped faces and in pores.
	B23t	63-81	yellowish-red (5 YR 4/6) clay loam with strong medium to fine angular blocky structure, firm when moist, sticky and plastic when wet, pH 5.4, clear, smooth (?) boundary, many thick clay films on ped faces and in pores.

Table 15.1 (Continued)

Key to Augered Samples		
Horizon	Depth (in cm)	Description
B31	81-99	reddish brown (5 YR 4/4) heavy loam with moderate medium subangular blocky structure, firm when moist, sticky and plastic when wet, pH 5.4, clear, smooth (?) boundary.
B32	99-117	reddish brown (5 YR 4/4) sandy loam with weak medium subangular blocky structure, very friable when moist, slightly sticky and nonplastic when wet, pH 5.4, abrupt, smooth (?) boundary.
IIC1	117-	gravel; unable to sample with auger.

under periglacial conditions following the latest deglaciation. Although a clast comparison between the gravels and colluvium could not be performed for the Fisher Farm area, these gravels are also considered Pleistocene in age.

The passing of time is marked by successive migrations of the stream channel to and from the immediate study area. At one point, sediments are partially dissected by localized stream activity, leaving an irregular, somewhat higher terrace feature. At a later date (see below), particularly vigorous stream activity took place, scouring deeply into the gravel and exposing bedrock. The eventual stranding of this channel and the sealing off of its outlets with floodplain deposits resulted in the localized depression. The filling of this depression over an approximately 2500 year span resulted from slope denudation and stream flooding. Evidence presented in the following section and in Chapter 16 suggests that drainage conditions within the depression varied over this time span. Most importantly, however, the processes responsible for the gradual filling of the channel continued through the roughly 800 year episode when Late Woodland populations occupied the adjoining terrace.

IV. THE INTERNAL STRUCTURE OF THE STRATIFIED DEPRESSION

Stratigraphic information for the stream channel derived from 3 sources: archaeological test trenches, auger holes placed in the bottom of complete test trenches, and a backhoe cut made along the N12 line just prior to backfilling the excavations in 1978. Figure 15.3 shows the position of relevant test trenches excavated during 1977 and 1978 as well as the locations of stratigraphic profiles and soil profiles discussed in this chapter. Figure 15.4-15.10 illustrate the key stratigraphic profiles.

Each of the strata filling the depression was surprisingly uniform in color and texture throughout its expanse. The excavators had little trouble identifying boundaries between strata except in cases of localized aboriginal disturbance. Only Stratum 7, which was highly localized along the lower edge of the terrace, caused any identification problems. This general clarity, coupled with the evidence for a gradual rather than an erratic filling history, permitted the archaeologists to follow the natural stratigraphy in their vertical excavation procedures. Each stratum served as a Master Level, numbered 1-8. Master Levels that were particularly thick and were known to contain significant archaeological deposits were further subdivided into arbitrary (often 5 cm) layers. These latter distinctions were recorded with the letters A-E as needed.

The lower half of the channel feature was filled with very fine grey silt deposits containing no archaeological materials, only numerous layers and pockets of peaty material. This pre-cultural deposit was labeled stratum 8. Strata 4-7 were intact, culture-bearing deposits that filled the upper half of the depression. However, deposits continued to form on top of the channel as a result of terrace erosion and stream flooding. We believe the artifacts in Stratum 3 resulted from post-occupational wash deposits while those of Strata 1 and 2 were so displaced by plow activity that they are of no comparative value.

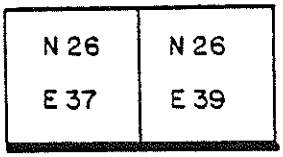


FIG. 15.4

FIG. 15.5

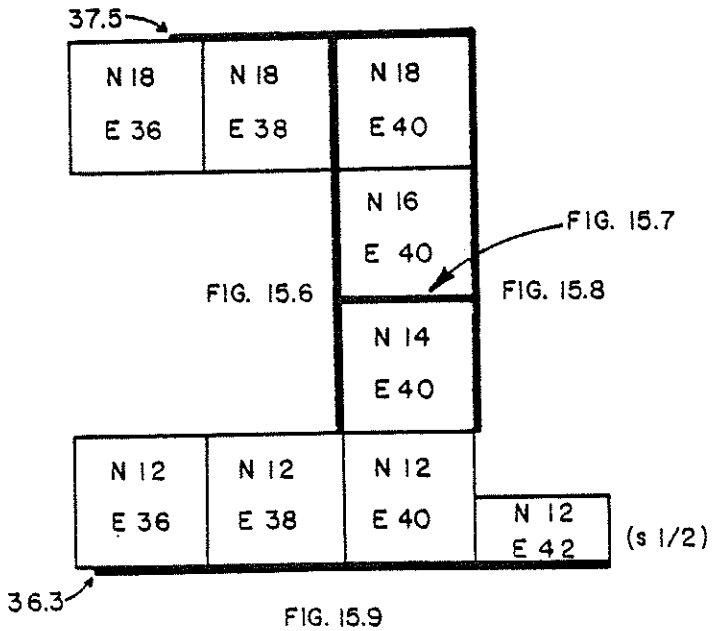


FIG. 15.9

FIG. 15.10

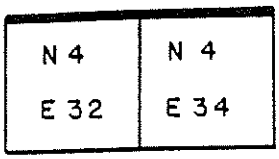


Figure 15.3: Principal Excavation Units in the Stream Channel--Profile Key

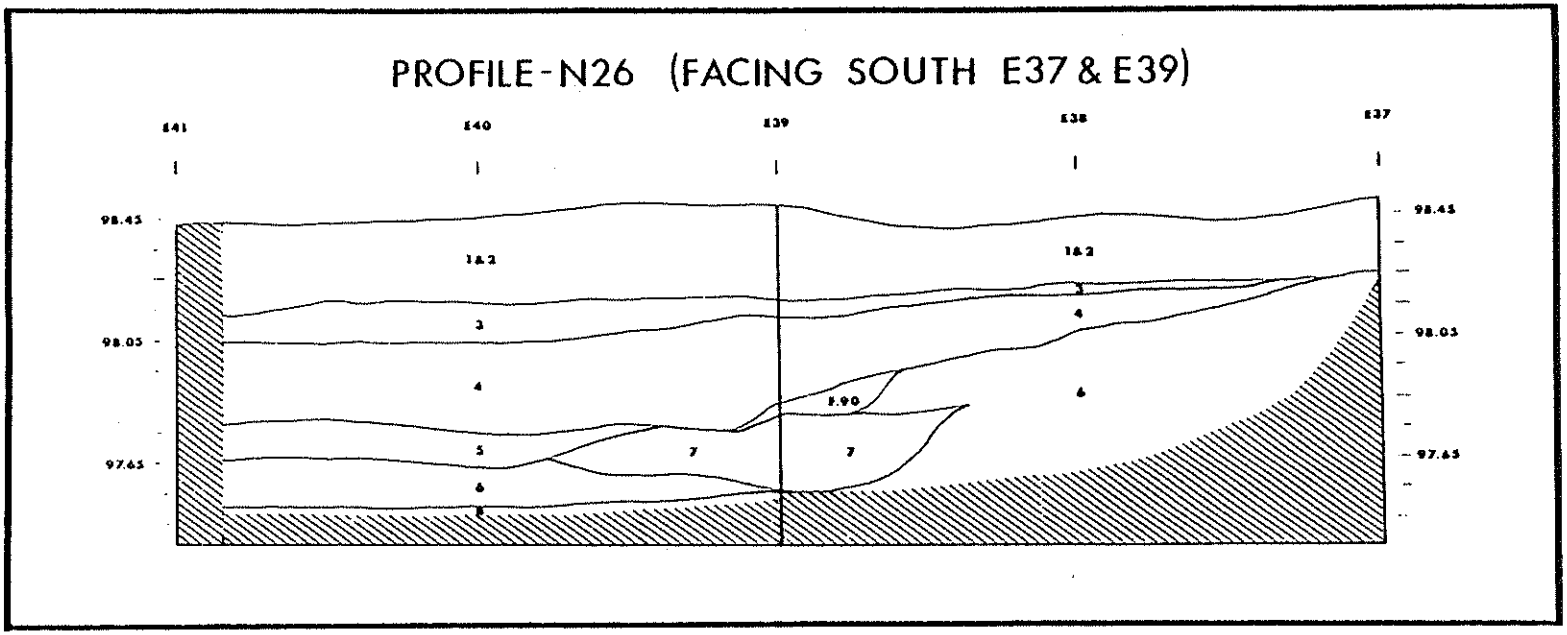


Figure 15.4: Stratigraphic Profile--N26E37-41

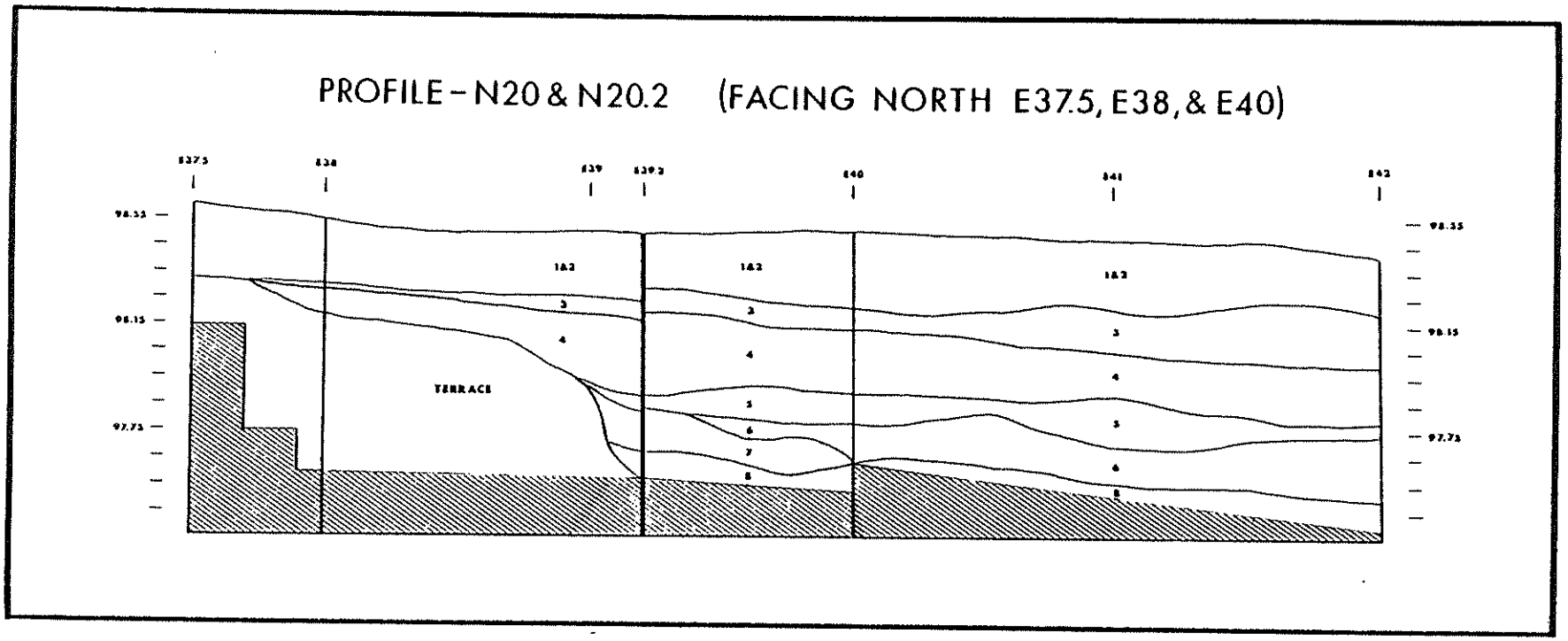


Figure 15.5: Stratigraphic Profile--N20 and 20.2E37.5-42

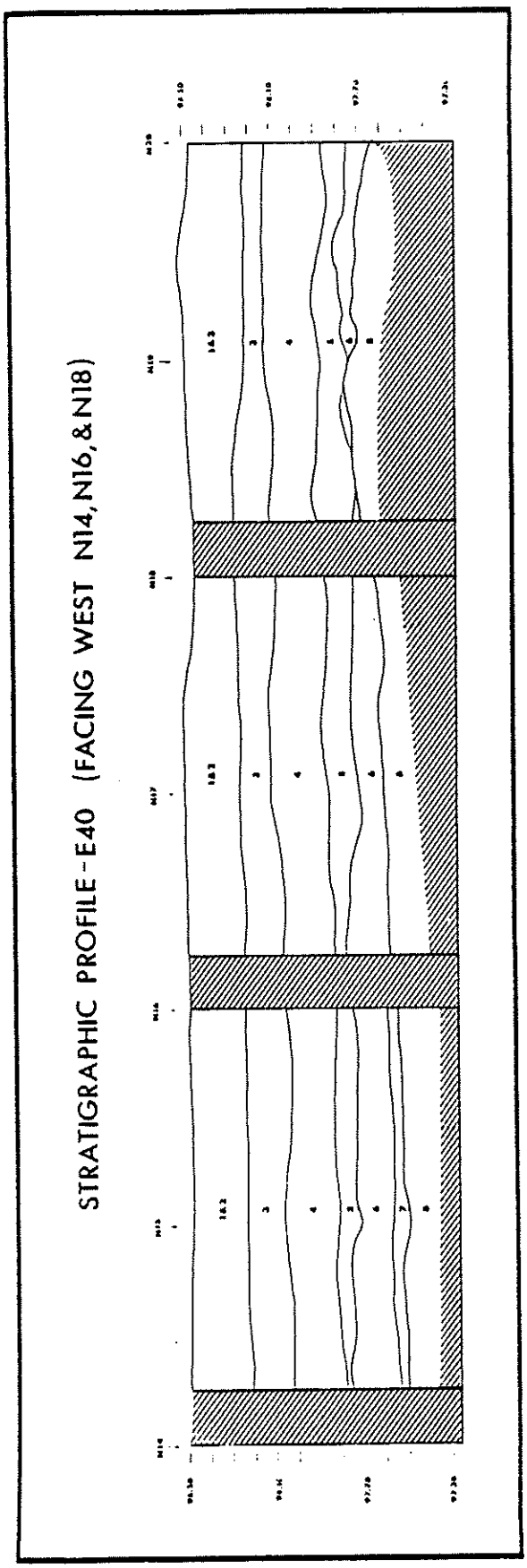


Figure 15.6: Stratigraphic Profile--N14-20E40

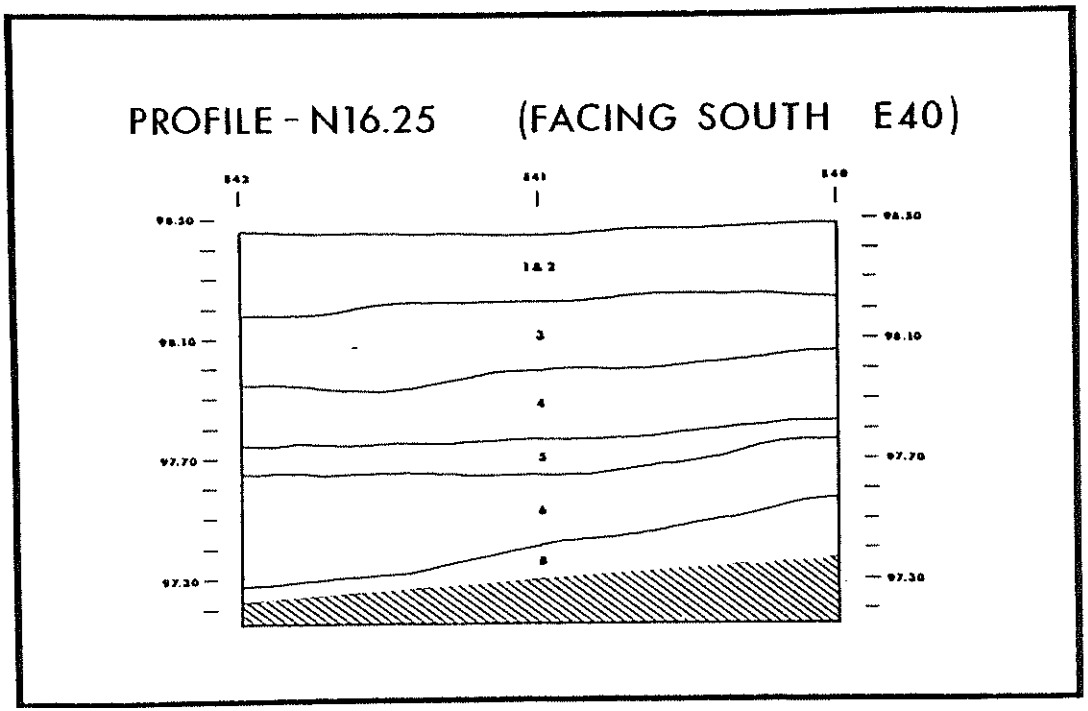


Figure 15.7: Stratigraphic Profile--N16.25E40-42

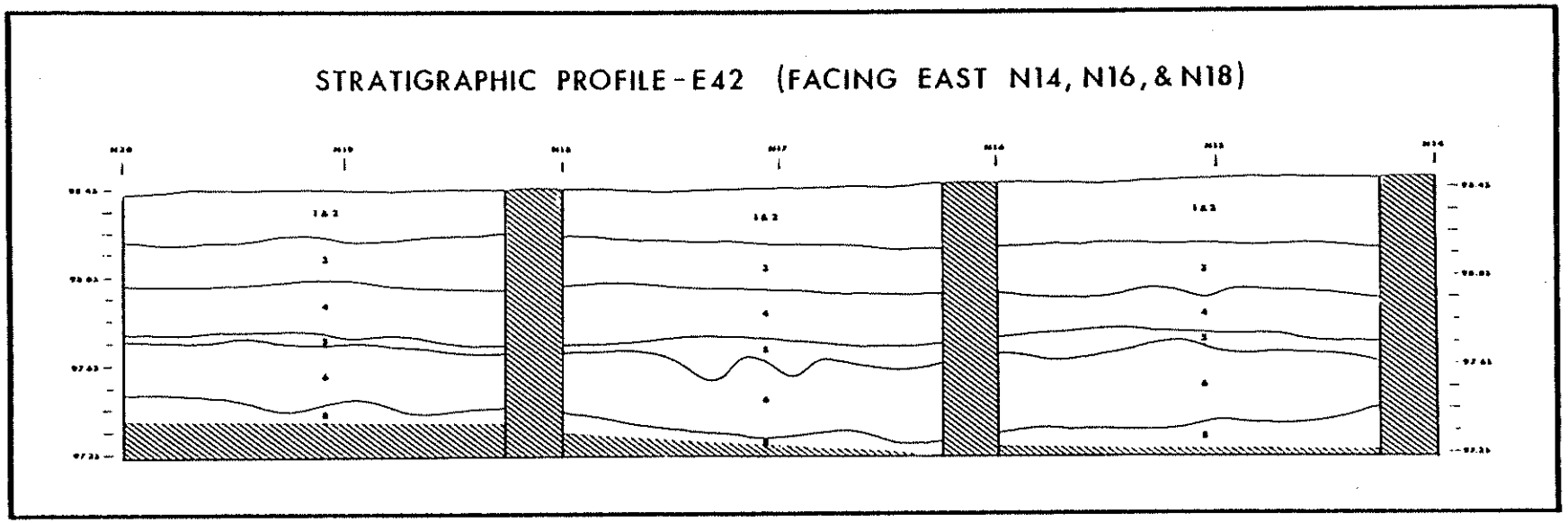


Figure 15.8: Stratigraphic Profile--N14-20E42

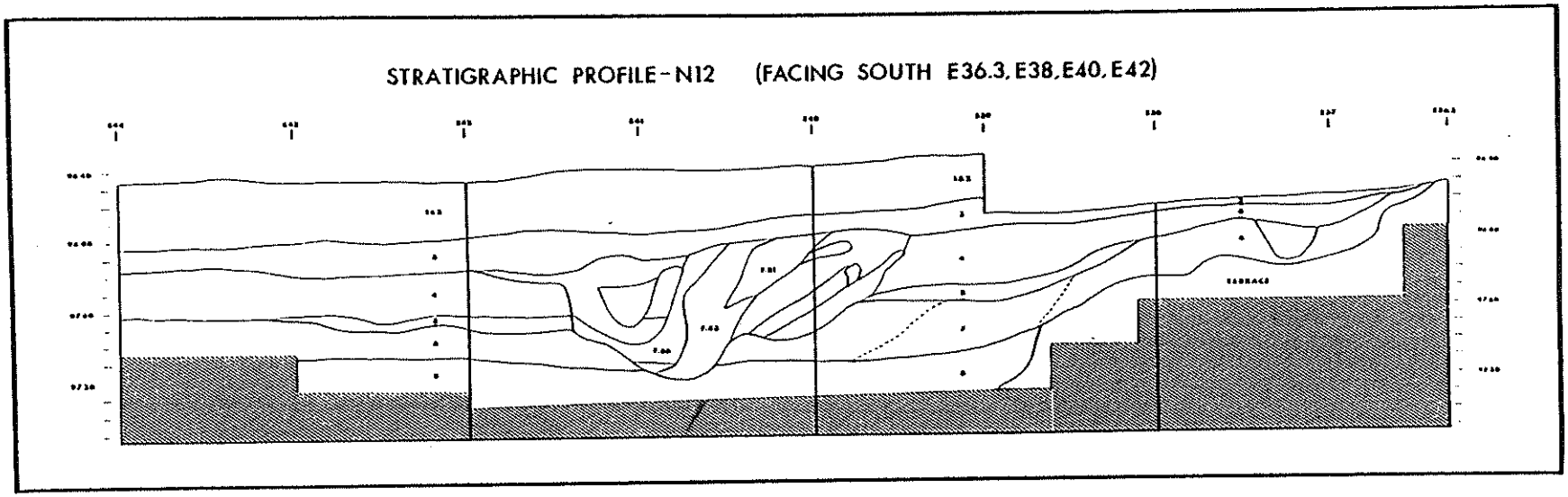


Figure 15.9: Stratigraphic Profile--N12E36.3-44

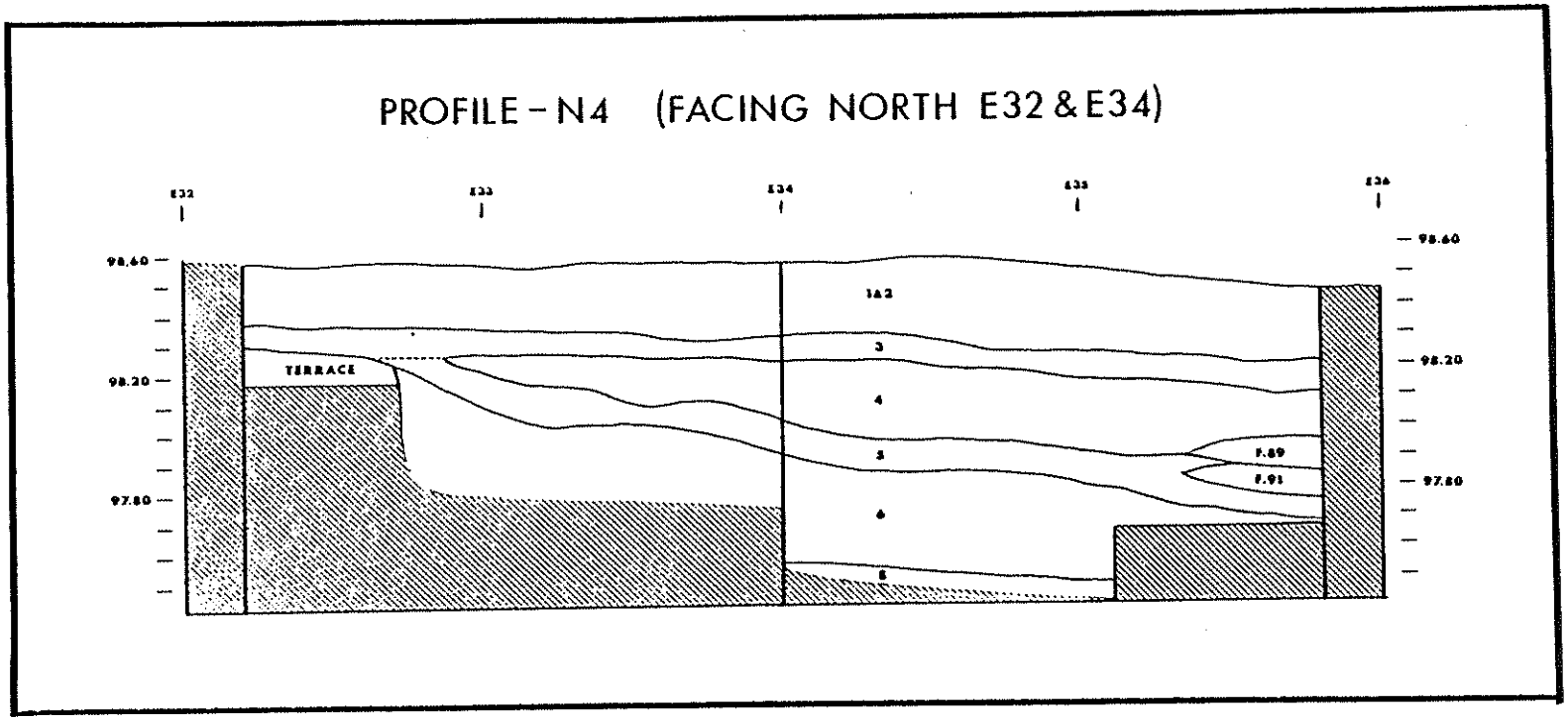


Figure 15.10: Stratigraphic Profile--N4E32-36

Two points must be remembered in order to properly interpret the illustrated profiles. First, all profiles either include part of the terrace or are close enough to it to exhibit a W-E downhill tilt in most strata. No excavations were made (and hence, no profiles were drawn) more than a few meters from the terrace edge since it was assumed that most discarded village material would be along this slope. Second, the excavation units were aligned on the N-S grid to maintain compatability with the work of previous years at Fisher Farm. However, the interface of the terrace and stream channel was only approximately N-S and it curved to the southwest in the southern portions of our excavation. Because of this, our 1978 excavation units can be thought to "slide" obliquely off the terrace and into the channel as one moves from north to south. This effects the N-S profiles (for example, Figure 15.6) by making the upper boundaries of certain strata appear to drop from north to south (top of Stratum 5) and by making some stratum appear thicker in the south than in the north (Stratum 6).

Soil profiles, designed to corroborate the stratigraphic distinctions made by the archaeologists and to help determine the history of filling, were made at two points along the N12 line; one near E37.5 and another near E42.5. Auger tests into the floor of the trenches at these points were verified by the backhoe cut made later along this line (not shown in Figure 15.9). Tables 15.2 and 15.3 describe these profiles, while Table 15.4 compares them to the Master Level sequence.

Two important results follow from these tables. First, we were correct in assuming a close fit between the strata defined by the archaeological crew on the basis of color and texture and the more formally defined soil horizons. Second, soil profiles of the channel area are morphologically distinct from those of either the floodplain or the terrace.

V. TEMPORAL ASPECTS OF THE CHANNEL STRATIGRAPHY

Five radiocarbon dates provide direct chronologic control over the formation and filling rate of the channel area (see Chapter 17 for a fuller discussion of their context). Sample 11 consisted of wood derived from the peaty material that was directly overlying the bedrock formation in N12E42. The uncorrected date of 470±80 B.C. indicates this is the approximate time of the channel abandonment. We view the peaty material to be accumulated forest litter that fell into the channel in the time between the last significant water flow and the first accumulation of blue-grey silty deposits in Stratum 8. This date clearly marks the earliest point of stream channel deposition. Samples 6 and 9 are both associated with Stratum 6. By this time, significant aboriginal occupation occurred on the adjacent terrace. This and all subsequent occupations apparently used the depression as a refuse dump, with the volume of organic and inorganic debris affecting the character of soil development. The clearing of forests that presumably took place on the terrace and the adjoining floodplain also changed the amount and character of the material entering the depression. Dates of 1520±55 A.D. and 1505±55 A.D. for Samples 2 and 3 in Levels 4A and 4B, respectively relate to the last known aboriginal occupation at Fisher Farm.

Table 15.2: Soil Profile at N12E37.5

Horizon	Depth (in cm)	Description
Ap1	0-27.9	Dark brown (10 YR 3/3) silt loam with weak medium to fine subangular blocky structure, friable when moist, slightly sticky and slightly plastic when wet, pH 5.8, abrupt smooth boundary.
Ap2	27.9-33.0	Dark brown (10 YR 3/3) silt loam, massive, friable to firm when moist, sticky and slightly plastic when wet, pH 5.8, abrupt smooth to wavy boundary.
B2	33.0-35.6	Dark reddish brown (5 YR 3/3) silt loam with weak medium subangular blocky structure, friable when moist, slightly sticky and slightly plastic when wet, pH 5.6, abrupt wavy boundary.
A11b	35.6-43.2	Very dark gray (5 YR 3/1) silt loam with weak to moderate medium subangular blocky structure, friable when moist, slightly sticky and slightly plastic when wet, pH 5.4, gradual smooth boundary, few pieces of fire-cracked rock, many thick clay films in worm channels.
A12b	43.2-67.3	Dark brown (7.5 YR 3/2) silt loam with moderate medium subangular blocky structure, friable when moist, slightly sticky and slightly plastic, pH 5.6, abrupt smooth boundary, charcoal fragments are more abundant, many thick clay films in worm channels.
B2b	67.3-85.1	Dark reddish brown (5 YR 3/4) loam with weak to moderate subangular blocky structure, very friable when moist, slightly sticky and slightly plastic when wet, pH 5.2, abrupt smooth boundary, many clay films in worm channels.
A1b2*	85.1-116.8	Dark reddish brown (5 YR 3/2) silt loam with weak fine to medium subangular blocky structure, friable when moist, slightly sticky and plastic when wet, pH 5.4, abrupt irregular boundary, many clay films in worm channels.

Table 15.2 (Continued)

Horizon	Depth (in cm)	Description
IIB21b2**	116.8-132.1	Yellowish brown (10 YR 5/4) very cobbly silty clay loam with many coarse prominent strong brown (7.5 YR 5/8) mottles, moderate medium to fine angular blocky structure, friable when wet, pH 5.4, clear smooth boundary, many 3-10" size rounded to sub-angular cobbles.
IIB22b2**	132.1-	Pale brown (10 YR 6/3) cobbly silty clay loam with many coarse prominent yellowish red (5 YR 5/8) mottles, moderate medium angular blocky structure, friable when moist, sticky and plastic when wet, pH 5.4, very stony.

*(A1b2) indicates A-horizon of the second buried soil.

**(IIB21b2 and IIB22b2) indicates B horizons of second buried soil; however, these horizons greatly resemble the subsoil of the terrace rather than floodplain soil materials.

Table 15.3: Soil Profile at N12E42.5

Horizon	Depth (in cm)	Description
Ap1	0-34.3	Very dark grayish brown (10 YR 3/2) silt loam with moderate medium subangular blocky structure, friable when moist, slightly plastic when wet, pH 5.6, abrupt, smooth boundary.
Ap2	34.3-35.6	Dark brown (10 YR 3/3) silt loam with massive structure, although moderate medium platy structure in upper part, firm when moist, slightly sticky and slightly plastic when wet, pH 5.6, abrupt, smooth boundary.
B2	35.6-45.7	Dark reddish brown (5 YR 3/4) heavy silt loam with weak medium subangular blocky structure, massive in upper part, friable when moist, slightly sticky and plastic when wet, pH 5.6, abrupt, smooth boundary, many clay films in worm channels.
A11b	45.7-71.1	Dark reddish brown (5 YR 3/2) silt loam with weak to moderate medium subangular blocky structure, friable when moist, slightly sticky and slightly plastic when wet, pH 5.6, clear smooth boundary, many thick clay films in many worm channels, and frequent coarse fragments of fire-cracked rocks, compacted in upper part of horizon.
A12b	71.1-81.3	Dark brown (7.5 YR 3/2) silt loam with weak to moderate medium subangular blocky structure, friable when moist, slightly sticky and slightly plastic when wet, pH 5.8, abrupt smooth boundary, many thick clay films in many worm channels, fire-cracked rock common in horizon, charcoal very abundant.
B21b	81.3-94.0	Dark brown to brown (7.5 YR 4/4) loam with moderate medium to coarse subangular blocky structure, friable when moist, slightly sticky and slightly plastic when wet, pH 5.4, clear smooth boundary, common thin clay films in worm channels.

Table 15.3 (Continued)

Horizon	Depth (in cm)	Description
B22b	94.0-114.3	Dark brown to brown (10 YR 4/3) loam with moderate medium subangular blocky structure, friable when moist, slightly sticky and slightly plastic when wet, pH 5.4, abrupt smooth boundary, charcoal abundant in horizon.
B3b	114.3-129.5	Dark gray (10 YR 4/1) loam with weak medium subangular blocky structure, friable when moist, slightly sticky and slightly plastic when wet, many medium distinct strong brown (7.5 YR 5/8) mottles, pH 5.2, clear smooth boundary, charcoal abundant in horizon.
C1	129.5-162.6	Dark gray (10 YR 4/1) silty clay loam, massive, firm when moist, very sticky and very plastic when wet, pH 5.0, many coarse prominent yellowish-red (5 YR 5/8) mottles, abrupt smooth boundary, many 1/4"-1/2" sized charcoal fragments.
IIC2g	162.6-254.0	(augered; data incomplete) Bluish-gray (5 B 6/1) silt, massive, gravel stringer at 64" level, firm when moist, sticky and plastic when wet.
IIIC3g	254.0-309.9	Fibrous, leaf, stem materials, some altered; pine cones present.
IVC4	309.9-	Gravel (no sample augered).

Table 15.4: Relationship of Soil Profiles to Master Levels in the Stream Channel

Master Level	N12E37.5	N12E42.5	Radiocarbon Dates*
1	Ap1	Ap1	
2	Ap2	Ap2	
3	B2	B2	
4	A11b A12b	A11b A12b	1520±55 A.D., 1505±55 A.D.
5	B2b	B21b	
6	B2b	B22b	1130±80 A.D., 960±90 A.D.
Terrace	A1b2 IIB21b2 IIB22b2		
8		B3b C1 IIC2g IIIC3g IIIC1 IVC4 Peat Layer	470±80 B.C.

*Not tree ring corrected.

Numerous artifacts were discovered in Strata 1-7 that stylistically relate to the several episodes of Late Woodland culture history in Pennsylvania. While Chapters 18 and 19 deal with this material in detail, we can say here that their sequential occurrence in these strata independently substantiates the radiocarbon dates and argues for gradual filling processes and temporally meaningful vertical deposits.

A final point can be made about the soil profiles. Cambic horizons were discovered in 2 vertically separate areas of the channel stratigraphy. One weak cambic horizon was discovered in the recent strata (1-3), all clearly dating after 1520±55 A.D. Elsewhere, the B21b and B22b horizons are cambic horizons with moderate subangular blocky structure that probably formed between 1000 A.D. and 1300 A.D. These dates are in agreement with Bilzi and Ciolkosz (1977:122) who state that cambic horizons can develop in less than 200 years and may persist after 2000 years of soil development.

CHAPTER 16

THE PALYNOLOGY OF THE STREAM CHANNEL AT FISHER FARM

LARRY J. GORENFLO

I. INTRODUCTION

A palynological study was conducted with data from the Fisher Farm site. The pollen samples submitted for analysis were collected during the 1978 excavation season and originated from an area thought to represent a prehistoric stream channel. Two series of samples were obtained from these deposits: an upper sequence consisting of 6 samples collected from the Late Woodland cultural levels of the site, and a lower sequence consisting of 5 samples collected from the gray silt deposits underlying the cultural levels. It should be noted that this latter sequence, though representing pre-Late Woodland levels at Fisher Farm, dates to a time period when there was some aboriginal habitation elsewhere in the Bald Eagle Valley.

Two basic goals were established at the outset of this study. The first was to determine the microenvironment of deposition for the samples. A geological examination of the deposits and the field impressions of the excavators both suggest that this particular locale is an isolated flood channel of what was once part of the Bald Eagle Creek. The second goal was to determine when and how the initial impact of agriculture affected the environment around the Fisher Farm Site. The presence of cultigen pollen, along with signs of a deforestation episode, were to be the main lines of evidence.

II. COLLECTING AND PROCESSING OF SAMPLES

The two sequences of pollen samples were obtained during different phases of the excavations at Fisher Farm. The upper sequence was collected during the excavation of the midden. Excavation unit walls were "cleaned" flat and square with a trowel, and 6 soil samples for pollen analysis were extracted at various levels. The lower sequence, on the other hand, was collected during the backhoe investigation of the gray silt deposits at the conclusion of the 1978 season. While no additional cultural material was discovered in this trench, the presence of well-preserved lenses of peat and macrobotanical remains was noted and 5 additional pollen samples were collected. Both sequences were removed at approximately N12E42.5.

The laboratory processing of these samples proved difficult. A cursory inspection of each suggested that they consisted of incompletely sorted sand-clay-silt soil and relatively large amounts of organic material. The presence of organics in such quantities ruled out the use of a zinc chloride gravity separation and demanded techniques that would destroy the undesirable organic and inorganic constituents of the matrix. Initial treatments with warm 10% hydrochloric acid and warm 52% (concentrated) hydro-

fluoric acid were carried out to remove the lithic materials (carbonates and silicates, respectively). In most cases, these treatments are sufficient to destroy the lithic debris. However, in this case, small, highly dissected lithic material remained. Repeated treatments with concentrated hydrochloric and hydrofluoric acid yielded similarly unsatisfactory results.

Problems continued when an attempt was made to destroy the excess organic material in the samples. Since much of this material appeared to be leaf cuticle and wood, a ten-minute acetolysis treatment was initially used. This treatment proved quite unsuccessful, however. Subsequent experimentation indicated that the unwanted organics remained in acetelation treatments up to 17 minutes, although some destruction did occur to the palynomorphs. Similar treatments with both 5% and 10% potassium hydroxide were also tried, but the results resembled those of the acetolysis treatments.

At this point it was clear that slides made from the partially macerated palynological samples would be so "dirty" and palynologically sparse that they would be virtually useless. The one remaining approach was to try to physically remove the unwanted materials. Two screens were selected for this operation, one with 125 micron openings and one with 25 micron openings. Since most recent palynomorphs are between these size extremes, discarding all of the material that passes through the smaller screen and remains in the larger screen should eliminate the unwanted materials and retain the palynomorphs.

It should be briefly noted that screening techniques like those used here may produce non-representative samples. If too little or too much material passes through the respective screens, the smallest and largest palynomorphs will not be included in representative quantities. These problems were controlled in this research by placing the residue in the 125 micron screen and washing it with a minimum of 600 ml of distilled water at high pressure. This assured that the larger palynomorphs passed through the screen. The remaining residue was then placed in the small screen, but was not washed as thoroughly since the 25 micron mesh size was larger than some angiosperm grains. As a final check, the material which passed through the smaller screen was mounted on slides and examined. Virtually no palynomorphs were found on these slides, suggesting that these residues may indeed be considered representative.

Final slide preparation was completed with a glycerin jelly mounting medium. The microscopic examination of these slides was carried out with an Olympus microscope, with counts being made at 400x magnification. As is customary in palynological investigations, grains were identifed as to genera and subsequently separated into 2 classes, arboreal pollen (AP) and non-arboreal pollen (NAP; fern and fungal spores, grass pollen, etc.). Where possible, a minimum of 300 arboreal pollen grains were counted per sample.

III. THE DATA

A. UPPER SEQUENCE

From an archaeological perspective, the samples of greatest interest are those from the upper sequence. These are the samples from the cultural levels, and it was through their study that we hoped to gain a better understanding of the environment at Fisher Farm during Late Woodland times. Such are the best laid plans. The goals were there, but the data were not, for all 6 of these samples were essentially devoid of any pollen.

Fortunately, other palynomorphs were present in these samples. The most important of these are algal resting cysts, achritarchs, and dinoflagellates. No counts were made, but the simple presence of these items gives us some clue as to the microenvironment of their deposition. Algae, achritarchs, and dinoflagellates are all organisms that live in fresh water environments. The presence of algae in the form of resting cysts suggests that this locale was not permanently inundated, but rather was repeatedly wet and dry. The combination of spring thawing and rains, along with a water table that can rise as much as 4' overnight (Hatch, personal communication), can be proposed as the sources of this water. Fungal spores and fungal tissue were also encountered, with a large amount of decaying wood in the samples as a potential host. Taken together, these data support the evidence presented in Chapter 15 that this area was a depression that was alternately wet and dry during different periods of the year. Pieces of wood dropped in or were thrown in and subsequently decayed. The paucity of pollen is somewhat of a mystery, and will be discussed below.

B. LOWER SEQUENCE

The absence of pollen in the upper sequence was an initial disappointment, since these were the samples of greatest archaeological concern. However, the fact that few post-Pleistocene pollen studies have been conducted in central Pennsylvania (Sears 1935; Kovar 1964,1967; Guilday et al. 1964) justified the examination of the rest of the samples.

Some chronological control is possible for this lower sequence. Two radiocarbon dates, one from the very bottom of the backhoe trench from which these samples originated and one from Level 6A of the upper sequence of samples, can be used to infer the dates of pollen samples in the intermediate positions. Assuming a constant rate of deposition in the lower deposit (and there is no geological evidence to assume otherwise) approximate dates can be calculated (Table 16.1).

The uppermost sample of the 5 in this lower sequence (Sample 1001) palynologically resembles those in the upper sequence; that is, it contains fresh water plants and animals but virtually no pollen. Though some pollen occurs in the next lowest sample, it is not until we reach the lowest 3 (Samples 1003-1005) that we find AP counts of adequate size for comparison.

Table 16.1: Estimated dates of the lower sequence pollen samples

Sample Number	Estimated Date
1001	695 A.D.
1002	520 A.D.
1003	260 A.D.
1004	100 A.D.
1005	725 B.C.

The pollen grains included in the AP category are Pinus, Tsuga, Carya, Juglans, Quercus, Faegus, and Larix. Graminae, Liliacae, Pteridium, and Monolete fern spores comprise the identified NAP palynomorphs. The AP and NAP counts and percentages are presented in Table 16.2 and Figure 16.1. As is customary with post-Pleistocene pollen studies, these counts are based on a "pollen sum", or the sum of the AP counts, as a statistic from which to calculate percentages (Faegri and Iversen 1975:124-25).

One aspect of the pollen profile for this lower sequence deserves some mention. As is clear from Table 16.2, there are very few different species of plants represented in these strata. This suggests either a very limited, homogeneous general environment, or a very specific and localized floral representation in and near the area of deposition.

IV. DISCUSSION

As Faegri and Iversen point out, pollen counts are "representations of vegetation, and any attempt to consider them as anything else is bound to lead to confusion" (Faegri and Iversen 1975:145-46). One needs to consider several factors when examining pollen profiles. Perhaps the 3 most important are differential pollen production, pollen transportation, and deposition and survival.

Certain plants produce larger quantities of pollen than others. For instance, a maple tree may produce 1000 pollen grains in one season, while some species of pine produce upwards of 350 million (cf. Faegri and Iversen 1975:52). Koski (1970, cited in Faegri and Iversen 1975:53) calculates that Finnish pine forests may produce as many as 80 kg of pollen per hectare each season, or approximately 280,000 grains per cm^2 of forest floor. It is easy to see how the presence of some grains in small quantities may indicate more actual plants than large quantities of another.

The mechanism of pollen transportation is also an important consideration when examining pollen profiles. There are two basic forms of transportation--wind and insect. These transportation systems also indirectly relate to pollen production, since wind transported pollen is usually produced in much larger amounts than is pollen transported by insects. Pollen carried by the wind is often over-represented in samples, not only because of its greater production, but also because of its greater chance of falling on a given depositional area in the form of "pollen rain." The

Table 16.2: Pollen Percentages at Fisher Farm[a]

	Arboreal Pollen								Non-Arboreal Pollen				
	Pinus	Tsuga	Carya	Juglans	Quercus	Faegus	Larix	N	Graminae	Liliacae	Pteridium	Fern Spores	Other
#1002	22.2	35.2	38.8	---	---	---	3.7	54	24.0	1.8	16.6	66.0	
#1003	45.3	31.3	22.4	T	---	T	T	335	2.4	1.2	T	1.2	
#1004	48.5	31.0	17.5	T	1.7	T	T	303	T	---	T	4.9	
#1005	46.0	18.6	22.0	2.0	1.3	4.6	---	300	1.0	8.3	1.3	3.6	2.0

[a] "T" indicates palynomorphs present in quantities less than 1% of Arboreal Pollen.

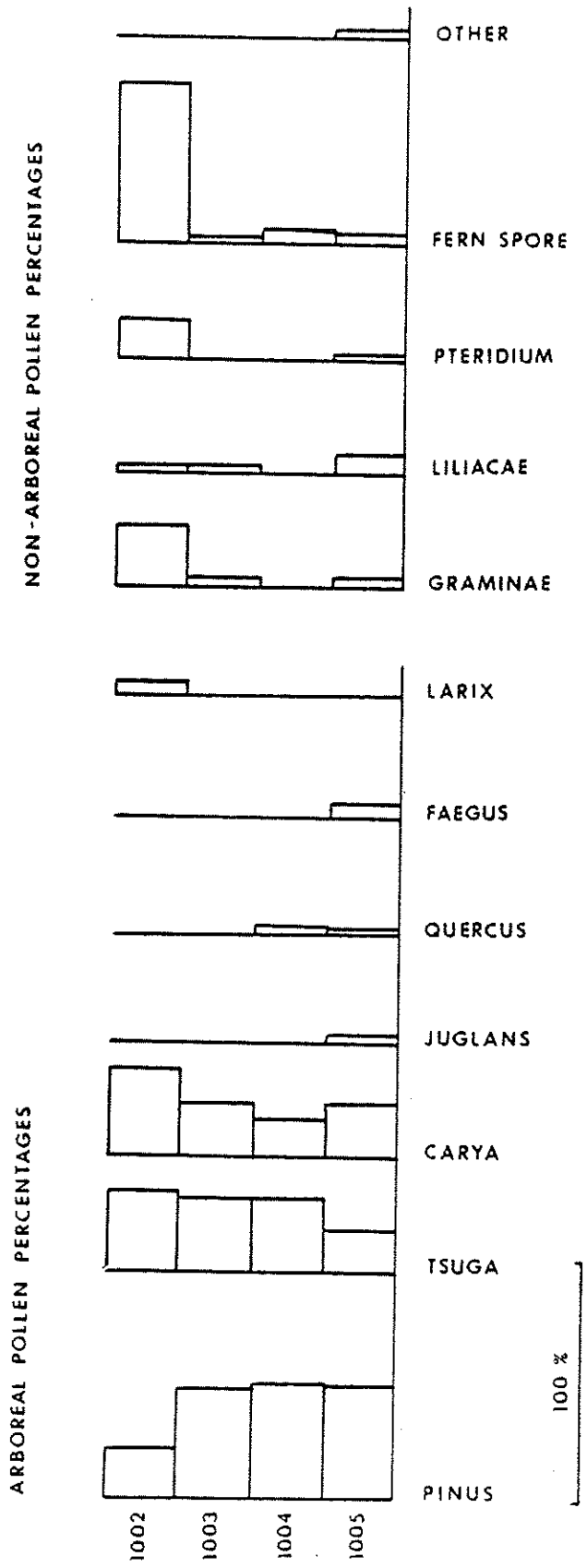


Figure 16.1: Pollen Profile for Samples 1002-1005

range of dispersal for windblown pollen is greater than that of insect-borne pollen. The presence of a grain like pine, which is morphologically capable of being transported great distances, does not at all guarantee that there was pine in the immediate area at the time of deposition. Fortunately, as Traverse (personal communication) points out, the majority of a plant's pollen is usually deposited within a few hundred yards. Thus, the presence of wind transported pollen can give us a general idea about the local areal vegetation.

Finally, one must be aware of the deposition and survival characteristics of different palynomorphs. Some grains have thicker and sturdier exines, or outer shells, than do others. Thus in particular environments certain grain types may not be rigorous enough to survive. Erdtman (1930:159-60), in discussing the interpretation of pollen statistics, suggests that it is necessary to understand a microenvironment's ability to catch and preserve palynomorphs before we can understand a given profile. For example, some grasses produce their pollen in early to mid-July (Rowley 1955:56-59). If a location was not receptive during this time of year, prohibiting the pollen's quick diffusion into the deposit, the grass pollen would remain on the surface and would not be preserved.

With these limitations in mind, we can now turn to the examination and interpretation of the pollen record of the Fisher Farm Site. The 3 bottommost samples provide us with the most reliable data, but there is little exciting change in their pollen profiles. Three types of pollen grains, Pinus, Tsuga, and Carya, make up the majority of the profile. All 3 of these grains are from large pollen producers and are wind transported. Tsuga, or hemlock, is the most environmentally sensitive of these 3 types and is usually associated with moist climates. The other 2 do not provide us with many environmental clues, since the different species within Pinus (pine) are (as is commonly done because of the difficulty in distinguishing among them) lumped into 1 group, and Carya (hickory) can exist in a wide range of environments outside of its optimum (Walker et al. 1960: 470). The data suggest a fairly warm and humid climate in the Bald Eagle Valley during the episode corresponding to the Middle Woodland Period.

The data from sample number 1002, although sparse, are included in both Table 16.2 and Figure 16.1 to demonstrate the sharp decrease in arboreal pollen at this level. The counts are based on the examination of 2 complete slides. Although the counts are statistically insufficient for detailed comparisons with the other samples, the severe decline they collectively indicate is probably a real one in the deposit. In attempting to explain the decrease in AP, we once again encounter possible problems in interpretation. Faegri and Iversen suggest that 3 possible causes may be used to explain pollen scarcity: 1) rapid growth of the deposit, 2) subsequent destruction of the pollen grains after deposition, and 3) low pollen production of adjacent vegetation (1975:108). The first cause does not seem applicable here, given the homogeneity of the gray silt deposit from which all samples in the lower sequence derived. On the other hand, either of the latter 2 causes are feasible. Number 2 relates, in a simplified way, to Erdtmen's discussion of the complexity of bog environments cited above. The presence of some pollen grains in these higher strata

does not, however, indicate an environment that is totally unreceptive to pollen grains, but rather one that is varyingly receptive at different times of the year. The drying out of the locale during the summer, thus lowering the amount of pollen entering the deposit, is a possible explanation. Number 3 relates to a number of factors that could change the vegetation contributing pollen to deposit, including fire and aboriginal deforestation. Interestingly, Florin's study of an agricultural clearance phase in Europe characterizes the area as initially covered with mixed forests, after which there is a decrease in the mixed forest pollen grains and a concomitant increase in herb pollen, cereal and weed pollen, as well as grass pollen and fern spores (cited in Erdtman 1969: 170). A similar replacement of AP with NAP as a result of human activity is seen in the pollen record of the post-contact phase of deforestation in the northeastern United States (Bernabo and Webb 1977:82). Archaeological evidence in the Bald Eagle Valley, however, does not support this line of thought. The Middle Woodland Period is poorly represented in the archaeological record of Fisher Farm as well as the Bald Eagle Valley generally (see Chapters 5 and 19).

The same explanations which are offered as possible reasons for a pollen decline in the lower sequence are again offered as explanations of the absence of pollen in the upper sequence. The actual matrix of deposition showed a distinct change in the upper strata as a result of cultural activity. Also, the area was intensively utilized by Late Woodland inhabitants, resulting in ground clearance for village construction, agriculture, and the collecting of building material and fuel.

V. CONCLUSIONS

Pollen studies of archaeological deposits can potentially provide a great deal of information about past environments and human interactions with those environments. However, as is often the case with such studies, several quite viable explanations for the nature of the pollen profile can be offered. Anyone offering a simplified, straight-forward characterization of a past environment needs an exceptional data base from which to work.

The lowest and richest palynological strata at Fisher Farm provide a record of an essentially unchanging mixed forest environment. The presence of Tsuga in relatively large amounts seems to indicate a moist environment, while oak and hickory suggest a warm period. Radiocarbon dates place these strata in the Middle Woodland Period of northeastern United States prehistory. The absence of Middle Woodland artifacts at Fisher Farm would appear to rule out human deforestation as a possible explanation of the AP decline between sample numbers 1003 and 1002. This negative evidence, coupled with the consistency in the lower sequence deposits, points to a changing depositional environment as the major cause of these changes. A shift in moisture patterns, making the locale drier in the middle to late summer, would be one possibility.

The upper sequence of pollen samples provides us with very little palynological data. The evidence we do have suggests a depression that is alternately wet and dry. The causes for the absence of pollen in these levels might relate to the removal of pollen producers from the area and an unreceptive environment for deposition. Clearing land for houses and agricultural fields must have been a common occurrence during Late Woodland times. Radical changes in the environment of depositions also occurred at this time, as evidenced by differences in the strata above and below the Strata 7/8 interface. It therefore seems likely that both of these factors in combination were responsible for the absence of pollen in the upper sequence.

CHAPTER 17

RADIOCARBON DATES FROM THE FISHER FARM SITE

JAMES W. HATCH

I. INTRODUCTION

During the three seasons of excavation at Fisher Farm, 124 samples were collected from archaeological contexts for radiocarbon dating. One additional sample, described below, was removed from stratigraphic contexts that were considerably older than the Late Woodland Period occupation in an effort to monitor the age and early filling rate of the stratified area immediately east of the village. In rare instances specimens of uncharred wood were discovered and saved as sampled material (see Appendix). The vast majority of samples represent partially or completely carbonized plant material (wood, bark, unedible or unusuable byproducts of gathered plants, etc.) from minimally disturbed features or stratigraphic levels.

Radiocarbon analyses have thus far been performed on 11 samples. The selection of these particular samples from the larger collection was mainly influenced by two factors: 1) the need to chronometrically fix the position of major artifact types, allowing for their subsequent use as intra- and inter-site time markers, and 2) the need to monitor the horizontal position of the several episodes of occupation across the terrace. With these as guiding principles, the usual considerations of sample size and contamination also entered into the selection process. All dates reported below are based on the Libby half-life. None have been tree-ring corrected.

II. THE SAMPLES

A. SAMPLE 1, RL-701, 1600±150 A.D., MSN 4 (1976), NO FEATURE NUMBER

Exploratory excavations in 1976 at N22E9 uncovered a series of 3 aboriginal post molds with substantial amounts of carbonized post fragments in place. One of these consisted of a large post whose upper portion had been damaged and slightly misplaced by plowing but whose base was charred and still intact. The exposure of adjacent areas in 1977 proved these 3 posts to be just south of the structure area in Area B (see Chapter 11).

This date confirms our field impressions that much of the activity taking place in this portion of the site was quite late. A middle Late Woodland to late Late Woodland occupation is clearly indicated.

B. SAMPLE 2, UGa 2678, 1520±55 A.D., MSN 356, LEVEL 4A

This large sample of charcoal was removed from the upper portion of Level 4A, at a depth of 97.98 m, in the south extension of square N12E40. Its stratigraphic integrity is sound and the resulting date can be extrapolated to material excavated from 4A throughout most of the stratified

area. Together with Samples 1 and 3 and the archaeological material from Levels 4A and 4B in this area, an unquestioned late Late Woodland occupation can be demonstrated at Fisher Farm

C. SAMPLE 3, UGa 2679, 1505±55 A.D., MSN 229, LEVEL 4B

Two wooden stake-like objects were excavated in 1978. This one has been identified as a portion of a yellow pine branch and it is probable that the other was also (see Appendix and the discussion of Sample 7 below). This sample was located in Level 4B, N12E39, at a depth of 97.91 m. It was adjacent to the edge of Feature 81, part of a complex series of nested pits intrusive into the stratified area around N12E40. Being that close to Feature 81, there was some initial concern as to its stratigraphic integrity. However, the resulting date, both alone and in concert with that of Sample 2 from Level 4A, supports its stratigraphic reliability.

D. SAMPLE 4, UGa 2276, 1350±105 A.D., MSN 43, FEATURE 28

This sample derived from the southwest quadrant of Feature 28, the "keyhole" structure discussed in Chapter 12. The date supports a middle Late Woodland episode of use, as does the discovery of a Shenks Ferry rim sherd in the layered organic remains on the structure's floor. Given the relative frequency of Shenks Ferry ceramics in Stratum 5 and the lower half of Stratum 4 in the stratigraphic area, it is reasonable to infer this date for some moment in the depositional history of these strata. Regionally, the unquestionable association of both the rim sherd and the sample with the keyhole structure helps resolve Smith's dilemma regarding the chronometric position of the approximately 30 keyholes excavated previously in north-central Pennsylvania (1976).

E. SAMPLE 5, RL-702, 1130±110 A.D., MSN 11 (1976), FEATURE 9

A concentration of Clemson Island ceramics, composed of large sections of several vessels nested one inside the other, was discovered in 1976. The contextual association was, at the time of excavation, thought to be a single discrete trash pit. Two adjacent 2 m x 2 m squares, S20E34 and S22E34, captured all of the depression. It was noted, however, that a thin (ca. 5 cm) band of dark soil continued beyond the excavation in all directions. Further excavations in 1977 and 1978 in this and nearby areas demonstrated this feature to be a localized depression positioned near the southern edge of the larger stratified complex that paralleled the eastern edge of the site. Being on its southern periphery, there is no way to directly translate the vertical position of the carbon sample and its associated material into the more complex stratigraphic sequence further north. However, given that a date of 1130±80 A.D. was obtained from Level 6A, a zone rich in Clemson Island ceramics (see Sample 6), and that this sample was physically touching the Clemson Island sherd concentration, we can assume temporal comparability.

F. SAMPLE 6, UGa 2677, 1130±80 A.D., MSN 225, 230, 238, 239, 243, 246, LEVEL 6A

The need for a corraborative date for Feature 9 (Sample 5) led to the collapsing of charcoal samples from several proveniences excavated during the 1978 season. Although spread over a nearly 6 m long area, all samples clearly were taken from level 6A. The excavators in each of the 3 adjacent trenches from which this material originated all commented on the clarity of the distinction between Strata 5 and 6 and the fact that the charcoal recovered came from within Level 6A. After controlling for both the north to south and the west to east tilt of Stratum 6 over the 6 m area, the elevational positions of each sample are considered equivalent. The depths ranged from 97.72-97.68 m.

G. SAMPLE 7, UGa 2680, 1125±60 A.D., NO MSN NUMBER

This specimen was the first of two stake-like wooden objects discovered during the 1978 excavation (see Sample 3). It was clearly lying on the interface between Strata 3 and 4 and is not interpreted as being directly associated with either. Given the generally poor conditions of preservation for all non-carbonized organic remains at the site, we immediately assumed it to be a modern intrusive piece. The historic artifact mixture associated with Stratum 3 certainly added to this belief. However, there was no evidence in the immediate area, from above or below, that would explain its subsequent intrusion.

The discovery of a similar object in level 4B in an obviously aboriginal context gave support to the prehistoric nature of this sample. Its assumed date was expected to be the most recent in the stratigraphic sequence. Clearly it is not. It is presently regarded to be an old, redeposited specimen from the village proper which was moved to the stratified area sometime after the depositional events of Stratum 4 but prior to the historical period.

H. SAMPLE 8, UGa 2676, 1075±125 A.D., MSN 26, FEATURE 4

The very large, shallow layer of charcoal and burnt clay labelled Feature 4 was sampled for both radiocarbon and flotation material. The date of 1075±125 A.D. is compatible with the general scatter of Clemson Island ceramics in contextually reliable positions in the area, as well as our overall impressions of this portion of the site dating from early Late Woodland times.

I. SAMPLE 9, UGa 2458, 960±90 A.D., MSN 346, 347, 350, LEVEL 5/6 INTERFACE

A thin layer of closely spaced sherds was discovered at the interface of Strata 5 and 6 in square N26E39. The sherds consisted almost entirely of the Clemson Island series. The somewhat tilted and undulating surface to Level 6A in this square accounts for the 6 cm variation in sample elevations, ranging from 97.68-97.62 m. The decision to collapse the

the 3 separate samples was made to insure an adequate size for radiocarbon dating and was justified by the fact that the sherd configuration seemed to represent a single depositional event.

The 960±90 A.D. date for this material was somewhat older than expected. Samples 5 and 6, both associated with Level 6A, yielded dates of 1130±110 A.D. and 1130±80 A.D. respectively. However, neither the 960±90 date nor the later dates violate the developmental model for Late Woodland ceramics discussed in Chapter 18. The most likely explanation of the age of Samples 5, 6, and 9 is that Levels 5 and 6 experienced a somewhat patchy filling process, conditioned by the slope and elevation of each specific location in the stream bed and the dynamics of each depositional event.

J. SAMPLE 10, UGa 2683, 705±70 A.D., MSN 21, FEATURE 12

This sample came from the western half of Feature 12, a circular pit 31 cm x 33 cm x 16.5 cm in depth. The pit was filled with compacted charcoal and, apart from the possible truncation by plowing, showed little soil admixture and no evidence of post-depositional disturbance. Botanical analyses of the flotation sample from the eastern half of the feature yielded burned wood chips and bark as 71% of the sample by weight. Incidental occurrences of maize, Chenopodium, and hickory nut were also found. A single Clemson Island rim sherd was found in Feature 11, a pit with roughly comparable dimensions and contents approximately 1 m east of Feature 12.

The late Middle Woodland date associated with this feature represents the earliest culturally associated date from Fisher Farm and probably indicates the earliest significant occupation of the site. The association of Clemson Island ceramics in the vicinity of the feature is compatable with similarly early dated contexts for Clemson Island ceramics in a number of sites from north-central Pennsylvania and early Owasco ceramics in central New York (Smith, personal communication; Ritchie 1969).

K. SAMPLE 11, I-10772, 470±80 B.C., NO MSN NUMBER, BOTTOM OF STRATIFIED DEPOSIT

Immediately prior to our filling the excavation trenches at the end of the 1978 season, a back hoe cut was made perpendicular to the edge of the terrace and half way across the stratified deposits. The cut followed the N12 line that had been previously excavated and continued to bedrock. As discussed in Chapters 15 and 16, a peat layer of remarkably well preserved forest litter was discovered between the bedrock and the bottom of a blue-gray silt accumulation. A radiocarbon sample of tree branch material was collected at 300 cm below surface in N12E42 by Waltman and submitted for dating by Edward Ciolkosz, Professor of Soil Genesis and Morphology at The Pennsylvania State University. The uncorrected date of 470±80 B.C. indicates the earliest moment that deposition could have begun in the stratified area. The date's value lies in its allowing us to estimate the ages of the pollen samples discussed in Chapter 16 for the pre-Late Woodland deposits. No cultural material was directly or indirectly associated with the sample.

III. DISCUSSION

The results of the radiocarbon analyses of the 11 Fisher Farm samples provide an interpretive backdrop for the reconstruction of 1) the pace and direction of occupational change, 2) the horizontal distribution of the occupations across the terrace, 3) contemporaneous events on a regional level, and 4) the dynamics of the filling process associated with the stratified area. Each of these topics is discussed in some detail in other chapters of this report. However, certain problems can be addressed here.

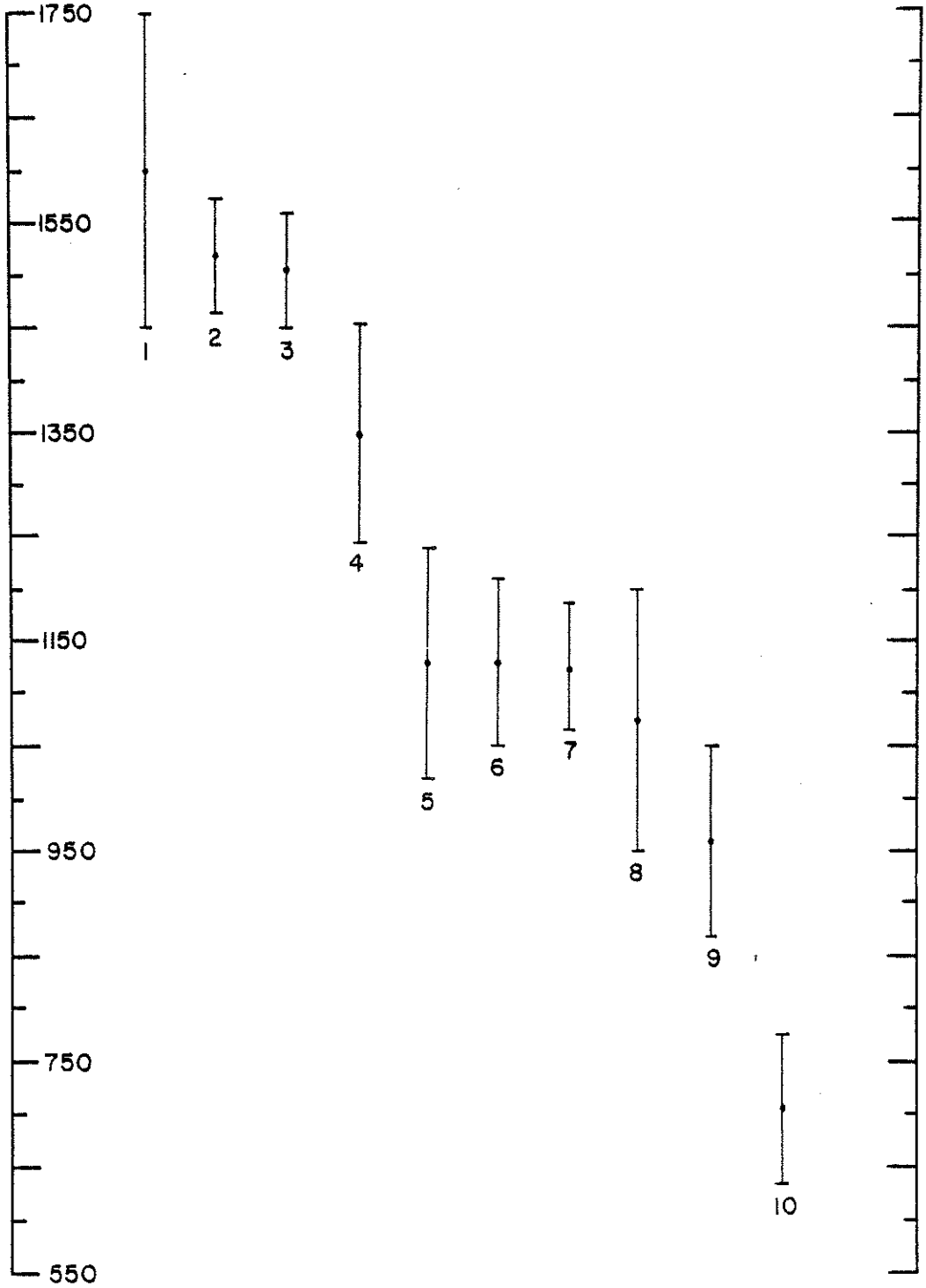
As Figure 17.1 clearly indicates, we succeeded in selecting samples whose chronometric range spans the Late Woodland occupational history of the site. Given the material and/or locational associations of each sample, some chronometric evaluation is possible for all portions of the site's Late Woodland occupation.

From a regional perspective, this sequence supports certain aspects of the culture historical sequence assumed for the West Branch valley and contradicts others. The earlier portion of the series, from 705±70 A.D. to 1350±105 A.D., relates to occupations principly using Clemson Island and early Shenks Ferry (Blue Rock Phase and Stewart Complex) ceramics. The few published dates associated with similar material from the West Branch valley are compatable with this temporal range. The dates of 1505±55 A.D., 1520±55 A.D., and 1600±150 A.D. with their associated "late" Shenks Ferry (Lancaster and Funk-like) and Susquehannock-like material record an episode of occupation that has generally not been considered in previous culture historical reconstructions for the area. This discovery seriously affects the social implications of culture historical reconstructions throughout the Susquehanna drainage, as will be discussed more completely in Chapter 18.

Our attempt to provide tight chronometric control over the stratified area through a number of internally derived dates met with only partial success. Samples 2, 3, 6, 7, and 9 were excavated in 1978 from the culture-bearing strata of this area, but as is seen in Figure 17.1, two problems exist. First, a sizable temporal gap exists between Levels 4B and the 5/6 interface. Carbonized remains in this zone did not occur in the quantities necessary for traditional radiocarbon dating methods. As a result the chronometric position of these strata must rely on the one externally derived date (Sample 4) associated with similar ceramic material.

The second problem is a more serious one. As mentioned above, the dates of Samples 7 and 9 place them in earlier contexts than otherwise implied by their stratigraphic position. We cannot account for their position as a result of some vertical distortion of material, nor can we assume actual dates more compatible with our expectations with much statistical confidence. Our preferred explanation for the early dates of these samples is that they are indeed accurate and that the seeming discrepancies resulted from either the patchy filling process of the stream bed depression within each stratum (Sample 9) or the redeposition of older material from the adjacent terrace (Sample 7).

TABLE 17.1: MEANS AND STANDARD DEVIATIONS OF TEN RADIOCARBON DATES FROM FISHER FARM. (SAMPLES 1-10)



Three factors could be responsible for the inclusion of earlier material in the stratified area (material made or used significantly earlier than the moment of its deposition):

Downslope erosional wash--Erosional wash was offered as an explanation in Chapter 15 for some of the matrix of the stratified area. One must therefore assume a portion of each stratum's contents to consist of early material brought in by this process.

Non-erosional downslope movement--Early material could also have rolled into the area or been accidently pushed in if the material were on the surface and near the edge of the terrace.

Aboriginal deposition of older debris--The intentional aboriginal deposition of material probably accounts for the vast majority of the archaeological remains in this area; that is, the regular dumping of garbage and village debris. Numerous lenses were seen during the excavation of this area with concentrations of charcoal, lithic debitage, fire-cracked rock, and ceramic sherds. These appeared to be discrete dumping events or individual basketloads of household debris. However, one can imagine the intentional dumping of earlier material, perhaps even mixed with contemporary debris, after a pit was excavated or a structure was built on a previously occupied spot.

One of these factors probably accounts for the presence of Sample 7 in a more recent stratigraphic position. However, it may also be significant that Samples 7 and 9, and only these two, were situated at the interface of 2 strata and were not within either. If these interfaces are interpreted as momentary interruptions in the dynamic filling process of the stratified area, allowing material to accumulate without being covered over, then they may be particularly insensitive to discrete temporal characterizations accomplished by radiocarbon dating.

APPENDIX

THE IDENTIFICATION OF AN ARCHAEOLOGICAL WOOD SPECIMEN

PAUL C. KERSAVAGE

I. INTRODUCTION

In May 1979 a small wood specimen was submitted to the Forest Resources Laboratory of The Pennsylvania State University for identification. The wood sample, as received, was approximately 2" long, was parallel to the grain, and had a circular-shaped cross-section of about 1". The wood was dry, dark grayish-brown in color, and was surrounded by a thin layer of bark.

II. SPECIMEN PREPARATION

A disc 3/8" along the grain was first sawn from the specimen. An interesting phenomenon occurred at this time. Immediately after the disc was sawn, a viscous fluid exuded from the wood and formed on the freshly cut surfaces. This fluid possessed a strong pine-like odor, which volatilized into the atmosphere in approximately 1 hour. The specimen was then sawn and split into sectioning blocks in the form of 3/8" cubes by using a coping saw and a small microtome knife. After the sectioning blocks were split from the disc, they were impregnated with water under a vacuum for 24 hours and were then embedded in ice to facilitate sectioning. From these blocks thin sections were cut on a microtome, and slides were prepared for microscopic study. The microtome slices were a nominal 20 μm in thickness and were cut from tangential, radial, and transverse surfaces of the sectioning blocks.

III. SPECIES IDENTIFICATION

A dichtomous key based on microscopic characteristics was used for species identification (Panshin and DeZeeuw 1964). Based on the use of this key and microscopic study of the microtome-sliced sections, it was determined that the wood specimen had the following characteristics:

Wood without vessels (nonporous).

Both longitudinal and transverse resin canals present.

Ray tracheids dentate.

Ray parenchyma cross-field pits pinoid to lenticular, generally variable in shape and size, and usually 1-6 per cross field.

Latewood band usually 10 or more cells in width.

Radial diameter of the lumens of the last-formed latewood tracheids about equal to the radial thickness of the secondary wall.

Based on these characteristics and their comparison with slides of known conifers in the Forest Resources Laboratory's wood slide collection, the archaeological wood specimen was identified as a species of southern yellow pine (Pinus spp.). At the present time, there is no accepted method for differentiating among the different species of southern yellow pine based on wood identifications alone.

IV. TISSUE DETERMINATION

According to Panshin and DeZeeuw (1964), the fibers of stem, branch, and root tissues of coniferous woods differ in their lengths. Those for the stem average 30 mm, those of root tissue are described as being slightly longer, and the fibers of branch wood are approximately one-half that of stem fibers. The fiber lengths of the archaeological specimen were measured from a tangential section under a microscope with the aid of a fillar micrometer eyepiece from a random sample of 40 measurements. The average fiber length was determined to be 1.5 mm, indicating branch tissue.

V. SUMMARY AND CONCLUSION

The results of this study indicate the specimen to be a portion of branchwood of a species of southern yellow pine, probably pitch pine (Pinus ridiga Mill.), since it was found in an area within its natural range and had microscopic features similar to that found on known slide specimens of pitch pine. These findings support the hypothesis that the sample was an aboriginally used specimen and not a root intrusive into the layer in which the specimen was found.

CHAPTER 18

AN ANALYSIS OF THE CERAMICS FROM THE STRATIFIED DEPOSITS AT FISHER FARM

JAMES W. HATCH

I. INTRODUCTION

The discovery of 232 rim and neck sherds from the stratified deposits excavated in 1978 at Fisher Farm provides the basis for 1) the recognition of the several ceramic series present, 2) their chronologic placement, and 3) the construction of a model of ceramic change. This model is offered as an alternative explanatory device to the existing framework of Witthoft and Farver (1952), Heisey (1971), and others based on information from southeastern Pennsylvania. It is believed to better accomodate the growing body of Late Woodland ceramic data from central Pennsylvania.

This chapter will generally avoid the problems which have been the focus of attention of most other researchers--the discovery of a unilineal evolutionary trajectory along which to fit ceramic types and the equation of various "peoples" and "lifestyles" with the occurrence of those ceramic types. Instead an underlying polythetic composition will be assumed for the taxonomy to be discussed, one which allows for considerable independent variation in space and time of the individual ceramic traits and makes no *a priori* sociological assumptions regarding the coherency of trait clusters and the ethnic affiliations of their makers. The research will focus on the definition of chronologically sensitive ceramic markers which can be used to help segregate the several overlapping components at Fisher Farm. So little temporally controlled ceramic research has been carried out in central Pennsylvania that the chronologic associations of all ceramic types to be discussed must be locally demonstrated. To borrow the chronologic associations of dated ceramics from the better researched areas, central New York and southeastern Pennsylvania, seems at the outset too risky. By demonstrating the temporal position and span of certain ceramic types here, it is hoped this research will service both those concerned with phasing other central Pennsylvania sites with similar pottery and also those concerned with aligning chronologic sequences in the Mid-Atlantic and Northeastern regions.

II. REVIEW OF PREVIOUS RESEARCH

As a test of the adequacy of existing ceramic type definitions for the categorization of the Fisher Farm assemblage, a formal numerical analysis was undertaken of the 232 sherds excavated from the stratified deposits in 1978 (Swartz 1979; Koontz 1979). Forty-six variable-state attributes were selected and a step-wise program of research was carried out using Ward's hierarchical agglomerative cluster analysis (Wishart 1978). Swartz focused on the 7-cluster solution suggested by the Scree Test, while Koontz subjectively selected the 22-cluster solution. Swartz was troubled by the

problem of similar morphological zones from distinctively different types falling together--a problem aggravated by the small size of the sherds available for the analysis. At the 22-cluster solution level, all effects of this problem were gone. With only 15, or 6% of the sherds exhibiting decorative characteristics of more than one type (Swartz 1979:112-113), both researchers found that the key attributes of the clusters formed replicated those of the traditional typology. With this assurance, we can turn to this typology as a basis for further taxonomic discussion.

Previous ceramic research in Pennsylvania has noted three broad stylistic series for the Late Woodland Period in the Susquehanna watershed; Clemson Island, Shenks Ferry, and late shell-tempered varieties. Because the Fisher Farm Site contains sherds of all three series, their general spatial and temporal dimensions will be discussed here.

A. CLEMSON ISLAND

The Clemson Island series defines a number of types characterized by cord-marked or fabric-impressed outer surfaces, chert or quartz temper, and a distinctive arrangement of deep punctations near the rim. The punctations are aligned in rows, and while up to 4 rows may occur on the same vessel, a single row is most common. The punctations are most often made deep enough to raise nodes on the opposite surface. Arrangements of these elements occur on either the inner or outer surfaces of the vessel. Less prevalent traits include cord-wrapped paddle or cord-wrapped stick design elements in distinctive zones; for example, rim interiors and neck exteriors. Incised rims, lips, and neck exteriors can also be found. All of these decorative elements are applied to rather poorly fired, medium to large conical jars. The series is most commonly found in the middle and upper portions of the Susquehanna watershed. Only two published reports reference radiocarbon dates in direct association with Clemson Island ceramics in Pennsylvania. The Nash Site from the West Branch produced a date of 960±80 A.D. (Smith 1976:3), while the Wells Site along the North Branch yielded dates of 980±100 A.D. and 1070±100 A.D. (Kent, et al. 1971:332). All three dates indicate an early Late Woodland association.

At present the only extended discussion of Clemson Island pottery in the literature is Catherine McCann's summary of the ceramic material discovered in Jones' excavation of the Clemson and Book mounds (1971). Within her sample of 70 rim sherds, considerable variation in decorative attributes was found. However, no formal types were proposed.

Like several other researchers, McCann comments on the difficulty in distinguishing sherds of the Clemson Island series from the Owasco material common to much of central New York:

> It is frequently difficult to distinguish sherds of this type from those of early Owasco vessels. Forms are often very similar, and many of the same decorative designs are used: parallel horizontal lines of paddle-edge impressions (cord-wrapped stick), vertical and oblique plats, herringbone designs, etc.

> No reliable criterion can be given for distinguishing between Owasco and Clemson-Book sherds in all or even a majority of cases, but there are a few differences which may serve the purpose in particular instances. ...Owasco sherds are not decorated below the neck, while Clemson-Book sherds sometimes bear decoration over a considerable part of the body area. Necks of Owasco vessels are smoothed to receive decoration, but in the great majority of decorated Clemson-Book rim sherds the decoration is applied to the cord-marked or fabric-impressed surface without preparation of a smoothed area. A few Clemson-Book rims show a little smoothing, but it is not complete enough to obliterate the original surface finish and it may be accidental (McCann 1971:423).

From the perspective of New York and a much longer tradition of research with the ceramic materials, Ritchie appears to have little difficulty distinguishing Clemson Island and Owasco ceramics. In discussing the early Owasco Roundtop Site, located in the headwaters of the Susquehanna's North Branch in southern New York, Ritchie states:

> Of much interest at the Roundtop site is the occurance of pottery characteristic of the so-called "Clemson's Island focus" in the middle Susquehanna Valley. Since large sherds of this kind were found in direct and unequivocal association with other styles of pottery in the same pits, there seems to be no doubt of the intrinsic relationship at the site of Clemson's Island and Early Owasco ceramic varieties. ...Support for this conclusion is found in the fact of similar associations on a few Pennsylvania sites. While the writer has seen Clemson's Island sherds in a private collection, said to have come from a Susquehanna Valley site north of Binghamton, the Roundtop site has provided the first incontrovertible evidence of this kind in New York.
> ...I regard the little-known Clemson's Island culture as the temporal equivalent in Pennsylvania of the Hunter's Home phase and the beginning of the Carpenter Brook phase in New York, and there is evidence from the Roundtop site of some still obscure relationship between Clemson's Island and Early Owasco cultures....
> ...Associated with such pottery on Pennsylvania sites of the "Clemson's Island focus," are sherds of such early Owasco types in New York as Levanna Cord-on-Cord and Carpenter Brook Cord-on-Cord....(Ritchie and Funk 1973:187).

The geographic range of Ritchie's "Owasco culture" is thus seen in part to overlap that of the "Clemson Island culture," largely based on the occurance of the two ceramic series on certain sites. To Ritchie, this presents a sociological problem that is, at best, difficult to interpret. Discussing the geographic distribution of Owasco material, he states:

> To the south of the state, however, the Owasco province extended well down the Susquehanna Valley, apparently as far as the West Branch Valley....(1969:274).

Although rarely stated, the tendency to treat punctations as an invariant attribute of Clemson Island ceramics exists among researchers in Pennsylvania and New York. Without the punctations, only those attributes suggested by McCann serve to distinguish Clemson Island and Owasco types. Ira Smith, in a recent personal communication (dated September 27, 1978) discusses the occurrence of "...'Clemson Island' (that is, punctated) pottery..." in the West Branch Valley in connection with early Owasco-Carpenter Brook phase pottery. Similarly, Lucy notes that "Many examples lack the punched-through bosses, and thus merge into classic early Owasco and late Point Peninsula types" (1971:384). Presumably McCann's frequent inability to distinguish Clemson Island and early Owasco ceramics in the Clemson-Book assemblage stems from the fact that only 60% of her sample was punctated.

The logical starting point for recognizing specific typological variants within the Clemson Island series is the temporally and spatially better controlled Owasco series in New York. The early seriational work of Ritchie and MacNeish (1949) served to distinguish a number of "cultures" and "phases" for the New York area, and the ceramic types associated with each have subsequently been refined by means of numerous radiocarbon dates and additional excavations.

Two archaeological cultures have been consistently referred to as relevant to the study of Clemson Island ceramics--Point Peninsula and Owasco. Fifteen pottery types constitute the Point Peninsula ceramic series, defined by Ritchie and MacNeish in the following manner:

> The Point Peninsula series is characterized by rectangular dentate-stamp or corded-stick decorations, body decoration, relatively small elongate-bodied vessels with conoidal base, nearly pointed or rounded lips on slightly everted (often sharply at the top) rims, and the coiled process of manufacture. The interior surface is commonly channeled and the exterior, smooth in the earlier stages, often corded in the later ones (1949:100).

These ceramics are said to be diagnostic of the post-Hopewellian Middle Woodland occupants of all but the coastal areas of New York state. The subsequent Late Woodland Period is initiated by the Owasco culture, and it too is associated with a distinctive pottery series:

> The Owasco series is characterized by corded-stick ornamentation, the absence of body decoration, flattened and often splayed-out lips, and the paddle-and-anvil method of manufacture. The interior surface is smooth, the exterior surface cord-impressed or, in the later Castle Creek Focus, sometimes check-stamped. Necks are prevailingly smooth to receive decoration extending down from the rim. Bodies are

> elongate and bases conoidal in the Canandaigua Focus, elongate or semiglobular with rounded bases in the Castle Creek Focus. In general, the vessels are of relatively large size, ranging from a capacity of approximately two gallons upward to twelve or more gallons (1949:107).

Sixteen distinct types form the Owasco series.

In addition to type definitions, Ritchie and MacNeish performed a frequency seriation of ceramic samples from 9 Point Peninsula and Owasco components. According to the authors, the result is a chronologically sequential ordering of components. This seriation established a basis for subdividing each culture: the Point Peninsula into early (Kipp Island) and late (Hunter's Home) and the Owasco into early (Carpenter Brook), middle (Canandaigua), and late (Castle Creek) phases. Since 1949 only 3 of the 9 seriated components have been radiocarbon dated. However, a number of related components have been excavated and their combined ceramic collections and radiocarbon dates impressively reaffirm the accuracy of the original component ordering. Table 18.1 presents those late Point Peninsula and Owasco components that have associated radiocarbon dates, as well as their phase affiliations.

It is interesting that the original seriation has been verified on the basis of subsequent radiocarbon dates, since the relative frequencies of the types comprising the samples derived from these later sites are highly variable, even within the same subareas and phases. As Table 18.2 clearly shows, marked differences may exist between components of the same phase, whether they are between or within the same watershed. Such variation often masks the chronologic sensitivity of ceramic frequency seriations. However, with a radiocarbon dated series, the duration and phase integrity of each pottery type is independently controlled.

Of the 31 pottery types that comprise the Point Peninsula and Owasco series, 17 are believed to occur in the 2 phases of principal interest, Hunter's Home and Carpenter Brook (Table 18.3). Most of the 31 types last through several different phases, making the definition of phase affiliation on the basis of the ceramic inventory sometimes difficult. Fortunately, a few regularities are seen in the component assemblages.

Kipp Island Phase--Point Peninsula Rocker-stamped and Point Peninsula Corded types comprise the majority of sherds found on most Kipp Island Phase sites. Small amounts of Vinette ceramics represent the decline of this earlier series, while small numbers of Jack's Reef types represent a more recent development.

Hunter's Home Phase--This phase is a recent construct, largely identified on the basis of radiocarbon dates in the 900-1000 A.D. range. As Ritchie states, "It is a vague stage of transition into inchocate Owasco culture, and difficult to explicitly define" (1969:254). Ceramically it is said to postdate the older dentate and rocker-stamping of early Point Peninsula and Kipp Island times, with platting and corded horizontal motifs replacing them. The literature is unclear, but this phase is

Table 18.1: Radiocarbon Dates for Late Point Peninsula and Owasco Culture Components in New York*

Culture	Phase	Component	Radiocarbon Dates (AD)	Location			
				Western	Central-Finger Lakes	Central-Susquehanna	Eastern
Owasco	Castle Creek	Nahrwold	1310± 95				X
		Chamberlain	1290± 60			X	
		Castle Creek	1435±200			X	
			1196±200		X		
	Canandaigua	O'Neil #4	1298±200		X		
			1160± 80		X		X
			1150± 80			X	
		Snell	1156±200			X	
		Bates	1190±100		X		
			1125±100		X		
		Sackett	1130±150			X	
	Carpenter Brook	Maxon-Derby	1100±150			X	
			1100±100				X
		Roundtop	1070± 60	X			X
Point Peninsula	Hunter's Home	Portage	1000± 75			X	
		Willow Tree	955±250		X		X
		White	905±250		X		
		Kipp Island #4	895±100				X
		Black Rock	850± 95		X		
	Kipp Island	Wickham #2	740±100		X		
		Kipp Island #3	630±100				

*After Ritchie 1973.

Table 18.2: Owasco Ceramic Variation Between and Within Watersheds in Central New York*

Early Owasco - Carpenter Brook Phase

Susquehanna River (N.Y.)		Finger Lakes Region	
Roundtop Site - 1070±60 A.D. (n=501)		Maxon-Derby Site - 1100±100 A.D., 1100±150 A.D. (n=47)	
Carpenter Brook Cord-on-Cord	58.6%	Carpenter Brook Cord-on-Cord	51.0%
Levanna Cord-on-Cord	29.8%	Levanna Cord-on-Cord	<6.0%
Owasco Platted	3.0%	Owasco Platted	<6.0%
Owasco Corded Horizontal	2.8%	Owasco Corded Horizontal	26.0%
Owasco Herringbone	.2%	Owasco Herringbone	<6.0%
Owasco Corded Collar	3.6%	Owasco Corded Oblique	<6.0%
Levanna Corded Collar	2.0%	Wickham Corded Punctate	<6.0%

Middle Owasco - Canandaigua Phase

Susquehanna River (N.Y.)		Finger Lakes Region	
Bates Site - 1125±100 A.D., 1190±100 A.D., 1298±200 A.D. (n=244)		Sackett Site - 1130±150 A.D. (n=427)	
Owasco Herringbone	8.0%	Owasco Herringbone	13.6%
Owasco Corded Oblique	8.0%	Owasco Corded Oblique	43.1%
Owasco Platted	34.0%	Owasco Platted	17.2%
Owasco Corded Horizontal	49.0%	Owasco Corded Horizontal	3.0%
Snell Incised Platted	.8%	Owasco Corded Collar	8.7%
		Levanna Cord-on-Cord	8.4%
		Castle Creek Punctate	.7%
		Canandaigua Plain	6.3%

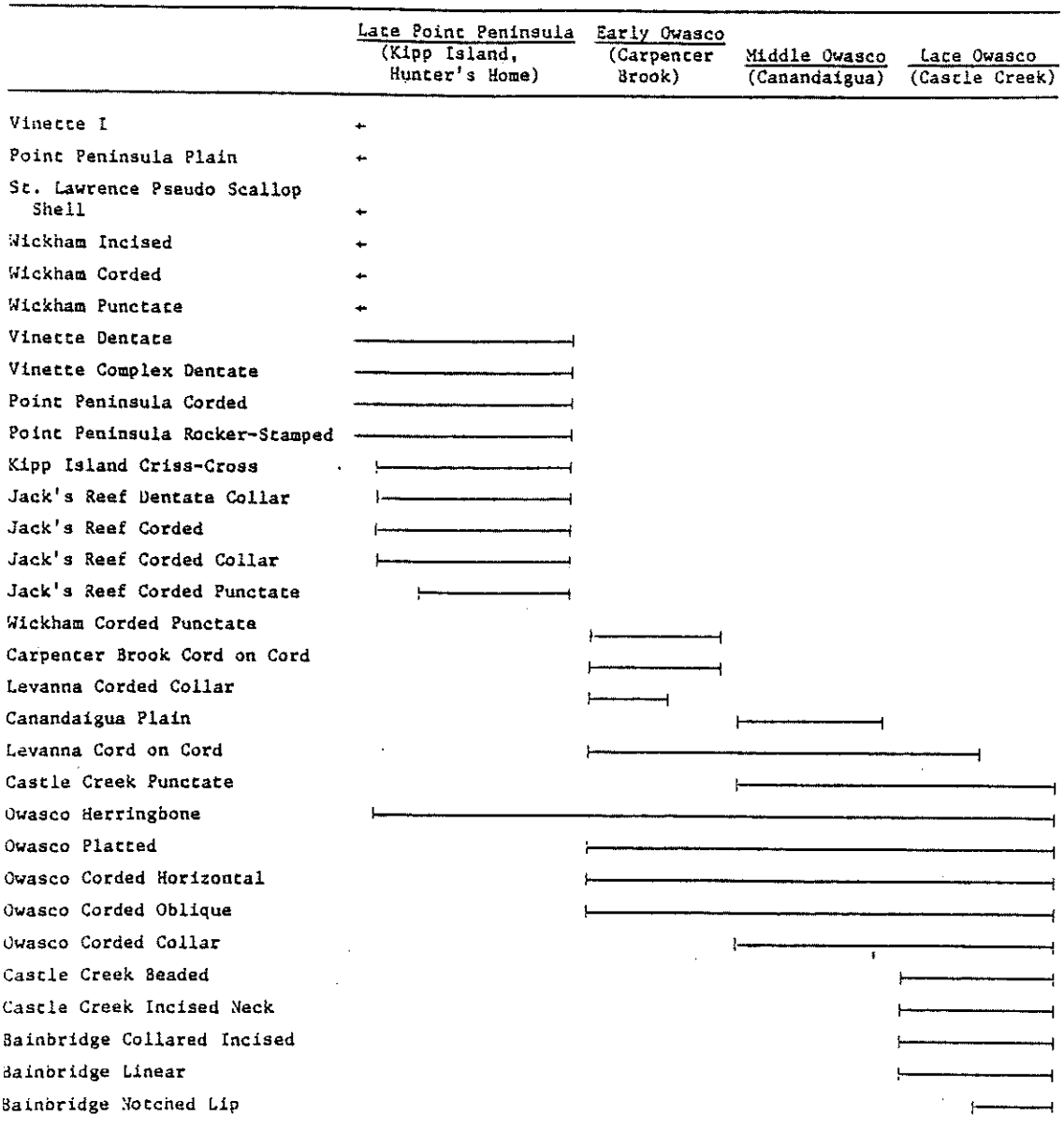
Table 18.2 (Continued)

Late Owasco - Castle Creek Phase

Susquehanna River (N.Y.) Castle Creek Site - 1196±200 A.D., 1435±200 A.D. (n=446)		Susquehanna River (N.Y.) Bainbridge Site - no date (n=363)	
Owasco Platted	17.0%	Owasco Platted	5.0%
Owasco Corded Oblique	15.0%	Owasco Corded Oblique	2.0%
Owasco Corded Collar	13.0%	Owasco Corded Collar	21.0%
Owasco Corded Horizontal	13.0%	Owasco Corded Horizontal	12.0%
Owasco Herringbone	12.0%	Owasco Herringbone	8.0%
Castle Creek Beaded	12.0%	Castle Creek Beaded	2.0%
Bainbridge Collared Incised	9.0%	Bainbridge Collared Incised	39.0%
Castle Creek Incised Neck	5.0%	Castle Creek Incised Neck	1.0%
Castle Creek Punctate	2.0%	Bainbridge Linear	6.0%
Levanna Cord-on-Cord	2.0%	Bainbridge Notched Lip	3.0%

*Data for the Roundtop, Maxon-Derby and Bates sites derived from Ritchie and Funk (1973). The Castle Creek and Bainbridge site data are published in Ritchie and MacNeish (1949). Data for the Sackett site derived from both Ritchie and MacNeish (1949) and Ritchie and Funk (1973).

Table 18.3: Phase Duration of Late Point Peninsula and Owasco Ceramics*



*After Ritchie and MacNeish (1949:100-116).

apparently associated with substantial amounts of the Jack's Reef types and/or mixed assemblages of late Point Peninsula and early Owasco sherds.

Carpenter Brook Phase--Components dating to this early Owasco phase characteristically have Carpenter Brook Cord-on-Cord dominating the ceramic assemblage. Maxon Derby and Roundtop, for example, contained 51% and 59% Carpenter Brook Cord-on-Cord respectively (Table 18.2). Levanna Cord-on-Cord also occurs however, it is a less specific temporal marker and is more variable in its frequency of occurrence.

Canandaigua Phase--The middle Owasco phase is characterized as that episode in which both the Carpenter Brook Cord-on-Cord ceramics of early Owasco and the Castle Creek and Bainbridge ceramics of late Owasco are rare or absent. Owasco Corded Oblique, Owasco Corded Horizontal, Owasco Platted, and Owasco Herringbone usually co-occur, often comprising 70% or more of the ceramic assemblage. The frequency of occurrence of specific types varies greatly between Canandaigua Phase sites, however.

Castle Creek Phase--Modifications to the neck and rim and their embellishment with incised, linear motifs signals the late Owasco phase, although these forms co-occur with the same types characteristic of middle Owasco times. This new decorative trend is continued, in rapidly changing form, throughout the subsequent Iroquois period.

Of the 17 types occurring during the Hunter's Home and Carpenter Brook phases, 11 have such a limited or remote distribution in New York that they have no real comparative value for this research. Portions of the discussion of decorative attributes and diagnostic features originally presented by Ritchie and MacNeish (1949) are reproduced below for the remaining 6 types. The reader is referred to the primary source for additional information regarding temper, morphology, and other vessel characteristics.

Carpenter Brook Cord-on-Cord--In this type all the designs characterizing the Owasco Corded Oblique, Owasco Herringbone, and Owasco Platted types are to be found superimposed upon a corded-surface finish. Attempts were made to subdivide this type on the basis of design but without success, for trends appeared to be the same for each variant.

Levanna Cord-on-Cord--Cord-wrapped paddle impressions cover the exterior surface. The rim is slightly outflaring and additional decoration, if it occurs at all, is limited to cord marking on the lip.

Owasco Herringbone--Extending down from the lip is a herringbone pattern consisting of parallel horizontal rows of elements which are oblique in alternate directions. Cord-wrapped stick impressions or linear corded impressions cross the lip, and in some cases they encircle the upper part of the rim. Rarely the lip is unembellished. Usually there are oblique impressions on the rim interior.

Owasco Platted--The commonest design is a plat of corded-stick imprints on the neck. These plats consist of short, horizontal, cord-wrapped stick impressions (about 1" long), one above the other, which

form vertical or oblique rows. Usually above these plats the exterior and interior rim surfaces bear short, oblique, corded-stick impressions reaching across the lip.

Owasco Corded Horizontal--The dominant design is a series of short oblique impressions above rows of horizontal impressions that encircle the neck and upper rim. On some of the sherds the upper oblique lines are absent and the horizontal rows extend to the lip. Lips may be decorated by cross or parallel impressions or may bear no decoration at all. The rim interiors are usually embellished by oblique impressions.

Owasco Corded Oblique--The dominant decoration is a series of short, parallel, oblique impressions on the rim exterior and interior. Occasionally these lines extend down onto the neck. Sometimes a second offset row occurs below the first (Ritchie and MacNeish 1949:108-112).

B. SHENKS FERRY

The distinctive character of the Shenks Ferry series clearly associates it with portions of the Susquehanna and adjacent watersheds. With only slight modifications, the distributional map offered by Kinsey and Graybill in 1971 (5, Figure 1) is still accurate. Although this ceramic province embraces much of the Juniata, West Branch, North Branch, and main Susquehanna drainages, most of the published research dealing with Shenks Ferry ceramics is based on samples from Lancaster and Lebanon Counties. The intensive Late Woodland research carried out in these counties during the 1960's and early 1970's accounts for the southeasterly interpretive bias common to the literature, and within this area the relative internal chronology and ceramic type definitions are very well controlled. However, the unfortunate tendency of some researchers to extrapolate this data to spottily known Shenks Ferry material to the northwest, in the upper reaches of the Susquehanna watershed, has resulted in a decade of confusion concerning the general direction of Shenks Ferry culture history.

The ceramic basis for the recognition of Shenks Ferry components has been presented by Witthoft and Farver (1952), Kinsey (1960), Heisey and Witmer (1964), and Heisey (1971). Of the 8 recognized types--Shenks Ferry Cord Marked (Collarless, Collared Corded, Cord Impressed), Shenks Ferry Incised (Simple, Multiple Banded, Complex), Lancaster Incised, and Funk Incised--only the latter 4 are relevant to the stratified deposits at Fisher Farm. Their principal decorative attributes, as discussed by Heisey (1971), are reproduced here:

Shenks Ferry Incised--Multiple Banded

> Decoration is a combination of uninterrupted bands of horizontal, oblique, or occasionally vertical lines. Bands usually alternate between horizontal and oblique. Sometimes corded lines substitute for one of the incised bands (1971:50).

Shenks Ferry Incised--Complex

> Decorated with complex geometric patterns of incised lines on collar, neck, and shoulder. Cord-impressed elements may be combined with or substituted for incising (1971:50).

Lancaster Incised

> Decoration--Variously shaped geometric plats filled with poorly controlled incised or trailed lines confined to collar. A band of short oblique slashes often underlines the collar decoration, encircling the vessel on the smoothed neck (1971:58).

Funk Incised

> Decoration--Includes all the motifs of Lancaster Incised, but in addition has lip notching. Lines of small punctates often outline incised plats (never on Lancaster Incised) (1971:58).

A frequency seriation of 14 Shenks Ferry sites of the lower Susquehanna River demonstrates an overlapping but sequential distribution from the early Shenks Ferry types to Lancaster Incised, and finally to Funk Incised (Kinsey and Graybill 1971:36).

Chronometrically dated components in this area are sparse. The Murry Site in Lancaster County has a single radiocarbon date of 1410±100 A.D. associated with a predominantly Funk Incised ceramic assemblage. The West Branch has two reported radiocarbon dates, both from the Bull Run Site (Bressler 1978). The first, a portion of a stockade believed to be associated with the Shenks Ferry component, dates to 1230±100 A.D. while the second was directly associated with several Shenks Ferry Incised sherds and dates to 1480±95 A.D.

Heisey (1971) distinguishes three phases within the episode dominated by Shenks Ferry ceramics in Pennsylvania--Blue Rock, Lancaster, and Funk. The Blue Rock Phase is associated with the use of the Shenks Ferry Cord Marked and Incised types listed above, while the latter phases represent a stylistic continuum from Lancaster Incised to Funk Incised. Heisey contends that only during the Blue Rock phase did Shenks Ferry potters occupy areas outside of southeastern Pennsylvania. In his reconstruction of dramatic population movements during the Late Woodland, Heisey describes the expansion and the sudden collapse of the Shenks Ferry region during the Blue Rock Phase:

> Then with seeming abruptness, the Shenks Ferry people are back on the Piedmont part of the valley. There are no known sites for the later Lancaster-Funk Phases north of Blue Mountain. The retreat from the West Branch, North Branch, and the Middle Susquehanna valleys resulted in the concentration of sites on the Lancaster Plain... (1971:66).

Apparently Heisey believes that the Susquehanna watershed north of Blue Mountain was devoid of Late Woodland populations until the Susquehannock

expansion during the mid-1500's. This belief apparently rests on the following facts and assumptions:

1. Blue Rock Phase ceramics equate with a defined (early Shenks Ferry) time span.

2. Blue Rock Phase ceramics are relatively consistent throughout their geographic range.

3. Chronologic implications of the Blue Rock Phase are identical wherever Blue Rock Phase ceramics are found.

4. Only Blue Rock Phase types of Shenks Ferry ceramics are found north of Blue Mountain.

Item 1, as stated above, had at the time of Heisey's article been demonstrated only for the lower Susquehanna area. Item 2 was supported by the earlier work of Witthoft (1954) in his examination of the ceramics from the Stewart Site in the West Branch Valley. In it he described the Stewart Complex, a set of attributes that metrically distinguish these ceramics from the Shenks Ferry material of the lower Susquehanna. However, Witthoft considers these differences to be minor ones:

> The Stewart pottery shows a greater complexity and variety of neck incising and a lesser variety of rim incising, as compared to the Shenks Ferry series of the same pottery type. This and the absence or near absence of cord-wrapped paddle-edge work serve to distinguish the pottery of the Stewart area from that of the Shenks Ferry area. I believe these are minor geographic differences between the artifacts of people who were practically alike in their material culture, and I do not think the differences are important enough or exclusive enough to merit the separation of the pottery into type by areas. These are exceedingly minute distinctions compared with the differences between Shenks Ferry pottery and that of other tribal areas nearby at the same time level (Kent, et al. 1971:472).

On this basis Heisey apparently included the Stewart Complex material in the Blue Rock Phase. Neither Items 3 nor 4 were well controlled at the time of Heisey's writing. Aware of this, he proposed a number of alternate scenarios that could eventually overturn his central thesis. Although none of them dealt with the demonstration of occupational continuity throughout the Susquehanna watershed during Late Woodland times, it is exactly this situation which will be discussed below for Fisher Farm.

Recognizing the need for a more even archaeological coverage of Late Woodland sites in the Susquehanna watershed, the Pennsylvania Historical and Museum Commission sponsored a series of projects in the North and West Branch Valleys during the 1970's. In the West Branch, Ira Smith's excavation of several Clemson Island and late Late Woodland sites (1976) was complimented by William Turnbaugh's valley survey (1977) and the Society for Pennsylvania Archaeology, Williamsport Chapter's excavations of the Shenks Ferry Bull Run Site (Bressler 1978). As will be discussed below, the combined results of these efforts support the model of ceramic change derived from Fisher Farm.

C. SHELL-TEMPERED CERAMICS

The late phases of Pennsylvania prehistory are associated with the appearance and rise in frequency of shell-tempered ceramics. Some evidence suggests that the trait of shell tempering and several others unrelated to pottery first appear in the western part of the state, arriving as a result of "stimulus diffusion" from the Ft. Ancient occupants of the Ohio River Valley through unspecified mechanisms. Shell tempering appears to be earlier in the Monongahela sequence than in the McFate (Mayer-Oakes 1955), Quiggle (Smith, personal communication), Wyoming Valley (Smith 1973), and Susquehannock (Witthoft and Kinsey 1969) ceramic material. The trait is absent from the Iroquois ceramics of New York (Kent, et al. 1971).

The presence of shell-tempered pottery in the Susquehanna watershed has traditionally been associated with the Susquehannock ethnic group, given the known location of several protohistoric and historic Susquehannock sites in Lancaster County and the frequency of high collared, highly embellished shell-tempered pottery from them. However, as more controlled archaeological effort is placed in the North and West Branch Valleys, the perspective as originally conceived is no longer tenable. As first proposed, the Susquehannock ethnic group was believed to be an offshoot of the Cayugas living in the headwaters of the North Branch in New York State. A rapid move from New York into Lancaster County, subjugating the local population, was suspected during the late 1500's A.D. (Witthoft and Farver 1952). Some proponents argue that the inspiration for such a move was the added aboriginal control over early European trade in the Susquehanna watershed. While such a population movement will not be questioned here, the identity of all other shell-tempered ceramic-bearing components in the watershed as Susquehannock is. The specific types associated with the Susquehannock occupation in Lancaster County--Schultz Incised, Washington Boro Incised, and Strickler Cord-Marked--infrequently equate in design elements with shell-tempered pottery elsewhere in the watershed.

Given the small size of the shell-tempered sample from Fisher Farm, we will not consider the problem of type association in detail. Ongoing efforts by Smith (in preparation), Kent (in preparation), and others should resolve the typological and chronological problems based on more substantial samples than Fisher Farm can provide. For the time being, the small sample of sherds from Fisher Farm can be treated on an individual basis. As will be shown below, however, certain conclusions contrary to traditional thought must be drawn from these data.

Although inferential dates from early explorers and from excavated European trade items are common to the Lancaster County sites, the only published radiocarbon dates for shell-tempered wares come from central Pennsylvania. Susquehannock remains are reported at the Sheep Rock Shelter, Huntingdon County, where they are associated with dates of 1600± 100 A.D. and 1690±100 A.D. (Michels 1968). At the Nash Site in Clinton County, 2 wood fragments from a keyhole structure dated 1595±80 A.D. and 1715±80 A.D. are believed to equate with a Susquehannock component (Smith 1976:3-4).

III. A TYPOLOGY OF FISHER FARM CERAMICS

One hundred and fifteen of the sherds from the stratified deposits at Fisher Farm can be categorized using many of the same decorative attributes described in the previous section. Since many of the attribute combinations were shown to have considerable coherency as well as temporal sensitivity, it is anticipated that the Fisher Farm typology will also have these features. Given the large number of types present at Fisher Farm and the rather small sample from the stratified deposits, this exercise is best regarded as a pilot study for the region. The new type names are provisional, to be modified through further archaeological work.

Type 1--Levanna Cord-on-Cord (n=2) (Figure 18.1)--These sherds exhibit the usual heavy cord marking on the exterior and lip surfaces. No punctations, internal decorations, or special rim preparation occur.

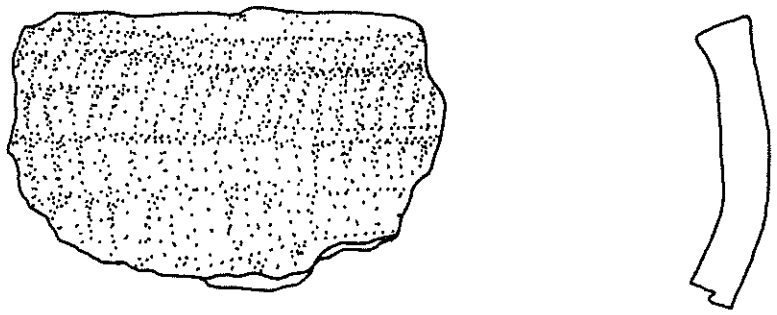
Type 2--Clemson Island Cord-on-Cord (n=4) (Figure 18.1)--Heavy cord marking on the exterior and lip surfaces, a flattened lip, slightly outflaring rim, and a plain interior identify these sherds as equivalent to Levanna Cord-on-Cord, except for a single row of outward protruding punctations approximately 1.1 cm below the lip.

Type 3--Clemson Island Platted Horizontal (n=5) (Figure 18.1)--This type is recognized by parallel horizontal rows of cord marking above and below a series of outward protruding punctations. The bold cord marking of each row was apparently created by the single twist of a loosely wound, cord-wrapped stick and is itself superimposed over a weakly impressed cord-wrapped decoration. Due to the small size of the sherds on which this type is defined, no information about lip or body decoration is available. Each of these sherds had split longitudinally as a result of a weak interior core and poor firing, so interior surface treatment, if any, is also unknown.

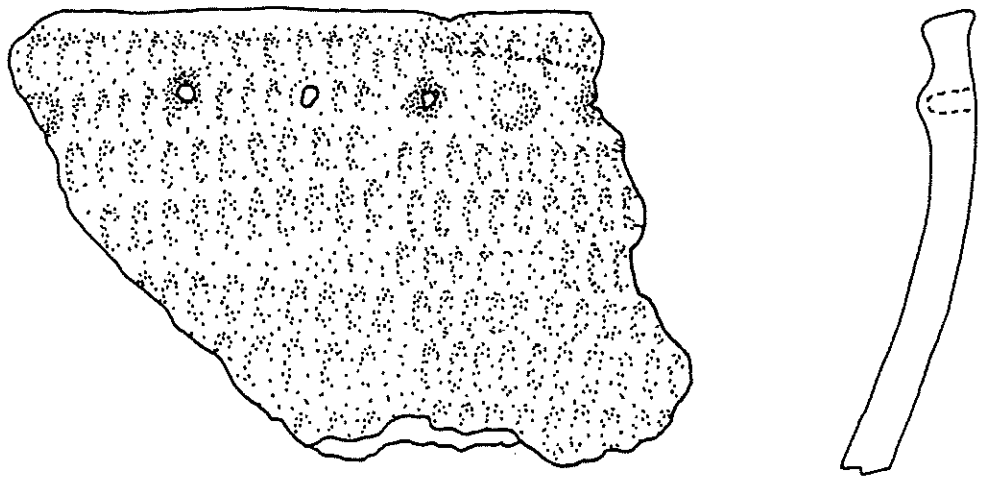
Type 4.1--Clemson Island Corded Horizontal, Variant 1 (n=6) (Figure 18.2)--Finely executed horizontal cord marking covers a well defined neck area on this type. The upper portion of the shoulder (approximately 1.5 cm in vertical height) is covered with bold oblique cord marking, while below the ridge of the shoulder the body surface is decorated with very bold cord-wrapped paddle impressions. Both the lip and the exterior surface of the slightly outflaring rim are embellished with fine oblique cord markings. The inner surface is devoid of decoration. A single line of outward protruding punctations occurs 1.5 cm below the lip.

Type 4.2--Clemson Island Corded Horizontal, Variant 2 (n=3) (Figure 18.3)--The sherds of this variant differ from the description of Type 4.1 by having 1) medium to bold cord-mark impressions covering the neck, 2) the continuation of the rim exterior and lip cord marking on the rim interior, and 3) inward protruding punctations.

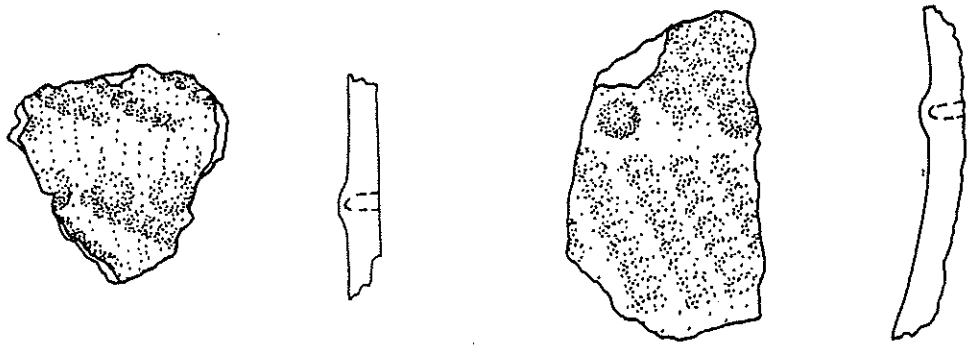
Type 5.1 Clemson Island Gashed, Variant 1 (n=16) (Figure 18.4)--A series of approximately 1.1 cm long gashes arranged in vertical plats on a cord-marked neck characterize this type. The vertical plats of Variant 1 are separated by 1.0 cm. Individual gashes were no doubt made with a



Type 1



Type 2



Type 3

Figure 18.1: Type 1 - Levanna Cord-on-Cord, Type 2 - Clemson Island Cord-on-Cord, and Type 3 - Clemson Island Platted Horizontal

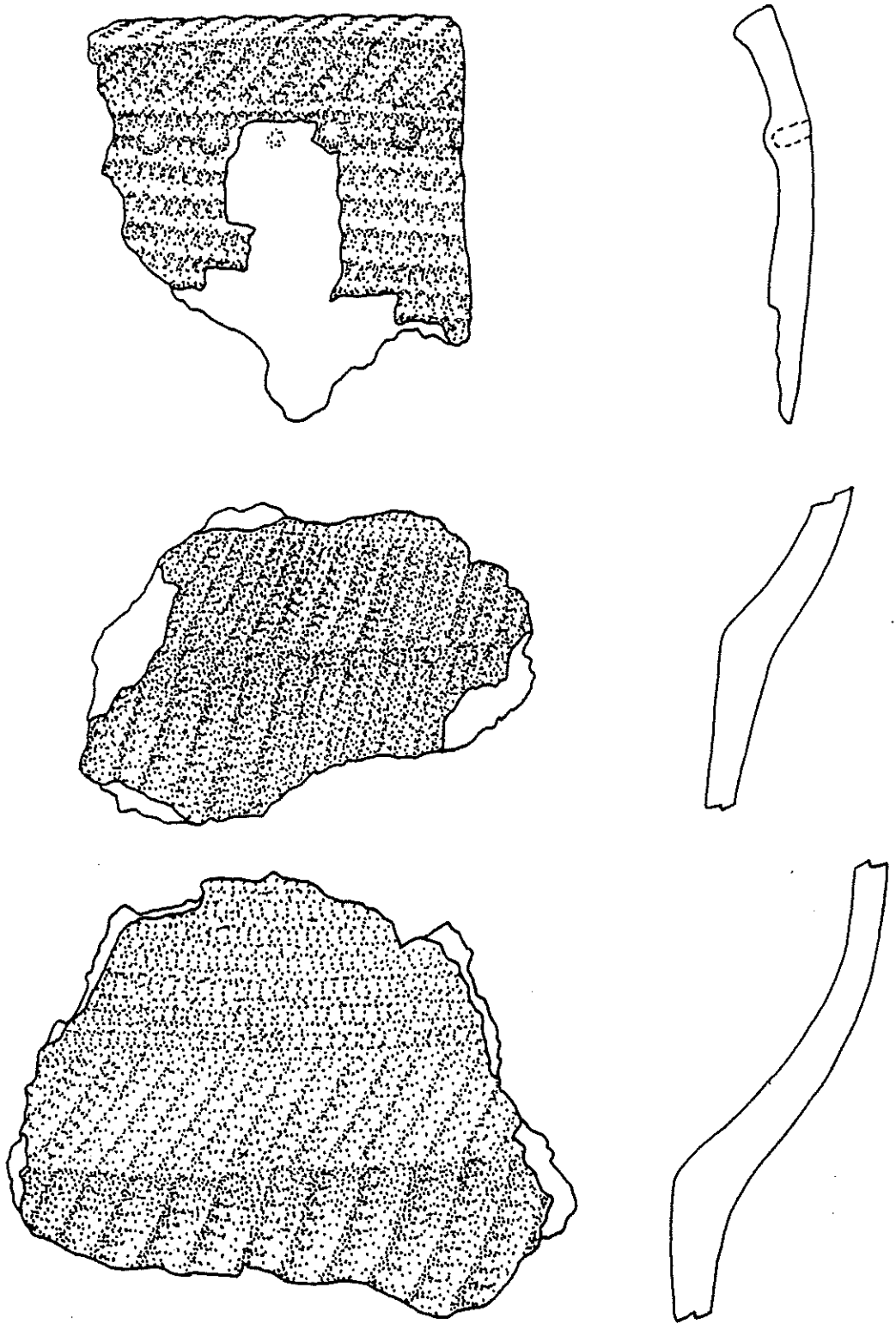


Figure 18.2: Type 4.1 - Clemson Island Corded Horizontal, Variant 1

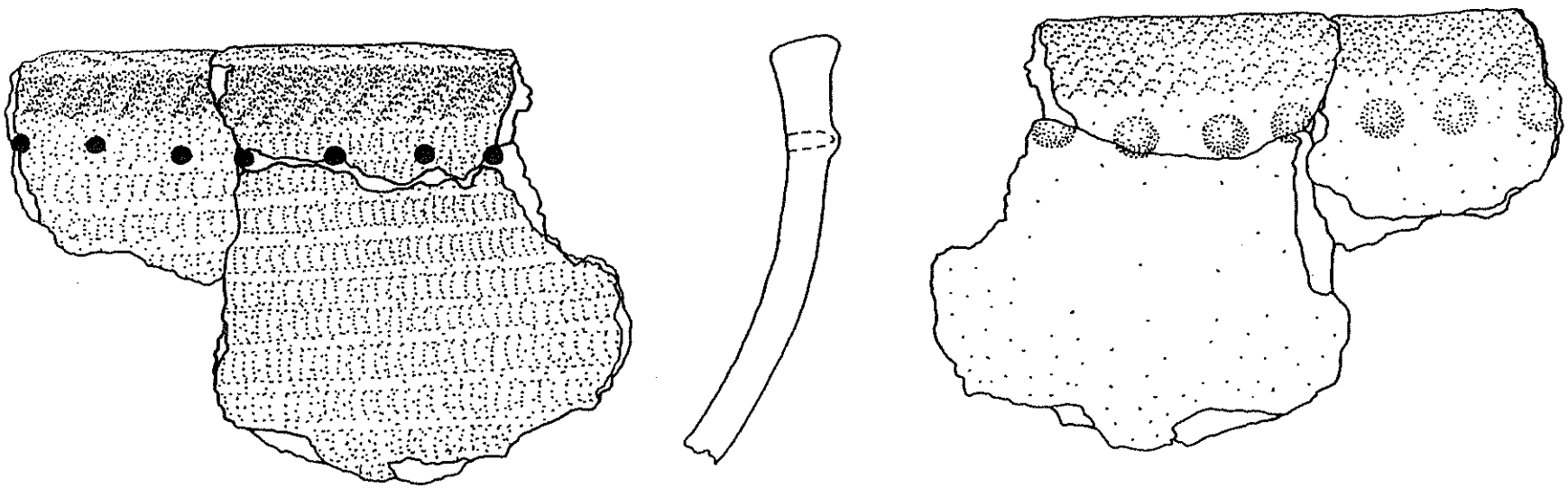
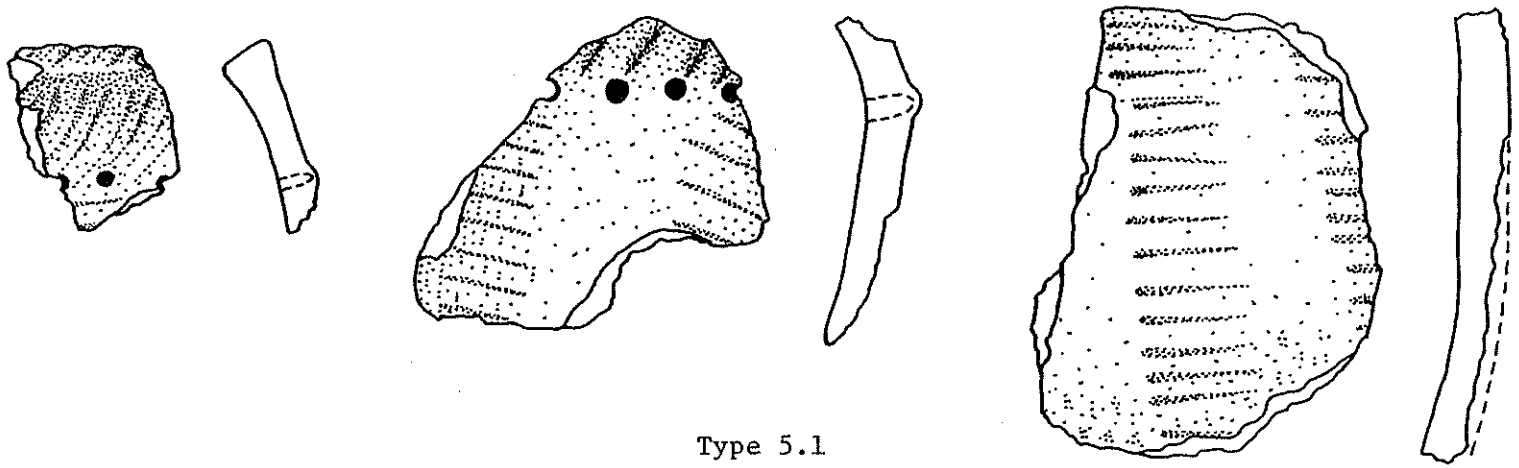
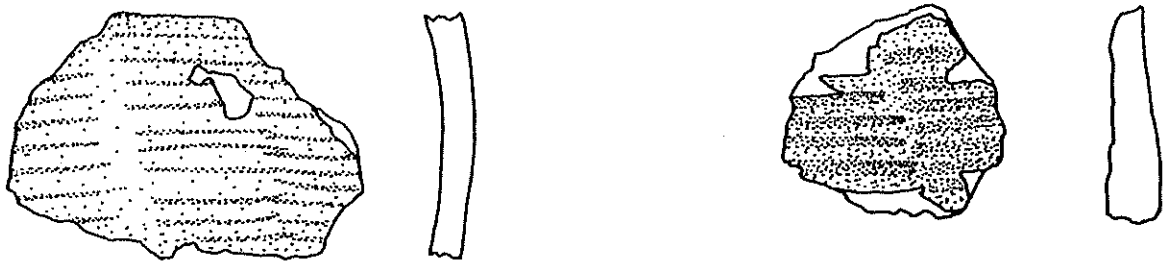


Figure 18.3: Type 4.2 - Clemson Island Corded Horizontal, Variant 2



Type 5.1



Type 5.2

Figure 18.4: Type 5.1 - Clemson Island Gashed, Variant 1, and Type 5.2 - Clemson Island Gashed, Variant 2

pointed bone or wooden tool. Typically one end of each gash is deeper and somewhat wider than the opposite end, with all gashes similarly aligned on the vessel. The platting is superimposed over a weakly impressed cord-wrapped paddle decoration. Above a single line of inward protruding punctations, located 1.5 cm below the lip, are a series of bold, oblique gashes made with a similar but larger tool. The flattened lip is heavily scored with deep gashes oriented somewhat diagonally toward the interior. Apart from the raised nodes, the interior of the vessel is plain.

Type 5.2--Clemson Island Gashed, Variant 2 (n=4) (Figure 18.4)--This type is identical to Clemson Island Gashed, Variant 1, except that the vertical plats on the neck are contiguous or slightly overlapping.

Type 6--Clemson Island Horizontal Complicated (n=15) (Figure 18.5)--This type is similar to Clemson Island Corded Horizontal except for the neck decorations. Here, an oblique band of bold cord markings cover the lower one-half of the neck while a cord-wrapped paddle decoration has been lightly impressed on the upper one-half. Superimposed on both are a large number of horizontal incisions of irregular length and depth. Below the neck, the usual band of bold oblique cord markings covers the upper part of the shoulder, while below the ridge of the shoulder, very bold cord marking presumably covers the rest of the body. A single line of inward protruding punctations rings the vessel just below the slightly outflaring rim. The rim exterior and approximately 0.8 vertical cm of the rim interior are decorated with medium texture oblique cord marking. The lip exhibits 2 narrow, concentric, incised lines.

Type 7--Clemson Island Dentate (n=1) (Figure 18.6)--A single rim sherd exhibited such a unique decorative style that it warrants special attention. A single row of outward protruding punctations occurs 1.2 cm below the slightly outflaring rim. Below this, a few lines of what appear to be oblique incising or gashing are seen. Above the punctations, the rim is decorated with a denticulate design. It consists of a series of depressions with a very fine, shallow connecting line. Such designs are reminiscent of those found on many Owasco and Clemson Island pipes. On the interior surface of the rim this band of design is vertical, on the lip and rim exterior it is oblique.

Type 8--Fisher Farm Irregular Cord Marked (n=3) (Figure 18.6)--Three sherds comprise the known sample of this type. The neck is lightly impressed with a cord-wrapped paddle decoration, upon which a series of what appear to be cord-wrapped stick impressions of irregular length and depth was made. While oriented horizontally, there is enough variation in their orientation to suggest a repeated whipping action with a very fine cord-wrapped stick. The rim is pronounced, somewhat protruding or overlapping. The exterior surface of the rim is decorated with the customary series of oblique cord-marked impressions while the lip shows a series of oblique notches or gashes. The interiors are plain. This type appears to be without punctation.

Type 9--Clemson Island Enlarged Rim (n=2) (Figure 18.6)--These 2 rim sherds are notable in the rather bulbous rim treatment and bold cord marking each possesses. The rim and lip have a somewhat rounded appearance

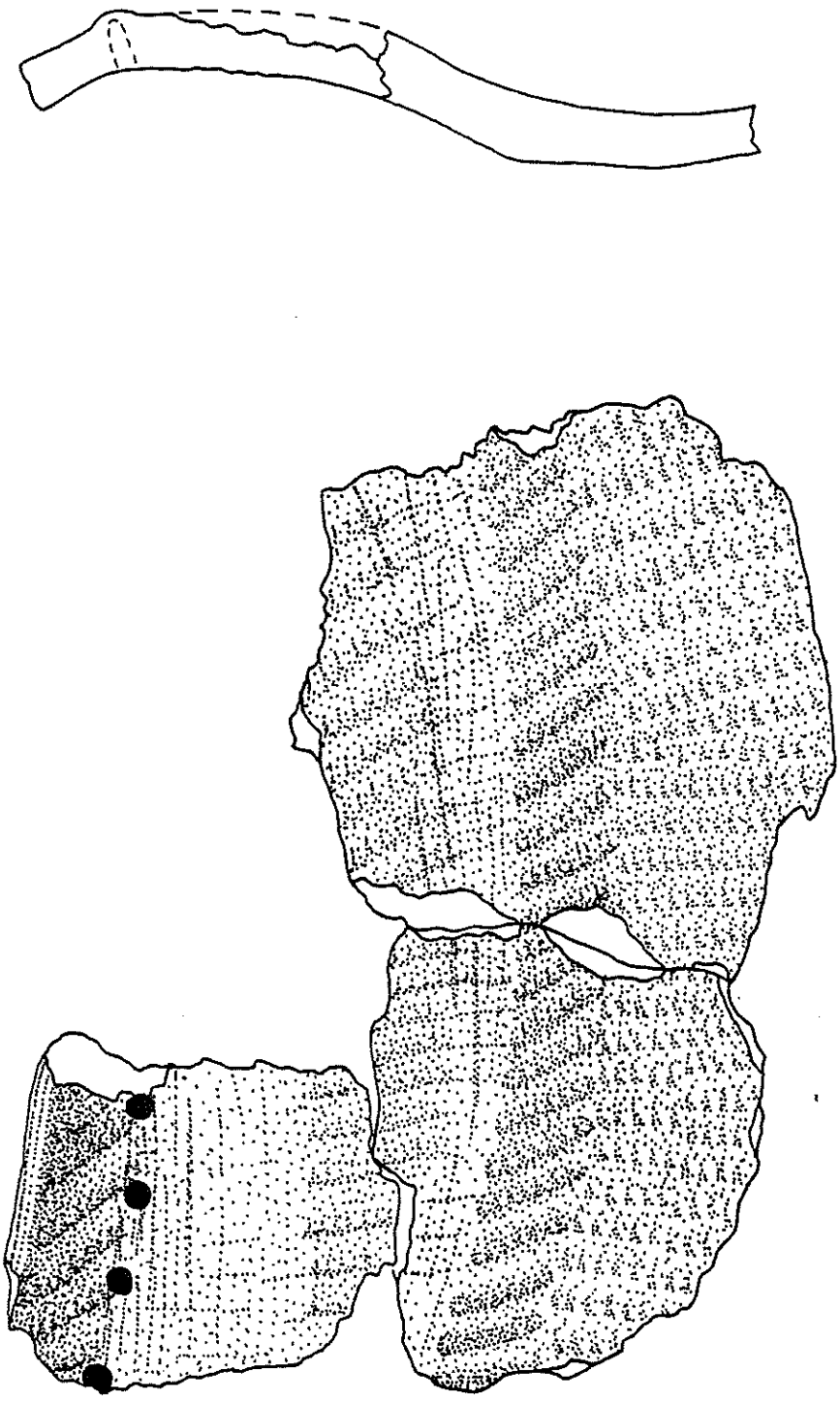
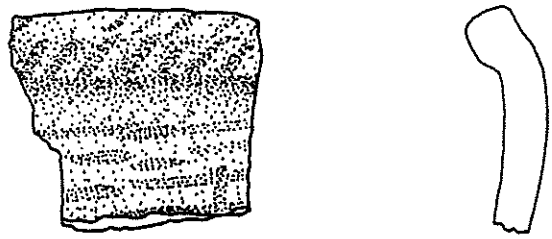
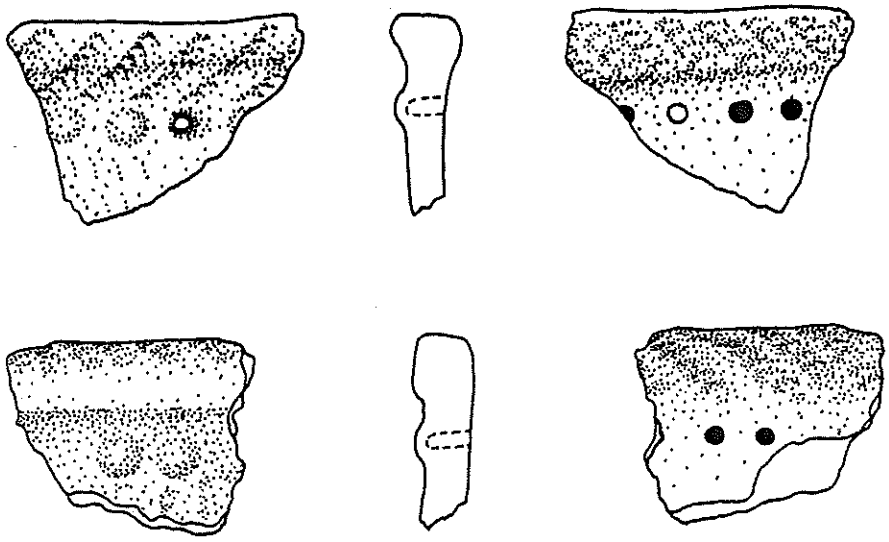


Figure 18.5: Type 6 - Clemson Island Horizontal Complicated

Type 7



Type 8



Type 9

Figure 18.6: Type 7 - Clemson Island Dentate, Type 8 - Fisher Farm Irregular Cordmarked, and Type 9 - Clemson Island Enlarged Rim

in cross-section and the oblique cord marking of the rim exterior, lip, and rim interior appears to have been executed with a single rolling motion across the top of the vessel with a cord-wrapped paddle. Bold, outward protruding punctations are seen on both sherds.

Type 10.1--Clemson Island Platted Oblique, Variant 1 (n=2) (Figure 18.7)--Parallel oblique plats of bold cord-wrapped stick impressions cover the rim, neck, and upper shoulder of this type. The plats are spaced approximately 0.6 cm apart and are applied to a plain surface. Below the bend in the shoulder, bold to very bold cord marking from a cord-wrapped paddle covers the exterior body surface. One cm below the square, slightly outflaring rim, a single line of inward protruding punctations occurs. Bold cord marking covers the lip, but the interior of the vessel is devoid of decoration.

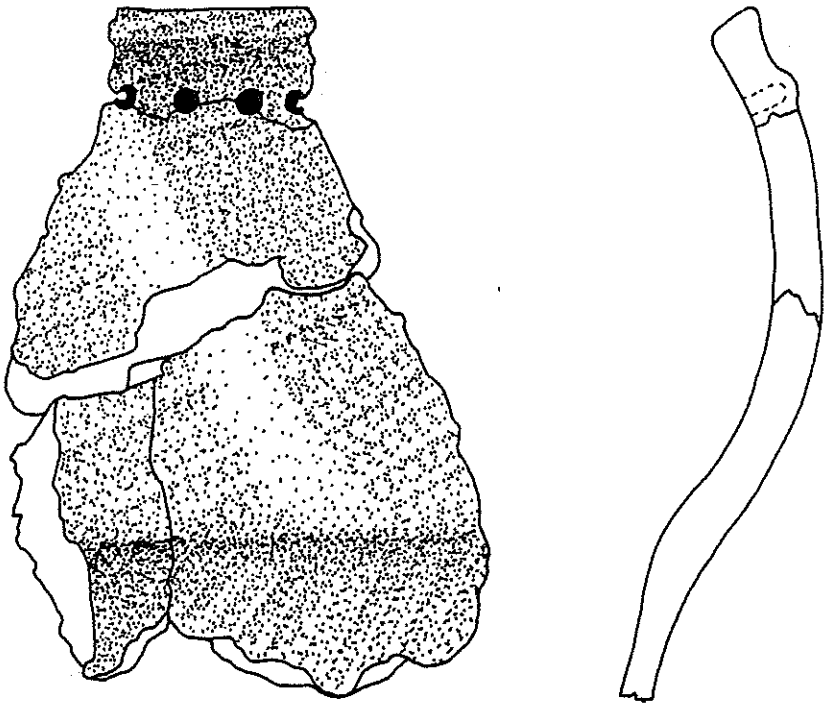
Type 10.2--Clemson Island Platted Oblique, Variant 2 (n=1) (Figure 18.7)--A single rim sherd of this variant shows the same characteristics as Type 10.1 except that 1) the neck platting stops just below the line of punctations, while above the punctations a band of oblique cord marking occurs, and 2) the neck plats are applied to a previously cord-marked surface.

Type 10.3--Clemson Island Platted Oblique, Variant 3 (n=2) (Figure 18.7)--The neck plats of this variant are contiguous. As a result, if any earlier cord marking existed, it has been obscured. Again, the plats cover the upper half of the shoulder, while immediately below, very bold cord marking covers the body.

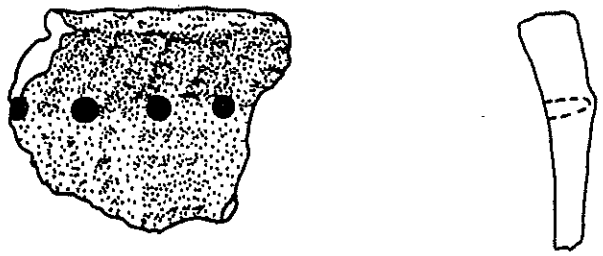
Type 11--Clemson Island Flared Rim (n=2) (Figure 18.8)--These 2 small rim sherds exhibit an extreme outward flare above the line of inward punctates. The lip is flattened, with a slight overhang on the exterior surface of the vessel. Fine cord-marked impressions running perpendicular to the exterior surface cover the lip. The interior surface is undercoated. The exterior rim and neck are cord marked, but weathering on these sherds makes its further description impossible.

Type 12--Clemson Island Fine Impressed (n=1) (Figure 18.8)--All decorative elements of this type are finely executed. The neck and lower one-half of the rim are covered with an obliquely oriented fine cord marking or fabric impression. The upper one-half of the outward flaring rim, the flattened lip, and the interior of the rim are decorated with a medium to fine cord marking. A single line of unusual protruding punctations occurs approximately 1.1 cm below the exterior edge of the lip. These are executed with a very narrow implement, their diameters averaging only 0.15 cm rather than the usual 0.25-0.35 cm of other Clemson Island types.

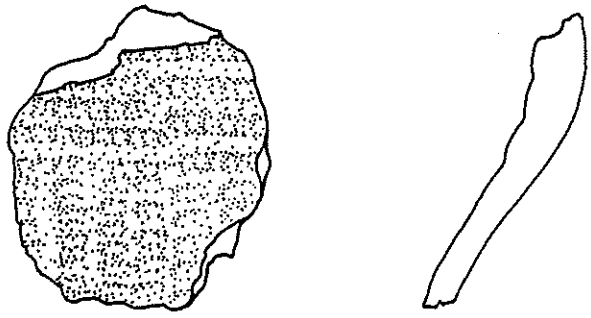
Type 13.1--Shenks Ferry Incised-Multiple Banded (n=24) (Figure 18.9)--These sherds clearly correspond to Witthoft's characterization of the Stewart Complex, a series more limited in design elements and with shorter rim height than commonly found in Shenks Ferry Incised. Only two essential variations are seen in this sample: horizontal and chevron neck incising. The latter motif is commonly bounded by bands of oblique incising, one just below the rim, the other at the base of the neck.



Type 10.1

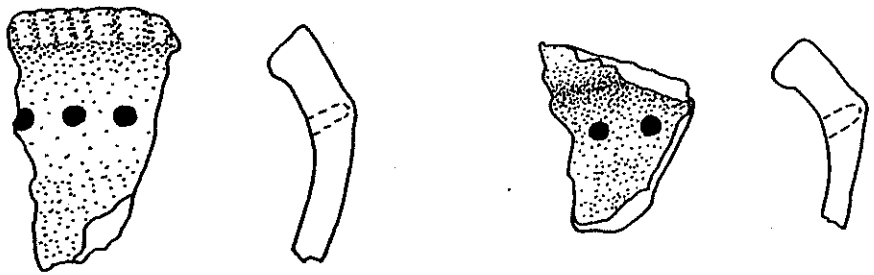


Type 10.2

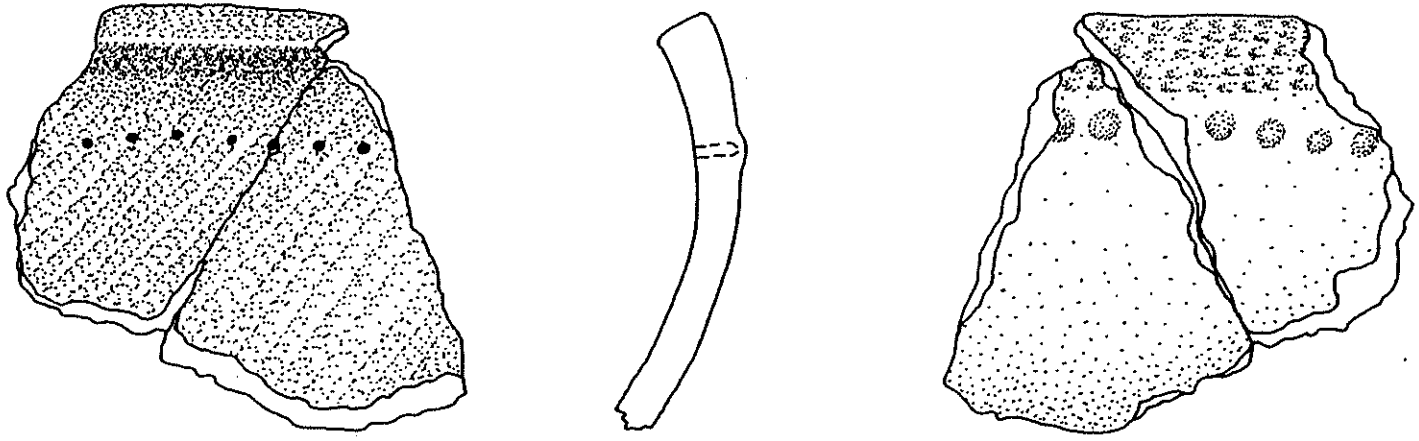


Type 10.3

Figure 18.7: Type 10.1 - Clemson Island Platted Oblique, Variant 1, Type 10.2 - Clemson Island Platted Oblique, Variant 2, and Type 10.3 - Clemson Island Platted Oblique, Variant 3



Type 11



Type 12

Figure 18.8: Type 11 - Clemson Island Flared Rim, and Type 12 - Clemson Island Fine Impressed

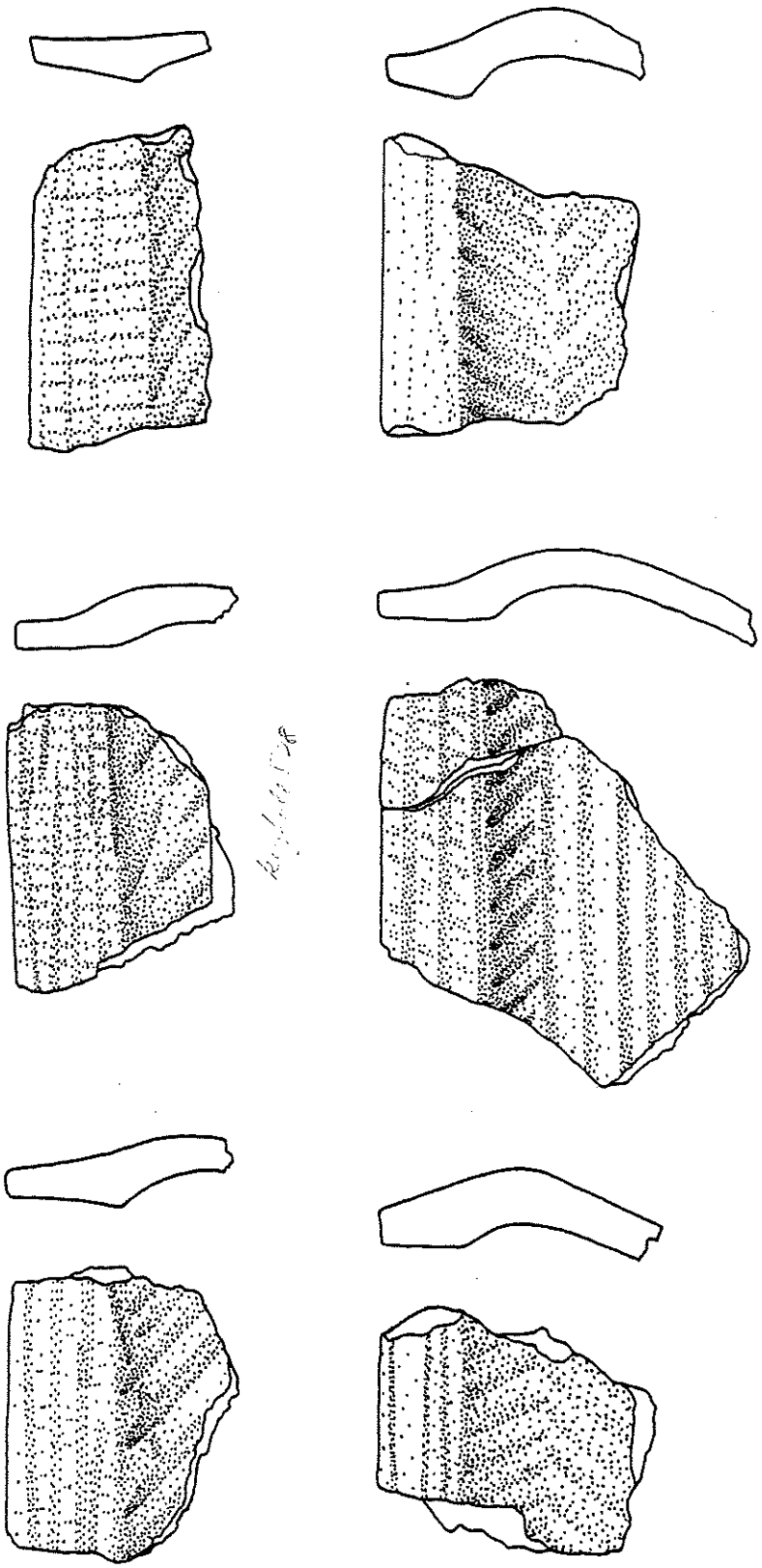


Figure 18.9: Type 13.1 - Shenks Ferry Incised - Multiple Banded

The incising itself is executed with either a sharpened or flattened tool, leaving either V-shaped or trough-shaped incisions in profile. The cord-marked rim surfaces tend to have two or three superimposed horizontal incisions encircling the vessel. Lips and vessel interiors are plain, while the body is cord marked. Figure 18.10a illustrates a nearly complete example of such a vessel found near the Fisher Farm Site and donated to the Museum of Anthropology, The Pennsylvania State University.

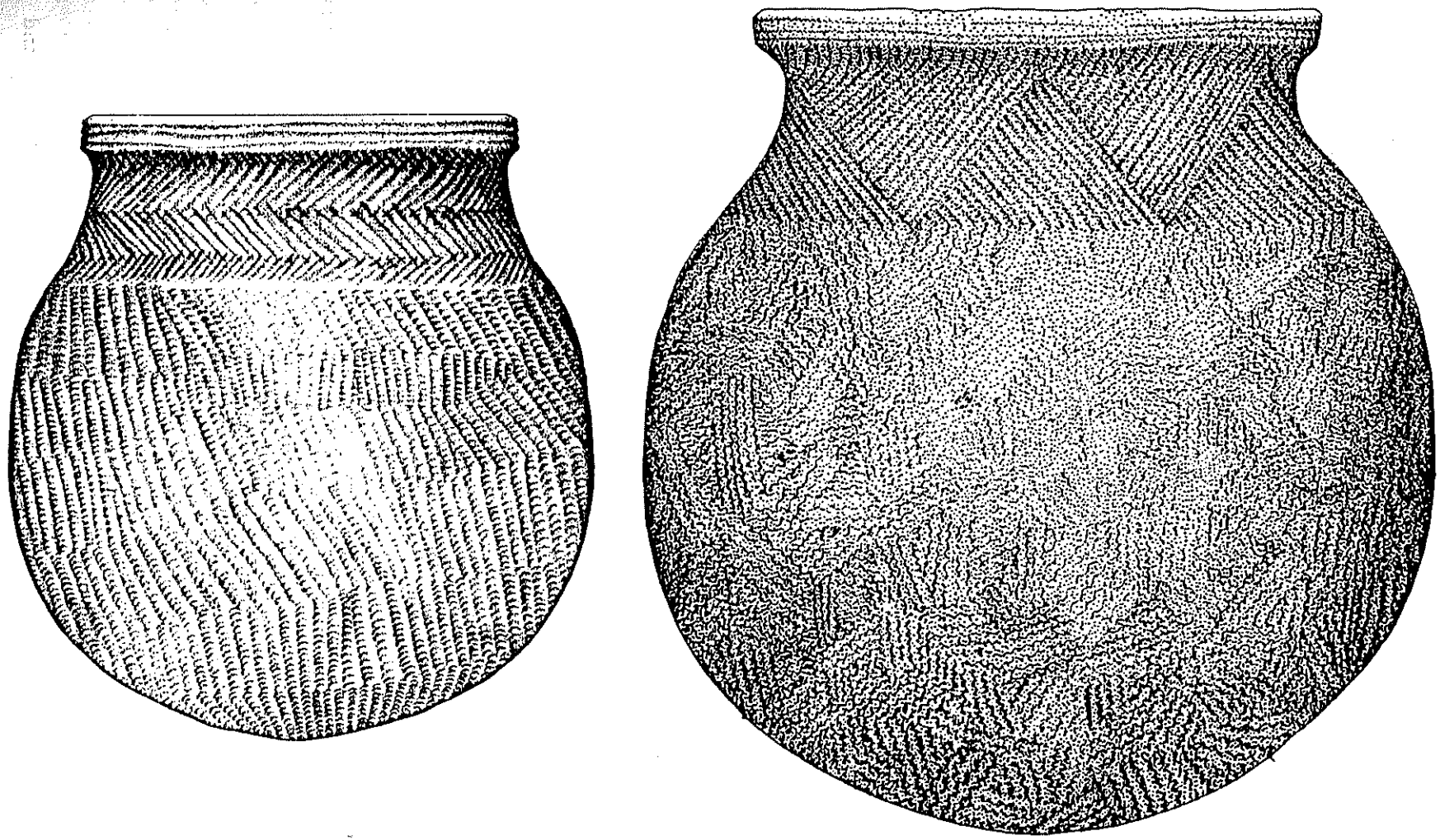
Type 13.2--Shenks Ferry Incised-Complex (n=5) (Figure 18.11)--Five sherds are known or suspected to be of this type. Given the small size of these sherds, it is difficult to determine if the zonations in neck incising common to this type do in fact occur; however, certain regularities are seen. Four of this group show no horizontal incisions on the cord-marked rim. Four also exhibit fine line, or V-profile incising. While we feel these traits to be common ones for the Complex type, they are by no means key attributes, as can be seen in Figure 18.10b. This vessel was found in Centre County in 1938 by Melvin Ellenberger while hunting fox on Tussey Mountain, approximately 15 miles from the Fisher Farm Site (Robinson 1939). Inverted and sitting on a stone slab in a small cist when found, it was probably intended to protect a small cache of foodstuffs. It exhibits trough-shaped neck and rim incising.

Type 13.3--Shenks Ferry Incised, Variant 3 (n=2) (Figure 18.11)--Two sherds show a rim height much more typical of Blue Rock Phase rims of Lancaster County. The 2 average 2.9 cm, compared to approximately 1.1 cm in the Stewart Complex material of Type 13.1.

Type 14--Lancaster Incised (n=6) (Figure 18.12)--Although defined on the basis of samples from Lancaster County, the temporal position of this type and its coherency as a distinctive attribute set suggest that this material is widespread in the Susquehanna drainage. The 6 Fisher Farm sherds display the usual squared lip and rim and a slightly outflaring rim or collar area. Fine incising, consisting of poorly controlled oblique lines, divides the collar into opposed triangular zones which are then filled with horizontal lines. The incising is applied over somewhat obliquely oriented cord marking.

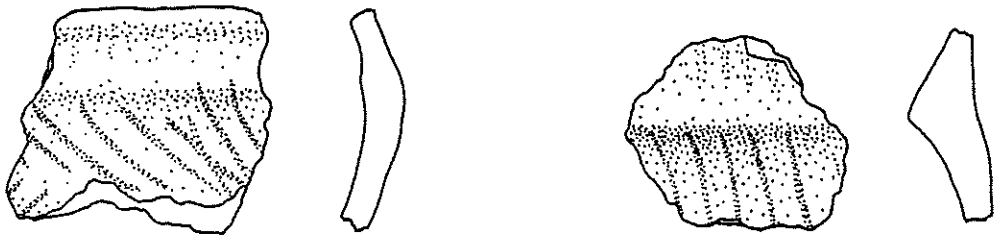
Type 15--Funk Incised (n=6) (Figure 18.12)--This collection of 6 sherds is somewhat mixed and, with further comparative analysis may be subdivided and associated with other types. However, as we will demonstrate below, they occur late in the stratigraphic sequence and all 6 exhibit the lip-notching characteristic of Funk Incised (Heisey 1971:58).

Type 16--Shell-Tempered (n=12) (Figure 18.13)--As mentioned earlier there is currently some confusion over the diagnostic value of shell tempering in the late prehistoric ceramics of the Susquehanna drainage. Traditionally the attribute was considered sufficient for assigning sherds to one of several Susquehannock wares. Several ongoing projects suggest a regional typology, without the traditional ethnic connotations, is more appropriate. Smith's work at the Quiggle Site may well serve as the basis for the definition of one of these regional variants.

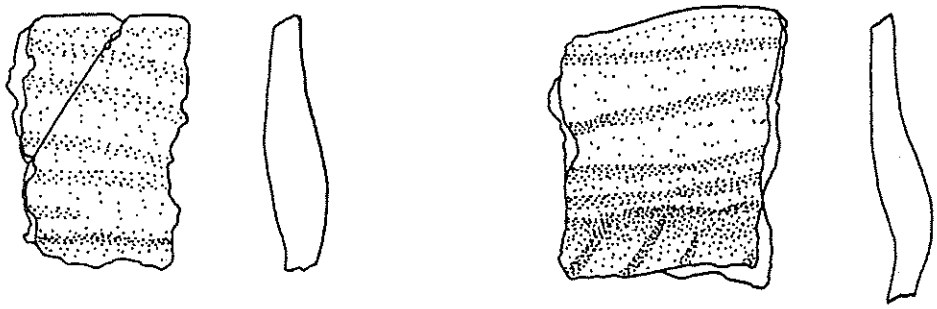


a b

Figure 18.10: Two Shenks Ferry Vessels. a) Type 13.1 - Multiple Banded, b) Type 13.2 - Complex (Scale equals 1/2 actual size)

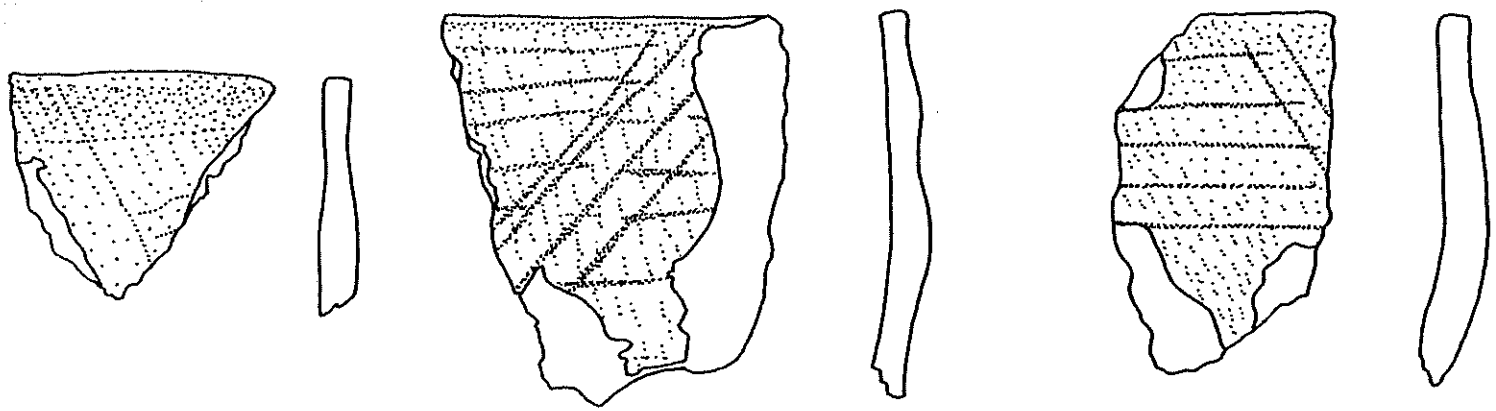


Type 13.2

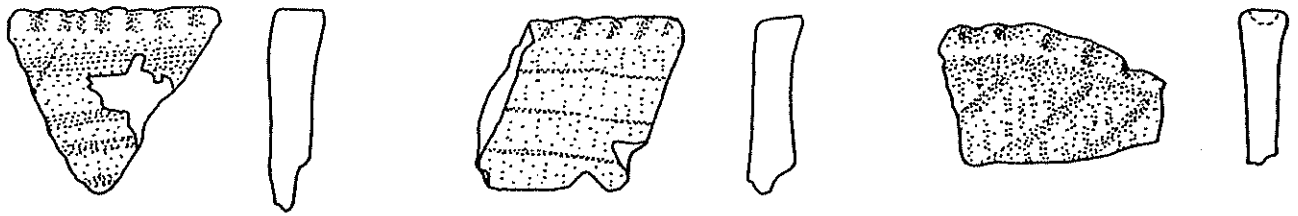


Type 13.3

Figure 18.11: Type 13.2 - Shenks Ferry Incised - Complex, and
Type 13.3 - Shenks Ferry Incised, Variant 3



Type 14



Type 15

Figure 18.12: Type 14 - Lancaster Incised, and Type 15 - Funk Incised

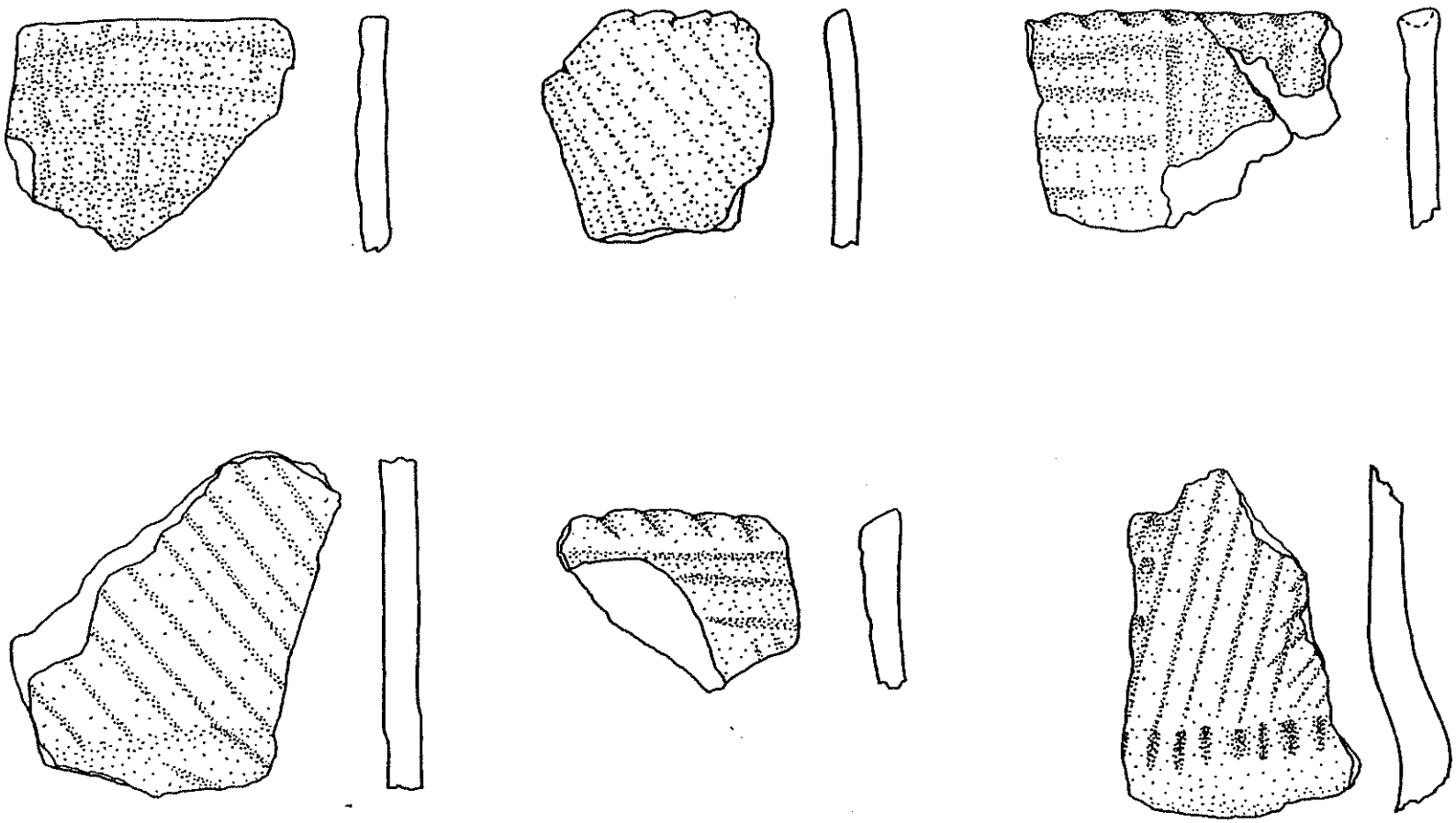


Figure 18.13: Type 16 - Shell Tempered

Our shell-tempered sample consists of sherds with decorative attributes that equate with Funk Incised, Lancaster-Funk hybrids, and other types. All sherds with intact lip segments (n=8) exhibit notching similar to that of the Funk Incised sherds described above. One sherd even has punctations surrounding triangular zones of incising on an excurvate collar, a trait common to Funk Incised (Figure 18.13, lower right). This same sherd exhibits a single row of punctates at the base of the collar, typical of Lancaster Incised. We will propose in the stratigraphic analysis below that shell tempering makes an earlier appearance in this region than suggested in the literature and that it represents an alternative tempering form in the ceramic series of the late Shenks Ferry and subsequent phases in central Pennsylvania.

IV. STRATIGRAPHIC ANALYSIS

During the 1978 season at Fisher Farm, 115 identifiable rim or neck elements were excavated from the stratified deposits along the eastern edge of the site. With the exploratory trenches dug at the end of the 1977 field season serving as a guide, the 1978 excavations sought to capitalize on the several natural strata in this area for excavation and chronological control. Natural strata thus served as a guide for the vertical definition of excavated layers within our test pits. We realized in advance, however, that some strata were of considerable thickness and their excavation as a single vertical unit might violate our very intention--chronologic control over ceramic variation. As a compromise between tight chronologic control and a reasonable pace for first-year field school students, we adopted a policy of excavating strata in arbitrarily defined 5 cm levels.

As excavation progressed, several things became clear. First, plowing over the surface of this area had destroyed all evidence for natural stratigraphy in the top 20-25 cm, homogenizing the distribution of artifacts and creating 2 artifical strata of no interpretive value--a plow zone (Stratum 1) and a slight pressure pan (Stratum 2). Stratum 3 appeared to represent deposits made after the aboriginal abandonment of the site. Artifacts from this stratum were very sparse. It contained historic objects as frequently as prehistoric ones. Stratum 4 was the first of 4 strata containing relevant prehistoric cultural material. It was a thicker deposit than the others, but like all strata below Level 2 in this area, it varied considerably in thickness over the course of the area. Not only did stratum 4 "feather out" along the area's western perimeter and become thicker toward the center, it also contained "pockets" along its bottom profile that would add an extra 5-10 cm to this depth. The excavated segments of Stratum 4 usually contained up to 15 cm of deposit, labelled by us Levels 4A, 4B, and 4C in 5 cm intervals. Those trenches that encountered a thicker area of Stratum 4 also had a Level 4D and occasionally Level 4E.

Stratum 5 was generally a thin deposit and was excavated either as a single unit, "Level 5" or as two units, Level 5A and 5B. Stratum 6 was, in places, considerably thicker but was again excavated as Level 6A and 6B. Stratum 7 was discontinuous, being found primarily along the bottom edge of the slope of the terrace, and was always excavated as a single level.

Given our ability to properly recognize each stratum when it was encountered, our operating assumption was that each level would be comparable between test pits and that sufficient ceramic samples from each chronologic episode would be accumulated over the field season by pooling the contents of each excavation level. With minor reservations we still believe this assumption holds. One obvious modification concerns the rate of accumulation over different portions of a stratum. Since deposits no doubt accumulated faster at the bottom of the terrace slope, a 5 cm arbitrary level excavated here probably incorporated a briefer span of time than a 5 cm arbitrary level excavated on the slope or along the edge of the terrace. This caused particular problems for the analysis in one area (test trenches N2E34 and N2E36) and, no doubt, some measure of analytic noise in all portions of the stratified area. Solutions to these problems will be discussed below.

Table 18.4 presents the stratigraphic distribution of the 115 sherds under discussion. If we eliminate Levels 1 and 2 from consideration due to plow distortion, the possibility of lateral displacement, etc., we remove only 3 sherds from the analysis. Level 3 should likewise be removed from further analyses, since our contention is that it represents a post-abandonment deposit and all artifacts within it must be in this area as a result of downslope wash.

Downslope wash, accidental aboriginal redeposition, and other factors were no doubt responsible for the occasional inclusion of older material in these deposits. We have assumed analytically that this is a constant, albeit infrequent, chronologic contaminant in all levels. We believe this process to be most evident in Table 18.4 among those types with highly sporatic distributions, such as Types 5.1 and 10.3. Here, single sherds occur in strata that are far removed from the main body or earliest occurrence of that type. We have attempted to partially eliminate the effects of later intrusions by removing those sherds separated by 2 or more levels from the rest of the distribution from further analysis.

Adopting this policy, we have also applied it to situations where the intrusion results in contexts that are too early. Again in Table 18.4, Types 14 and 16 each contain sherds which probably occur in Level 5 due to aboriginal disturbance. These sherds are also eliminated.

Finally, 2 sherds from N2E34 are eliminated on the basis of the non-comparability of the level definitions in this area compared to the rest of the stratified area.

With this improved data base, we can now experimentally begin to collapse levels and typological variation in the ceramic sample to monitor the principal direction of ceramic change at Fisher Farm (Table 18.5).

Levels 4A and 4B will be considered together for two reasons. First, the frequency of sherds of each type are quite similar between the two. The disappearance of Lancaster Incised in 4A and the continuation of Funk Incised and shell-tempered wares is clear enough in Table 18.4. Beyond this the data are similar. Second, the difference in mean values between the radiocarbon dates for the 2 levels is not statistically significant.

Table 18.4: Stratigraphic Distribution of Identifiable Sherds--1978 Excavations

Levels	Types																					
	1	2	3	4.1	4.2	5.1	5.2	6	7	8	9	10.1	10.2	10.3	11	12	13.1	13.2	13.3	14	15	16
1+2															1		1				1	
3							1										1					
4A						1								1			3	1			1	2
4B						1											3			1	3	3
4C		2	1	1						1			1			1	7		2	4		5
4D		1	1	1			1			1							4	1				
4E															1		2	1				
5	1		1	1			2		1	1	1	2		1			5	2		1		2
6A	1	1	2	2	3	12		1														
6B				3		2																
7				3																		

Table 18.5: Collapsed Stratigraphic Distribution of the Revised Ceramic Sample

	Levanzo Ceramic	Almagro Island																Shamba Ferry			Lance Incised	Fenish Inc.	Shell Impr.
Levels	Types →	1	2	3	4.1	4.2	5.1	5.2	6	7	8	9	10.1	10.2	10.3	11	12	13.1	13.2	13.3	14	15	16
4A+4B																		5			1	4	5
4C			2	1	1						1			1			1	7		2	4		5
4D+4E+5		1	1	2	2			3		1	2	1	2			1	1	11	4				
6A+6B+7		1	1	2	8	3	14		1														

Levels 4D, 4E, and 5 are usefully considered together, as well. As mentioned earlier, only a few of the test trenches encountered a sufficiently thick deposit of Stratum 4 to warrant Level 4D and 4E designations. Level 4C shows a more unique ceramic composition than Level 5, that is, the information loss resulting from collapsing the contents of 4D and 4E with 5 is less. The distinction will be kept, as necessary, in subsequent tables.

Finally, Levels 6A, 6B, and 7 are so obviously limited in their ceramic inventory to the earlier material that, for comparative purposes, there is no point in keeping them separate. Two radiocarbon dates from test trenches N14-18E40 and N26E39 do show a statistically significant difference in their means, even though they both derive from Level 6A. Clearly a gradual, patchy accumulation typifies the filling action of this area, even within a stratum. For general comparative purposes, however, these strata can be considered comparable.

The 22 different ceramic types and variants in this sample can also be usefully collapsed. We do so here using two basic principles, radiocarbon associations and typological affinity. ^{14}C-dates associated with spatially tight clusters of sherds clearly indicate both the absolute age of the material and their relatedness as part of the same assemblage. Such an association occurred in Level 6A in N26E39, where a dense concentration of sherds of Types 1, 2, 3, 4.1, and 5.1 was associated with a date of 960±90 A.D. Similarly, the discovery of a cluster of Type 4.2 ceramics in N14-18E40 associated with a radiocarbon date of 1130±80 A.D. clearly suggests these types were part of the same ceramic assemblage. Types 5.2, 7, 8, 9, 10.1, 10.2, and 10.3 are dealt with as a group because of their similar stratigraphic distributions and their being such a limited part of the Clemson Island/Owasco typological concept. Similarly Types 11 and 12 are both very late in the Clemson Island/Owasco ceramic range. The 3 variants of Shenks Ferry Incised are considered together because of their recognized chronologic association at other Shenks Ferry sites and their decorative typological coherency.

Table 18.6 expresses the revised frequencies, with the typological and stratigraphic compressions discussed above, while Table 18.7 reduces the typological variation further to the three principal ceramic categories. The information in these tables can be summarized as follows:

1. Levels 6 and 7 exhibit an exclusively Clemson Island/Owasco assemblage. The types included in this assemblage are Levanna Cord-on-Cord and several punctated Clemson Island types that otherwise are decoratively quite comparable to Ritchie's early Owasco material.

2. Levels 4D through 5 show a mixture of Clemson Island/Owasco and Stewart Complex variants of Shenks Ferry. Although the numbers are small, a gradual inversion appears to take place, from 61%-39% in Level 5 to 43%-57% in Levels 4D and 4E.

3. Level 4C contains the largest variety of types, with the last Clemson Island/Oswaco sherds occurring simultaneously with Stewart Complex material and two new types, Lancaster Incised and shell-tempered wares.

Table 18.6: Stratigraphic Distribution of the Typologically Compressed Sample

Types / Levels	1,2,3 4.1,5.1	4.2 6	5.2,7,8, 9,10.1, 10.2,10.3	11 12	13.1,13.2, 13.3	14	15	16
4A-4B					5	1	4	5
4C	4		2	1	9	4		5
4D-5	(a) 3 / (b) 3 — 6		2 / 8 — 10	1 — 1	8 / 7 — 15			
6-7	26	4						

(a) Counts for Levels 4D and 4E combined.
(b) Count for Level 5.

Table 18.7: Stratigraphic Trends in the Ceramic Series at Fisher Farm--
I) Raw Counts and II) Percentages per Level

Series / Levels	CLEMSON ISLAND		SHENKS FERRY		SHELL TEMPERED
4A-4B			10		5
4C	7		13		5
4D-5	(a) 6 (b) 11	17	8 7	15	
6-7	30				

I

Series / Levels	CLEMSON ISLAND		SHENKS FERRY		SHELL TEMPERED
4A-4B			66%		33%
4C	28%		52%		20%
4D-5	43% 61%	53%	57% 39%	47%	
6-7	100%				

II

(a) Values for Levels 4D and 4E combined.
(b) Values for Level 5.

4. Levels 4A and 4B contain only Shenks Ferry and shell-tempered types, with the later varieties of Shenks Ferry material (notched rim) and shell-tempered wares increasing relative to Stewart Complex and Lancaster Incised material.

V. CHRONOLOGIC INTERPRETATION

Our ability to use these data to construct a model of ceramic change with regional import is predicated on two assumptions: the analytic units (strata) have chronologic integrity and the numbers of sherds in each stratum are at least a coarse reflection of their actual frequency during the periods these strata represent. Four of the 5 radiocarbon dates from known stratigraphic context at Fisher Farm support the first assumption. As discussed earlier, dates of 960±90 A.D. and 1130±80 A.D. were associated with Levels 6A, while dates of 1520±55 A.D. and 1505±55 A.D. were associated with Levels 4A and 4B respectively. An additional date of 1350±105 A.D. from terrace Feature 28, the keyhole structure, was associated with the Stewart Complex sherd illustrated in Figure 18.9 (top, center), and on the basis of the sheer numerical frequency of similar ceramics probably relates to the lower portions of Level 4. In combination, these dates support the notion of a proper chronologic sequence.

The second assumption is one that is very difficult to support, but is routinely made by archaeologists dealing with similar circumstances. The actual frequency of sherds accumulating in the stratified deposits at Fisher Farm was no doubt affected by a series of natural and cultural factors. We have already mentioned downslope wash and its directional bias. However, the use lives of each vessel type, the social context of their deposition, and many other factors may also have been influential. Our inability to quantify the types of impacts these factors may have had leaves us no other option but to ignore them and assume the reported frequencies are meaningful in a relative sense. Our only check is the degree to which similar patterns of ceramic change can be confirmed in subsequent excavations.

The data from Fisher Farm, as seen in Table 18.7, suggest that its ceramic history is best viewed as one of gradual, overlapping replacement of major ceramic series, not as the rapid total replacement of one series by another as was once believed for the region. The discovery of intermediate decorative motifs between, for example, Clemson Island/Owasco and Shenks Ferry, is not as relevant to the region's ceramic history as is the demonstration of their coexistence. Given that this is the first intensively investigated, deeply stratified deposit of Late Woodland material in the region, the data deriving from it must for the time being be viewed as the most suitable archaeological backdrop for evaluating ceramic change in the West Branch Valley, and perhaps, for central Pennsylvania generally.

By proposing a model of gradual ceramic replacement, three important consequences follow. First, the ceramic sequences of central Pennsylvania and the better known central New York area become more compatible, at least for their pre-Iroquoian and pre-Susquehannock phases. The coexistence of cord-marked, often rimless wares with rimmed, incised wares is now seen to occur in both areas, with the gradual phasing out of the former

varieties and increases in the latter. In New York, intermediate and evolutionary traits in morphology and decoration can be demonstrated in Castle Creek ceramics. In Pennsylvania, Turnbaugh (1977:233) has argued for a similar process between Clemson Island and Shenks Ferry and has even specified its probable path. The most interesting point, however, is that the approximately 1300 A.D. date for the Castle Creek phase in New York (Ritchie and Funk 1973:166) corresponds to our inferred date for Levels 4D-5, the period in which the early coexistence of Clemson Island/Owasco and Stewart Complex-Shenks Ferry material is most evident. Even if one were to consider the existence of the 7 Clemson Island/Owasco sherds in Level 4C as entirely the result of the introduction of older material during its creation, their coexistence in Levels 4D-5 is much harder to disregard.

The second consequence of the proposed model concerns the equation of shell-tempered pottery in the upper Susquehanna drainage with the Susquehannock ethnic group. Given the dates of Level 4A and 4B, the shell-tempered pottery in Level 4C was almost certainly made in the 1400's A.D. We propose that shell tempering was simply viewed as a technological alternative by the indigenous inhabitants of this area and that not until the late 1500's did the Susquehannock physically occupy portions of the area. If the equation between shell tempering and the Susquehannock occupation is not abandoned, then the data from Fisher Farm suggests that the notion of the Susquehannock migrating down the North Branch Valley during the late 1500's must be reconsidered.

A third and more general consequence of the proposed model concerns the future recognition of components in the region. Rather than assuming that admixture between several chronologically distinct components has occurred on sites with mixed ceramic assemblages, we should independently test this notion on a case by case basis. Those instances where it cannot be supported will add credence to the model being proposed here, and refinements in phase identification will become possible.

CHAPTER 19

THE FISHER FARM PROJECTILE POINTS

ROBERT E. TUDEK, JR. AND JAMES W. HATCH

I. INTRODUCTION

The 83 projectile points from the 1976-1978 excavations at the Fisher Farm site are discussed in this chapter. Attributes related to point length, width, thickness, manufacturing technique, and raw material are used to address the problems of chronologic relationships, phase-specific occupational densities, and intra-site component distributions.

II. ATTRIBUTE DESCRIPTIONS AND PHASE RELATIONS

The projectile point types of Fisher Farm represent a number of periods of human occupation in Pennsylvania. Only the Paleo-Indian and Middle Woodland Periods are unrepresented (Figure 19.1).

A. ARCHAIC THROUGH EARLY WOODLAND (N=22)

Recent stratigraphic excavations at a series of Northeastern sites have provided tightly controlled, radiocarbon dated contexts for Archaic and Early Woodland assemblages (see Chapter 5). Modifications to Ritchie's (1971) long-standing projectile point taxonomy have only recently been proposed that could seriously alter traditional perspectives on human settlement in the area during these episodes (Funk 1976; Brennan 1977; Calkin and Miller 1977). Because of this, and the small sample of pre-Late Woodland projectile points from Fisher Farm, the following taxonomy for the early points must be considered tentative (Table 19.1).

The Early Archaic Period is represented by 2 points, a Kirk Corner Notched and a Palmer (Plate 19.1:1A and 8A) (Coe 1964; Bebrich 1971). The former point is particularly diagnostic. It is made of brown chert and has one serrated blade edge showing moderate wear. The other blade edge is thick and poorly worked, suggesting that this point may in fact have served as a knife. Its asymmetric base is concave and lightly ground, and its maximum thickness is atypically near the point tip.

The Middle Archaic points at Fisher Farm include Otter Creek (Plate 19.1:4A) and Brewerton (Plate 19.1:3A and 9A-13A) types. In support of Hay's assertion (see Chapter 5) that the principal episode of jasper use in this area is the Middle Archaic, all 7 of these points are made of this material.

Four points comprise the Late Archaic collection, with all 4 representing variants of the Sylvan Lake type defined by Funk (1976) (Plate 19.1:5A-6A and 14A-15A). In addition, 6 Archaic point fragments are

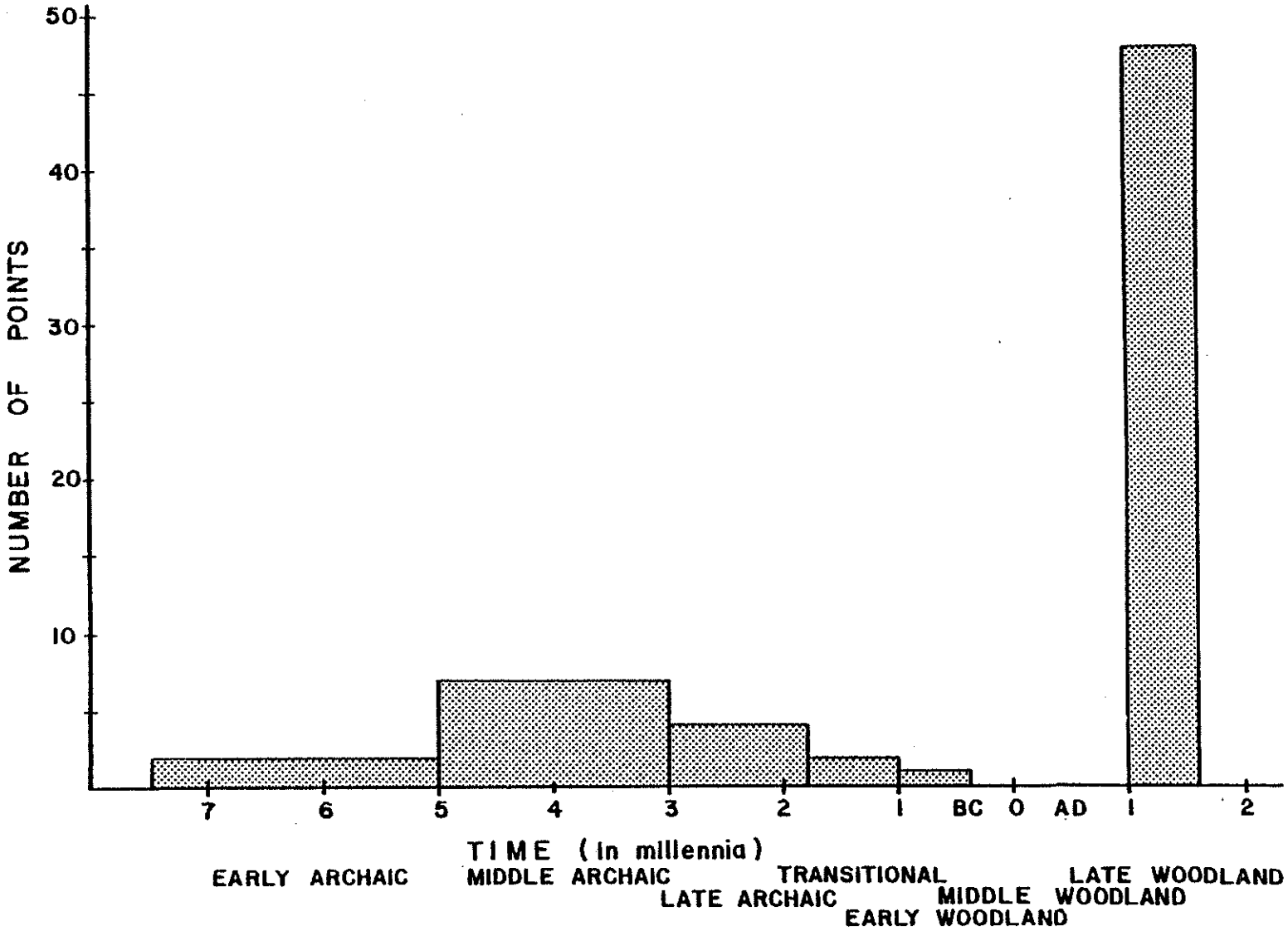


Figure 19.1: Projectile Point Frequencies by Period at Fisher Farm

Table 19.1: Attributes of Diagnostic and Untyped Triangular Projectile Points from Fisher Farm

	Level	Length (mm)	Width (mm)	Thick-ness (mm)	L/W Ratio	Material
Archaic through Early Woodland						
1A. S4E17	1	33	19	7		Chert
2A. S10.75W15.5	1	42	18	13		Jasper
3A. N16E24	1	36	17	8		Jasper
4A. N24E22	1	27	22	7		Jasper
5A. N25E13	1	23	24	8		Jasper
6A. N26E24	1	25	14	9		Quartzite
7A. S8E22	1	34	24	6		Chert
8A. S12.5W14.5	1	25	23	7		Chert
9A. S22E34	2	19	28	6		Jasper
10A. N14E33	1	43	21	10		Jasper
11A. N15E30	Surface	37	19	7		Jasper
12A. N27E17	1	37	21	8		Jasper
13A. N30E26	1	33	19	6		Jasper
14A. N35E40	Surface	32	25	10		Flint
15A. N36E26	1	28	19	8		Flint
16A. S20E30	1	Frag.				Jasper
17A. S20E30	3	Frag.				Chert
18A. N2E36	4A	Frag.				Jasper
19A. N18E40	6B	Frag.				Jasper
20A. N24E4	2	Frag.				Chert
21A. N27E17	1	Frag.				Chert
22T. N12E42	3	40	26	7		Jasper
Jack's Reef Pentagonal						
1J. N2E36	5	23	16 est.	4	1.3:1	Chert
2J. N31E14	1	24	21	5	1.2:1	Jasper
Levanna						
3L. S2E20	1	19	17	3	1.1:1	Flint
4L. S7E18	1	26	30	5	1:1.1	Chert
5L. S8E22	1	28	23 est.	6	1.2:1	Jasper
6L. S14E16	1	25	22 est.	4	1.1:1	Jasper
7L. S20E30	1	21	17	4	1.3:1	Chert
8L. N2E36	4C	23	8	4	1.3:1	Flint
9L. N10E38	2	25 est.	22	4	1.1:1	Chert
10L. N12E42	5	22 est.	22 est.	3	1:1	Chert
11L. N14E40	5	30	28	7	1.5:1	Flint
12L. N16E24	1	22	20	4	1.2:1	Chert
13L. N18E24	1	23 est.	23 est.	4	1:1	Flint
14L. N26E26	1	36	28	6	1.3:1	Slate

Table 19.1: Continued

	Level	Length (mm)	Width (mm)	Thick-ness (mm)	L/W Ratio	Material
Levanna (cont'd)						
15L. N27E17	1	25	22 est.	4	1.1:1	Flint
16L. N27E18	1	20	19	4	1.1:1	Flint
17L. N29E13	1	24 est.	22 est.	3	1.1:1	Chert
18L. N30E11	1	22	21	3	1.1:1	Flint
19L. N31E13	1	25	21	5	1.2:1	Chert
20L. N32E24	1	23 est.	21	4	1.1:1	Flint
21L. N33E15	1	24	21	3	1.1:1	Flint
22L. N34E20	1	19	17	4	1.1:1	Flint
23L. N34E22	1	19	19 est.	4	1:1	Flint
24L. N34E22	1	17	17	3	1:1	Flint
Shenks Ferry						
25S. N2E36	5	29	22	3	1.3:1	Flint
26S. N12E39	4C	30 est.	26 est.	3	1.2:1	Flint
27S. N19.5E39.2	4	26 est.	22	3	1.2:1	Chert
28S. N32E5	1	24	19 est.	3	1.2:1	Flint
29S. N32E13	1	33 est.	24	4	1.3:1	Chert
30S. N34E20	1	25	20	3	1.2:1	Flint
31S. N35E13	1	21	16	3	1.3:1	Flint
32S. N36E22	1	23	21	3	1.1:1	Flint
33S. N37E17	1	32 est.	26 est.	3	1.3:1	Flint
Susquehannock						
34Q. SOW20	Surface	34 est.	17	6	1.9:1	Flint
35Q. S10W26	2	23 est.	15	3	1.5:1	Flint
36Q. S22E36	1	32	23 est.	6	1.4:1	Chert
37Q. N12E40	4A	22	20 est.	3	1.1:1	Flint
38Q. N14E40	3	24 est.	16	3	1.5:1	Flint
39Q. N14E40	5	21	13	4	1.6:1	Flint
40Q. N15E24	2	32	21 est.	7	1.6:1	Chert
41Q. N26E37	4A	29	20	5	1.5:1	Flint
42Q. N31E14	1	25	13	3	2:1	Flint
43Q. N32E5	1	21 est.	15	4	1.4:1	Flint
44Q. N32E30	1	19	13	3	1.5:1	Flint
45Q. N33E15	1	21	13	5	1.6:1	Flint
46Q. N34E26	2	29 est.	17	4	1.7:1	Flint
47Q. N34E30	1	20 est.	14	4	1.4:1	Chert
48Q. N37E17	1	25	17 est.	4	1.5:1	Flint
Untyped Triangular						
49U. N14E36	6A	31	21	6	1.5:1	Rhyolite
50U. N24E4	2	24	16	6	1.5:1	Chert
51U. N27E17	1	18	18	4	1.3:1	Chert

Plate 19.1: Pre-Late Woodland Projectile Points from Fisher Farm

nondiagnostic, one possibly being used during the Woodland occupation as a knife since it was discovered in a feature containing Woodland ceramics. Fifty-seven percent of all Archaic points are made of jasper, 29% of chert, 9% of flint, and 5% of quartzite.

One of the 2 Transitional Period points is a very crude Susquehanna Broadspear (Plate 19.1:22T). It is made of red jasper and has step fractures on both blade edges. Its rough shape conforms to the Susquehanna forms defined by Ritchie (1971). The other is a jasper Fishtail point (Plate 19.1:2A).

A single, very well made black chert Meadowood point represents the Early Woodland Period at Fisher Farm (Plate 19.1:7A).

B. LATE WOODLAND (N=61)

Four types of projectile points are associated with the Late Woodland occupation at Fisher Farm: Jack's Reef, Levanna, Shenks Ferry, and Susquehannock. A total of 61 of these points were found between 1976 and 1978. Two of the points are Jack's Reef Pentagonals, 22 are Levanna, 9 are Shenks Ferry, and 15 are Susquehannock, 3 are untyped, and 10 are nondiagnostic.

The metric equivalents to the terms used in the discussion below are as follows:

Small--20-25 mm in length

Medium--25-30 mm in length

Medium-Large--30-35 mm in length

Large--35-40 mm in length

1. Jack's Reef Pentagonal

The Jack's Reef Pentagonal type from Fisher Farm is represented by only two points. Both have straight proximal zones of juncture which form right angles with the straight base edges (Plate 19.2:1J-2J). One point is made of Bald Eagle jasper, the other of gray chert. This point type was assigned to the early Late Woodland Period by Ritchie (1971:28). It is believed to have been a minor point type at that time and contemporaneous with the Levanna type. One pentagonal point was found in stratigraphic level 5 during the 1978 excavation. That level is estimated to date from the 1200's A.D.

2. Levanna

The Levanna type is characterized by its small to medium size, its low (equilateral) length/width ratio, an ovate or triangular blade outline, a straight or concave base, a thickish blade, and pressure flaking techniques that are sometimes crude and boldly expressed. The length/width ratio, ovate shape, and flaking techniques are its most distinguishing characteristics (Bebrich 1971).

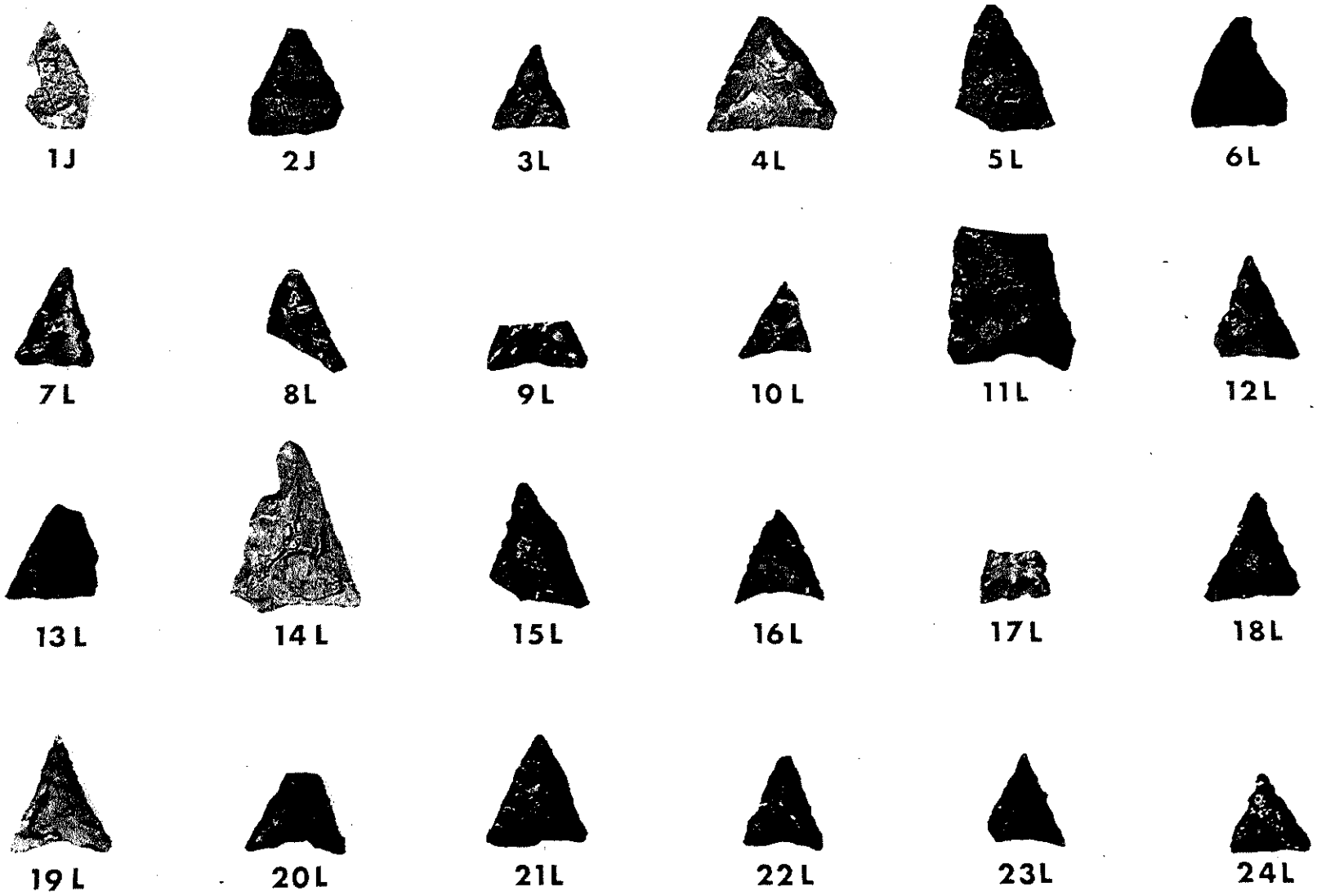


Plate 19.2: Jack's Reef and Levanna Projectile Points from Fisher Farm

The Levanna assemblage from Fisher Farm includes 19 small to medium sized points and 3 large points. The small to medium sized group ranges from 17-28 mm in length, 17-23 mm in width, 3-6 mm in thickness, and 1:1 to 1.3:1.0 in length/width ratio. The "average" point is 23 mm long, 20 mm wide, 4 mm thick, and has a length/width ratio of 1.1:1.0. Of the 19, 11 are made from black or gray-black flint, 6 from gray chert, and 2 from Bald Eagle Jasper. Blade edges are excurvate on 6 of these points, straight on 7, incurvate on 2, and asymmetrically excurvate/incurvate on the other 4. Most of the base edges are concave; 8 being subconcave, 6 being concave, 1 being triangulo-concave, and 4 being straight. Few of these points exhibit superior workmanship. Only 2 of the points show overall symmetry in blade outline and in longitudinal and transverse cross-section. Sixteen show asymmetry or design anomalies. Only 2 points have a length/width ratio greater than 1.2:1.0. Both appear to have been resharpened along one blade edge, reducing them from a more equilateral form.

The three large Levannas each exhibit different characteristics (Plate 19.2). One point (4L) is atypical, in that its width exceeds its length. Points 11L and 14L are very large and similar to the large Levanna points found at the Sheep Rock Shelter in Huntingdon County, Pennsylvania (Bebrich 1971:Figure 12, numbers 47-49).

Levanna points are believed to be synonymous with Clemson Island components throughout Pennsylvania. Although no Levanna points were found in features datable to this period at Fisher Farm, 2 points (10L and 11 L) were found in stratigraphic level 5 during the 1978 excavation. A mixed association of Clemson Island and Shenks Ferry ceramics were discovered in this level. This type has been designated by Ritchie as the predominant point from the late Middle Woodland through the middle Late Woodland Periods in New York (1971:31). It is given a similar temporal affiliation by Bebrich for central Pennsylvania (1971:198).

3. Shenks Ferry

The Shenks Ferry type is characterized by its small to medium-large size, a thick blade, skillful pressure flaking, a straight or incurvate blade outline, a subconcave base, and a length/width ratio slightly greater than that of Levanna points. The length/width ratio and flaking techniques are its most distinguishing attributes.

The Shenks Ferry projectiles from Fisher Farm consist of 9 small to medium-large points (Plate 19.3 :25S-33S). They range from 19-33 mm in length, 16-26 mm in width, 3-4 mm in thickness, and 1.1:1.0 to 1.3:1.0 in length/width ratio. The "average" point is 27 mm long, 22 mm wide, 3 mm thick, and has a length/width ratio of 1.2:1.0. These points are thin for their size. Of the 9 points, 7 are made of black or gray-black flint, and 2 are of gray chert. Blade edges are incurvate on 7, straight on 1 and ovate on 1. Eight of the points have subconcave bases and 1 is triangulo-concave. The majority show skillful pressure flaking techniques. Three of the points show overall symmetry in blade outline and in both longitudinal and transverse cross-section. Three are asymmetrical and 3 others are too incomplete to be fully measured. One point (29S) was apparently broken during manufacture.

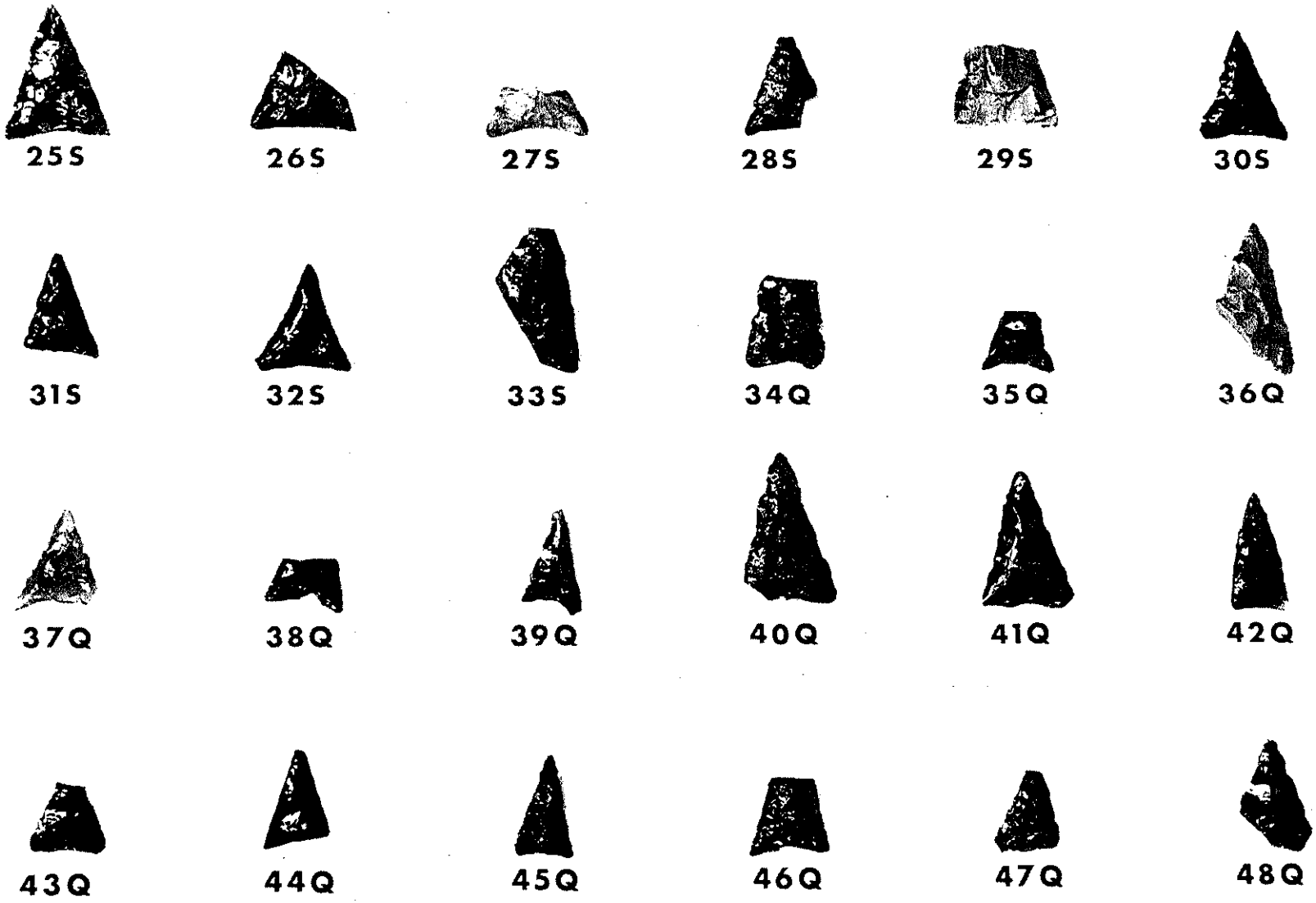


Plate 19.3: Shenks Ferry and Susquehannock Projectile Points from Fisher Farm

Similar points are believed to be affiliated with the Shenks Ferry occupation of Pennsylvania. Three of the points at Fisher Farm (25S-27S) were found in stratigraphic association with Shenks Ferry sherds. During the 1977 excavation, 4 of these points were found in a plow zone context on the terrace with only Shenks Ferry sherds present in the excavation unit. However, 6 of the points herein classified as Levannas were similarly found with only Shenks Ferry sherds.

4. Susquehannock

The Susquehannock projectile point type is characterized by its small size, triangular blade outline, subconcave base, skillful pressure flaking, and by the largest length/width ratio of the Woodland point types. Its small size and large length/width ratio are its most distinguishing characteristics.

The Susquehannock projectile point component of Fisher Farm includes 11 small to medium sized points and 3 medium-large points. One point (44Q) has not been included in either group; it is a tip fragment which cannot be reconstructed (Plate 19.3).

The small to medium sized group ranges from 20-29 mm in length, 13-20 mm in width, 3-5 mm in thickness, and 1.1:1.0 to 2.0:1.0 in length/width ratio. The "average" point is 24 mm long, 16 mm wide, 4 mm thick, and has a length/width ratio of 1.5:1.0. These points are thick for their size. Ten of the 11 points are made of black or gray-black flint, the other being made of gray chert. Blade edges are incurvate on 8, asymetrically incurvate/straight on 2, and ovate on 1. Base edges are subconvate on 5 of the points, concave on 5, and straight on 1. Workmanship on Susquehannock points is nearly as skillful as that on the Shenks Ferry points, even though the Susquehannock points are thicker and smaller, and hence more difficult to work. Eight show some form of asymmetry.

Two of the 3 medium-large points (36Q and 40Q) are made of chert and have a 1.5:1.0 length/width ratio. Both are crude in appearance and are concave-convex in longitudinal cross-section. They are similar to Bebrich's Type 44 found at the Sheep Rock Shelter (Bebrich 1971:Figure 12, numbers 50 and 51). The other point (34Q) is longer and narrower. It is made of flint and has a length/width ratio of 1.9:1.0.

Susquehannock points are believed to correspond to the Susquehannock cultural occupation of Pennsylvania, thought to have occurred from the late sixteenth to the eighteenth centuries A.D. Two points (37Q and 38Q) were found in strata known to correspond to the early sixteenth century.

5. Untyped Triangular Points

Three untyped triangular points were recovered from the Fisher Farm Site. One was found during the 1978 excavation in stratigraphic level 6, a Clemson Island component. It is a medium-large rhyolite point with a length/width ratio of 1.5:1.0. It is ovate in outline and oblique in

longitudinal and transverse cross-section. This point is not like any in the regional literature. Another is also 1.5:1.0 in length/width ratio, ovate in outline, and oblique in transverse cross-section. However, it is small, made of gray chert, and has a squared tip. It may have functioned as a cutting implement. The third untyped point is small, ovate in outline, made of gray chert, and has well-rounded corners. It is 1.3:1.0 in length/width ratio and is very similar to Type 41 recovered from the Late Woodland deposits at the Sheep Rock Shelter (Bebrich 1971: Plate 12, number 43).

III. PERIOD-SPECIFIC OCCUPATION

Figure 19.1 illustrates the period-specific frequencies of projectile points from Fisher Farm. The fact that nearly three-quarters of the sample are stylistically dated to the Late Woodland is in agreement with the results of all other analyses of Fisher Farm material remains--the Late Woodland is the principal episode of activity at the site. The pre-Late Woodland subset of points demonstrates an Early Archaic presence and suggests that the Middle Archaic Brewerton and Late Archaic stemmed (Sylvan Lake) phases were the most important early occupations. These patterns are in complete agreement with Hatch's and Hay's observations for the area at large (see Chapters 5 and 6).

IV. STRATIGRAPHIC ANALYSIS

During the 1978 season at Fisher Farm, excavations uncovered a major stratified area (see Chapter 15). The stratified area was adjacent to the terrace proper, from which debris and sediments eroded and garbage was discarded. As discussed in Chapter 17 and 18, the several superimposed strata were distinct and properly ordered temporally. Archaeological material within these strata were, for the most part, temporally ordered as well.

As discussed in some detail in Chapter 18, 3 criteria can be used to factor out intrusive or temporally irrelevant material in these strata. Briefly, this involves dismissing material from:

1. the plow disturbed Levels 1 and 2 and the post-abandonment Level 3
2. ambiguous stratigraphic settings (especially near the terrace edge
3. contexts separated by two or more levels from related material.

By applying these same rules to the 14 projectile points found in the stratified area, 5 are eliminated (Figure 19.2). Points 9L, 22T, and 38Q were all found in Levels 1-3. Points 8L and 39Q were each in ambiguous stratigraphic settings, the former along the terrace edge and the latter near a nested series of intrusive pits in N12E40.

The remaining 9 points exhibit a pattern of stratigraphic location and admixture that is strikingly similar to that of the ceramics. Level

STRATIGRAPHIC POSITION OF PROJECTILE POINTS FROM THE 1978 EXCAVATIONS AT FISHER FARM

POINT TYPE	IDENTIFICATION NUMBER	LEVEL
		1
△	9L	2
⏢ △	22T, 38Q	3
▲ ▲ ▲	27S, 37Q, 41Q	4A
		4B
△ ▲	8L, 26S	4C
		4D
		4E
△ ▲ ▲ ▲ ▲	39Q, 1J, 10L, 11L, 25S	5
▲	48U	6

⏢ UNTYPED TRIANGULAR

⬠ JACK'S REEF PENTAGONAL

△ LEVANNA

△ SHENKS FERRY

△ SUSQUEHANNOCK

⏢ TRANSITIONAL

▲ - IN CONTEXT △ - OUT OF CONTEXT

Figure 19.2: Stratigraphic Position of the Stream Channel Projectile Points

5 is seen to contain 3 types of points, 2 of which are traditionally associated with Clemson Island occupations (Jack's Reef and Levanna) and 1 associated with Shenks Ferry (Shenks Ferry). Ceramically, Clemson Island/Owasco sherds were found with Shenks Ferry sherds in Level 5. Shenks Ferry sherds were the dominant ceramic type in Level 4C and our single projectile point from this level is also Shenks Ferry. Level 4A, dating to the early 1500's A.D., saw shell-tempered pottery increasing in relative occurrence but with Shenks Ferry sherds still present. Both Shenks Ferry and Susquehannock points are found in Level 4A.

The congruence of these two data sets supports the long standing contention that both projectile point morphology and ceramic decorative motifs have chronologic value in the phasing of Late Woodland sites in the area. At the same time, both data sets highlight the inappropriateness of "replacement models" for explaining the dynamic aspects of the record of material culture in central Pennsylvania.

V. INTRA-SITE COMPONENT DISTRIBUTION

The pre-Late Woodland projectile points show a rather uniform distribution across the Fisher Farm site (Figure 19.3). Since it is probably not the case that such a pattern resulted from plow displacement (Roper 1976), we suggest that a light and irregular pattern of occupation took place on the terrace prior to the Late Woodland Period.

However, Figure 19.3 indicates that some differential use of the terrace did occur within the Late Woodland Period. By outlining the limits of the distribution of each Late Woodland projectile point type on the terrace, it becomes evident that 1) the Levanna component occurs over a majority of the site, but does not extend to the northern-most boundary, 2) the Shenks Ferry component is limited to the northern-most section of the site and overlaps the Levanna component to the south of it, and 3) the Susquehannock component is also principally in the northern-most section, although Susquehannock projectile points are found in other sections of the site. All types of Late Woodland projectile points were found in the stratified area east of the terrace during the 1978 excavation.

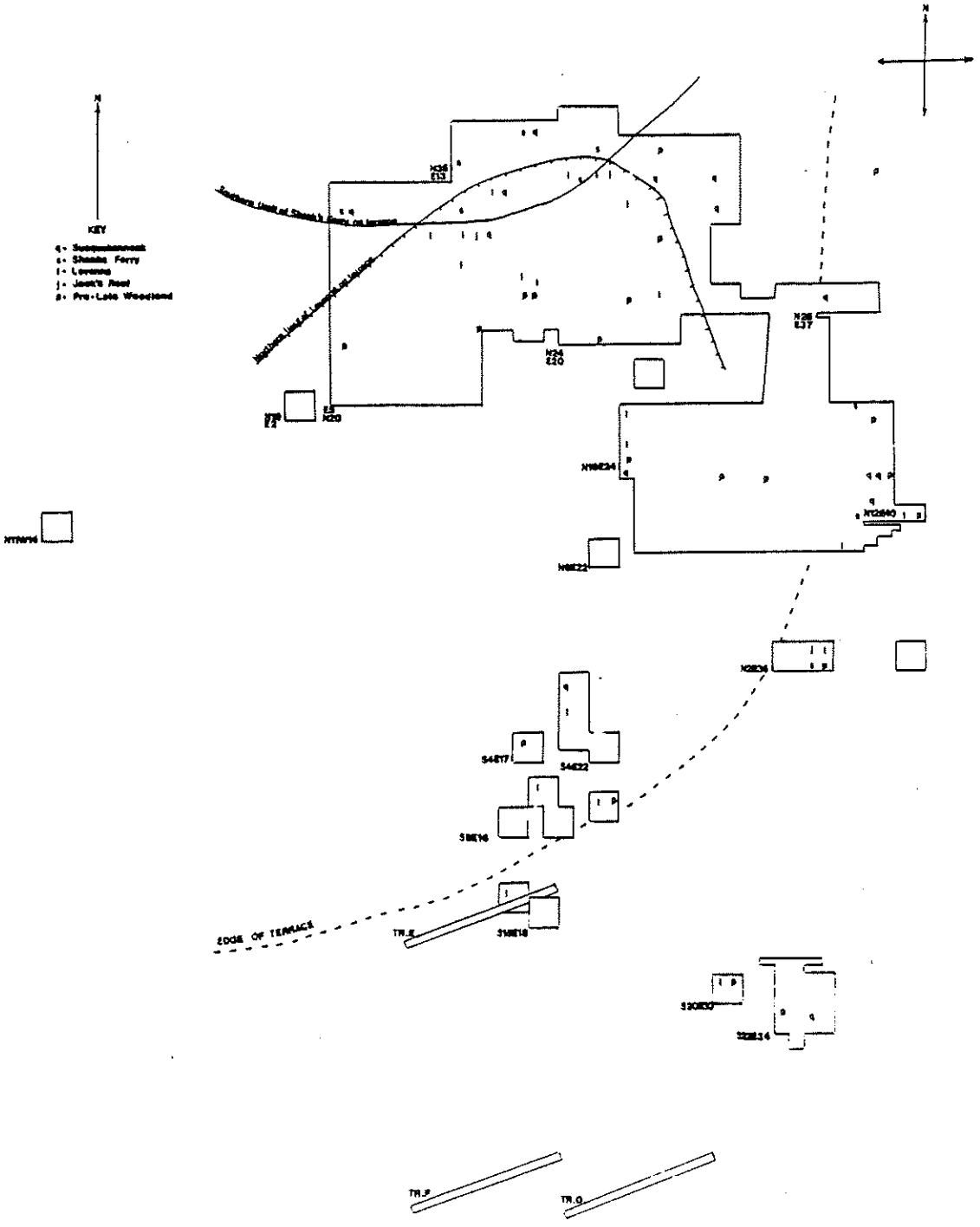


Figure 19.3: The Distribution of Projectile Points Across the Fisher Farm Site

CHAPTER 20

A SYNTHESIS AND PROSPECTUS OF THE PROGRAM'S LATE WOODLAND RESEARCH

JAMES W. HATCH

I. A SUMMARY OF FISHER FARM RESEARCH

The research dealing with Fisher Farm addresses 4 main topics:

1. The impact of plow disturbance.
2. The site's subsistence base during the Late Woodland Period.
3. The spatial organization of the Late Woodland community.
4. The chronologic validity of design variation in the Late Woodland ceramics and projectile points.

This chapter summarizes the results of this research and discusses their implications for model generation and testing in the Bald Eagle watershed.

A. THE IMPACT OF PLOW DISTURBANCE

Much of the archaeology in this region has used heavy equipment in the earliest stages of field research to remove the plow zone from shallow, plow disturbed sites. Such a methodology is believed to be warranted by the small amount of information that can be derived from plow disturbed contexts. The labor investment needed for intensive surface collections and systematic excavations of the plow zone is not justified, since these collections are felt to be ineffective guides to assemblage variability across the site. Yet a number of recent studies contradict this position, arguing for the interpretive value of systematic surface collections and plow zone excavations in disturbed sites (Talmage and Chester 1977).

Since neither camp can offer guidelines by which the limitations of plow zone collections can be anticipated, we feel that every site should be approached experimentally. If guidelines for dealing with plow zone materials are ever to be proposed, they must be based on a series of controlled observations that assess the cumulative impact of plow disturbance under a variety of site conditions. Fisher Farm is the first of our attempts to measure the archaeological impact of plow disturbance, and its case is somewhat extreme. Over 100 consecutive years of plowing the terrace has created a 20-25 cm plow zone and the shallowness of the site where plowing first began has led to the destruction of much of its contextual associations.

Stevenson's analyses (Chapters 8 and 9) focused on 2 types of information distortion: artifact-specific vertical separation in the plow zone, and lateral displacement. The discovery of differential concentrations

of artifacts on the surface and in the upper and lower halves of the plow zone as a function of their size and material composition confirms the field impressions of this author while working on a number of disturbed sites in the area. Whether or not the patterns seen at Fisher Farm can be quantitatively demonstrated at other sites is an important question that we will have to pursue, and until we do, their archaeological significance will remain in doubt. However, should material sorting be found to occur in other plow disturbed sites, we would be forced to reevaluate research in which surface collections have played an important role.

Lateral displacement has no doubt occurred at the site, but its consequences are not as great as one might expect. Even in conjunction with vertical sorting processes, we were able to broadly define prehistoric activity areas using the surface and plow zone collections. There are two questions of concern in this type of research: 1) at what scale can we rely on surface or plow zone collections to provide accurate measures of subsurface activities, and 2) what artifact types or combinations of types designate functionally distinct areas? Plow disturbance is related to both of these questions since it enlarges the scale of reliable subsurface association and it homogenizes once distinct artifact clusters through successive plowing events. At Fisher Farm collecting units approximating 4 m x 4 m were shown to have reasonable success in predicting the location of subsurface concentrations of features and artifacts corresponding to different activity loci. Plow disturbance is assumed to be responsible for our inability to achieve any finer spatial precision. Identifying the types of activities that took place at these locations from the surface and plow zone collections alone was very difficult, as is clear from Chapters 9 and 12. These problems may be a function of the types of artifacts comprising the collections (debitage, ceramic sherds, etc., rather than functionally diagnostic tools) and our inexperience in relating these categories of artifacts to prehistoric activities, or they could be related to the superimposition of varying activity loci through the Late Woodland Period. Regardless of the source of the problem, we feel the importance of these patterns lies in their predictive value at other Late Woodland sites. If similar surface and plow zone artifact assemblages are found to be associated with the same types of activity loci, then we can begin using these patterns at still other sites predictively and planning future excavation strategies in response to their distribution.

B. THE LATE WOODLAND SUBSISTENCE BASE

Reconstruction of the subsistence base of prehistoric groups is often hampered by the tendency for economically important items to be recycled, consumed, or transported out of the site. This phenomenon often results in the prized commodities being scarce in the archaeological record, while those of lesser significance may be quite common.

The relative scarcity of cultigens at Fisher Farm does not lead us to conclude a non-agricultural subsistence base for the site. We regard the association of the Late Woodland sites throughout the Bald Eagle

watershed with prime agricultural land (see Chapter 6) and the discovery of Late Woodland sites elsewhere in the region with significant cultigen samples to be sufficient proof of Fisher Farm's agricultural orientation. Gorenflo had hoped to demonstrate the importance of maize and other plants in the diet at Fisher Farm through shifts in the pollen profiles, with increasing percentages of cultigen pollen corresponding to decreases in arboreal pollen. However, the absence of pollen and the tremendous technical difficulties he experienced with our samples from the carbon-rich culture bearing strata made this impossible. Baker's point in Chapter 14 is well taken. In an area devoid of broad, regularly inundated floodplains or frequent natural forest fires, weedy seed bearing plants are expected to have been a significant dietary supplement only during episodes of major forest clearance like the Late Woodland. Walnut hulls found in what we believe to be roasting pits at the site and acorns from other features attest to the attraction of these resources. The large tracts of soil suitable for nut bearing tree stands that are located near the site and the nuts' high nutritional value (see Chapter 3) both suggest an important role for this food at Fisher Farm. All of these items are recognized to have been part of the Fisher Farm subsistence base.

The single biggest problem in reconstructing the prehistoric diet at Fisher Farm and the seasonality of its occupation is the lack of identifiable faunal remains. The slightly acidic soil, the plow disturbance, and the temperature extremes in the area are all responsible for their absence. However, the large number of triangular projectile points (and if one accepts the scenario presented at the end of Chapter 12, the keyhole structure) indicate an important hunting orientation. The impact of hunting will be considered below in our discussion of the Late Woodland settlement system.

C. THE SPATIAL ORGANIZATION OF A LATE WOODLAND HAMLET

The spatial organization of the activities and features comprising the Fisher Farm community are discussed at several points in the preceding chapters. The dryness and stability of the terrace compared to the surrounding flood plain were no doubt responsible for the site's exact location. Within the hamlet we have the impression of distinctive bands or zones of particular feature and activity combinations, with their relative distribution being governed by principles of attraction (e.g., regularity of task) or repulsion (e.g., size of required feature, amount of smoke generated) vis-a-vis the domestic structures. Bands of related features were observed in Areas A, B, and C, where contiguous excavations opened enough area for such patterns to emerge. Some bands run parallel to each other in a westerly or southwesterly direction, probably continuing beyond the excavated area and across the terrace. Others may run perpendicular to these, toward the south. A similar zonal arrangement of features was seen at the Ramm Site (Smith 1976), a Late Woodland site on the West Branch in Clinton County. If the Ramm Site is eventually proven to be a hamlet, then the zonal pattern may well hold for all Late Woodland hamlets in the region.

D. LATE WOODLAND DESIGN VARIATIONS AS CHRONOLOGIC MARKERS

The chronologic integrity of certain ceramic and projectile point types, often used in Pennsylvania archaeology for dating purposes, was largely upheld by the stratigraphic analyses and radiocarbon dates from Fisher Farm. As discussed in Chapters 17-19, the radiocarbon samples removed from equivalent contexts of these artifact types agree quite well with their previously established chronologic sequence elsewhere in the Susquehanna watershed. The only significant departure might be the early 1500's A.D. and, perhaps, the late 1400's A.D. dates for the shell-tempered sherds in the stream channel. If one were to follow the traditional arguments for the association of shell tempering and the Susquehannock cultural group in the Susquehanna drainage, then these dates would conflict with the assumed late 1500's, early 1600's movement of the Susquehannock into the area. However, there is a growing (but unpublished) body of data that indicates considerable local variation in the shell-tempered ceramics of the West Branch valley, with some varieties predating or existing concurrently with actual Susquehannock wares elsewhere.

The more important discovery was the partial temporal overlap of Clemson Island and Shenks Ferry ceramics as well as of Shenks Ferry and shell-tempered wares. A similar overlapping pattern was observed for the Levanna, Shenks Ferry, and Susquehannock projectile points. The notion of the simultaneous use of two ceramic series in the same site has rarely been considered in the archaeology of Pennsylvania. Over the years the discovery of sherds of two different series in contexts that unequivocally demonstrate their coexistence (i.e., storage pits, burials) has most often been "explained" by reference to trade vessels or political captives. In contexts where the association was not as demonstrable, the co-occurrence of two or more series has been routinely assumed to result from the later admixture of multiple component assemblages.

The stream channel stratigraphy at Fisher Farm is the most extensively excavated, stratified Late Woodland midden deposit in the region. Because of this, we believe that artifacts from it constitute the most suitable data set for modeling ceramic and point morphology changes that is currently available. The model that best accomodates the discovered patterns is a very common one in archaeology and is often graphically represented by partially overlapping "battleship curves." As Chapter 18 has demonstrated, the stratified deposits reveal an episode in which Clemson Island and Owasco series ceramics are used exclusively, followed by an episode of rising Shenks Ferry coexistence. As the Shenks Ferry ceramics dominate, the Clemson Island and Owasco materials disappear. Shell-tempered wares make their initial appearance during the height of the Shenks Ferry peak and continue to increase, in coexistence with Shenks Ferry, until the end of the sequence.

If we provisionally accept this pattern as applicable to the region, and not simply to the Fisher Farm site, then the model presented here calls for a rethinking of our traditional ideas concerning Late Woodland cultural dynamics. Instead of equating each series with distinct social entities, we should think of a temporal continuum along which each series, and

varieties within series, can be placed. The fact that at points along this continuum two series may overlap in time and space need not cause interpretive problems. The answer to the question of why a single village may simultaneously decorate its pottery in two distinctly different ways is one that we can try to answer by consulting the ethnographic literature of the many groups who have done so in the recent past. The important point is that by accepting the model, we can more parsimoniously account for the patterning seen in the Late Woodland ceramic assemblages of the region. At the same time, we can take advantage of the frequency variation of the several series in the ceramic assemblages of the region's sites to seriate a Late Woodland sequence with finer precision than ever before.

II. TOWARDS A SETTLEMENT SYSTEM RECONSTRUCTION OF THE LATE WOODLAND PERIOD IN THE BALD EAGLE WATERSHED

The Late Woodland Period settlement pattern in the Bald Eagle watershed can be tentatively outlined using the phasing criteria described by Hay in Chapter 5; triangular projectile points of certain dimensions and/or a preponderance of black flint debitage in the component assemblage. At the time of this publication we are aware of about 55 Late Woodland components in the watershed. Forty-four of these were discovered during the 1978 Distract 9 Survey. The remainder are known to us from collector interviews, the state prehistoric site files, and coincidental discovery. This sample is no doubt a small fraction of the total Late Woodland site population in the area, and it has not been collected in statistically appropriate ways. The only excavated Late Woodland site in the watershed to date is Fisher Farm. The following discussion of its settlement system is therefore viewed as a characterization only-- a provisional model to be tested and refined.

The settlement pattern seems to include 4 site categories: nucleated (and often stockaded) villages, hamlets, isolated farmsteads, and hunting/resource camps. Only the distribution of the first category is known with any assurance. Large concentrated areas of Late Woodland village material have been located and collected by the area's few amateurs in the lower one-third of Bald Eagle Creek and Fishing Creek in Nittany Valley. A number of these sites are reported to have been submerged by the Foster Joseph Sayers Dam, a U.S. Army Corps of Engineers flood control and recreational facility completed in 1969. The remaining sites of this category are located on second terraces above broad expanses of flood plain, features characteristic of these drainages as one approaches their confluence with the West Branch at Lock Haven. Hamlets and farmsteads are also known to occur on either first or second terraces. Their distribution in the upper two-thirds of the watershed, if the area around Fisher Farm is any indication, is probably conditioned by their proximity to good agricultural acreage, compressed ecozonal variability, and waterways. Farmsteads appear to be sporatically distributed in "gaps" between hamlets. Hunting/resource camp locations are obviously conditioned by the distribution of resource concentrations. If we combine this partial knowledge of the Late Woodland settlement patterns in the Bald Eagle watershed with the survey and excavation data from nearby areas (Smith 1976; Turnbaugh 1977; Bressler 1978; Herbstritt personal communication) we can postulate a model of changing settlement systems through time for the area.

The Late Woodland Period in much of New York and Pennsylvania is recognized as a time of dramatic social and political change. Between approximately 1000 A.D. and 1600 A.D. a shift takes place from small, oval, nuclear family dwellings to large, oval or rectangular, extended family residences. Also during this same period nucleated villages, often located in highly defensible positions and/or with substantial fortifications, are added to the settlement inventory. These data reflect the stress building during the Late Woodland, a stress that culminated in the intense intertribal hostilities and political competition between semi-autonomous clans and villages that is so well documented for the historic era.

The years 1000-1600 A.D. embrace virtually all of the recognized Late Woodland components in north-central Pennsylvania. During the early portion of the period, equivalent to the Clemson Island and early Shenks Ferry ceramic phases, the settlement pattern probably consisted of agricultural hamlets, farmsteads, and hunting/resource camps only. Small oval or rectangular structures were the residences of nuclear or small extended families. These formed the primary social and economic unit. Hamlets included a number of family units which were bound together internally by kinship and marriage and united externally to other hamlets by loose bonds of tribal political alliance.

During the latter portion of the period, nucleated villages were added to the settlement system. Lineage and clan segments resided in larger residences and their leaders assumed more influential positions in social, economic, and political life.

The impetus behind the nucleation of much of the region's population during the late phase probably stemmed from the political friction within and between tribal groups that developed throughout the Late Woodland Period. The shift from nuclear family residences to progressively larger extended family residences could have been brought about by overall population growth through changes in fertility and mortality rates, by shifting economic strategies requiring larger, more tightly integrated work groups, or by other causes. As is so often the case in tribally organized societies, however, the differential advantages that accrue to certain (often larger) kinship units resulted in social and political friction. The resolution of such problems in tribal societies commonly requires the injured party to move some distance away and establish itself as an autonomous social unit. In areas of high population density the repeated occurrence of this phenomenon typically results in the formation of non-aggressive alliances between neighboring autonomous units, and ultimately, aggression against non-members. Since hostilities demand a defensive position (fortifications, strategic location) as well as a minimum number of defenders, some form of nucleation of local populations inevitably results.

It appears that the trends described above differentially affected Late Woodland populations in central Pennsylvania. Existing archaeological data suggest that during the first half of the Late Woodland Period, the West Branch Valley floor was the principal population center of north-central Pennsylvania. Although Bald Eagle watershed was nearby, large

portions of it were apparently regarded as hinterland. The adjacent portions of the Allegheny Plateau during the early Late Woodland apparently contained little significant population outside the few major flood plain areas.

In the latter portion of the period much of this changed. A radiocarbon date of 1230±100 A.D. from the stockade of the Bull Run Site in the West Branch Valley near Williamsport is believed to be associated with classic Shenks Ferry ceramics and "substantial" structures (Bressler 1978:30). By this date the episodes of exclusive Clemson Island/Owasco ceramics and mixed Clemson Island/Owasco and Shenks Ferry ceramics had ended and in all probability late Shenks Ferry and shell-tempered wares had not yet appeared. From this point on, defensive arrangements appear to dominate the settlement pattern in the West Branch Valley. A striking change took place in the Allegheny Plateau now as well. Nucleated villages similar in scale and design to those of the fertile flood plains of the West Branch Valley appeared on steeply sided hilltop locations. No series of carbon dates is yet available for these sites, although their ceramics indicate a late Late Woodland incursion.

Given the discussion above, it is reasonable to assume that social and economic pressures resulting from relatively higher population density were responsible for the early appearance of defensive nucleated villages in the West Branch valley. Sometime later, villages were established in the Allegheny Plateau, perhaps by groups breaking away from river valley settlements. Why the plateau was chosen for occupation at this time is open to debate. Under present conditions, the area's fertility, poor access to water, and short growing season would seem to be limiting factors. Even with slash and burn agricultural techniques temporarily improving soil fertility, it is hard to imagine how significant populations resided there during late Late Woodland times. Johnson et al. (1979) suggest that climatic variation during the Woodland Period may have led to the cyclical opening and closing of the area for agriculturalists.

> The time horizon for apparent abandonment of most of the Allegheny Plateau, i.e., circa A.D. 1550, approximates too closely the massive climatic deterioration of the mid-sixteenth century, which ushered in the Neo-Boreal climatic episode, to be mere coincidence....The onslaught of the Neo-Boreal had cataclysmic consequences for many of the Iroquoian tribes of the Northeast which were occupying territory only marginally suited for aboriginal maize agriculture. Settlement patterns were disrupted or aborted throughout the Northeast.

The impact of rainfall and temperature fluctuations on soil fertility and frost-free day isoclines in the Allegheny Plateau appears to have been sufficient to allow substantial agricultural villages in the area during some phases.

Unlike the other areas, the settlement pattern in the Bald Eagle watershed shows little evidence of change during the Late Woodland Period. Although the settlement pattern in the major flood plains of the lower

one-third of the watershed responded in identical fashion to the adjacent West Branch Valley areas, the size and location of sites in the upper reaches of the watershed remained stable. It is likely that military and economic matters were related to this stability.

Both the causes and consequences of nucleation can be expected to force compromises in the economic behavior of individual families. Without commitments to group security and cohesion, individual families would be free to optimally position themselves in the territory to satisfy their own economic needs. Under severe social or military pressure nucleated groups must accommodate their economic needs in less than optimal ways to guarantee their security.

With this in mind, two models can be proposed to account for the Late Woodland settlement pattern in the Bald Eagle watershed:

Model 1--During the early Late Woodland Period populations throughout the region, including the Bald Eagle watershed, were not under the threat of warfare to the degree seen in the later phase. As a result, populations were more loosely integrated, with individual families and kin groups dispersed through the area in the best locations to exploit its agricultural and wild food potential. Since Fisher Farm was located in proximity to several important resources, it was maintained, at least seasonally, as an agricultural hamlet. In late Late Woodland times, nucleated villages could not be established in the upper reaches of the watershed because the patches of quality agricultural soil were too small and dispersed. However, the area's insular location provided a measure of natural security that allowed local populations to continue using the area as before.

Model 2--The settlement pattern of the early Late Woodland was small and dispersed for the same reasons as stated above. However, the hostilities of the late Late Woodland forced a social consolidation of all the watershed's population. While not affecting the settlement pattern of the upper watershed (hamlets, farmsteads, and hunting/resource camps continued to be used), consolidation did affect the settlement system, or the regularity and manner in which these sites were used. Non-fortified sites in the upper watershed continued to be occupied, but only for a few weeks or a few months out of the year. Sites like Fisher Farm would be reoccupied during planting and harvesting seasons by a few families whose principal residences were the villages of the lower one-third of the watershed. After the harvest, surplus foodstuffs would be carried back to the fortified villages to serve as the winter supply. When hostilities arose, the normal pattern of seasonal movement could be interrupted and the watershed's residents could reconsolidate in the parent villages. Such a pattern was common in the proto-historic Northeast at the time of European contact and during the era of Iroquois military supremacy.

The test implications of both these models involve the analysis of floral, faunal, and architectural remains from different types of sites in the Late Woodland settlement system in the watershed. The near absence

of preserved animal bone at the Fisher Farm Site eliminates the most discriminating data set for answering questions concerning the permanency of occupation. The remaining evidence from the site is both slim and open to debate.

1. Cultigens, wild grass seeds, and nuts, all of which were found at Fisher Farm, are known to mature at varying times in the late summer to early winter months. The possibility that all these items were stored and then deposited during other seasons is remote. We can therefore assume that the site was occupied at this time of the year. However, the botanical record does not rule out the possibility of occupation at other times of the year.

2. A number of very large storage facilities designed to hold quantities of processed foodstuffs have been excavated in villages throughout the northeastern United States. No such facilities were encountered at Fisher Farm. This could imply that the populations living here were too small to require such facilities, that alternative storage techniques were being used, or that processed foodstuffs were being carried to other sites in the patterned seasonal movements of Fisher Farm's occupants. Deer and vegetable foods, such as cultivated plants and wild seeds, were probably most available to the Fisher Farm residents during the fall and early winter months. Site abandonment would therefore most likely have taken place during the winter and early spring.

Continued research of the Late Woodland Period settlement system by the Bald Eagle Archaeological Research Program will involve the excavation of a number of categories of sites and analyses of the several data sets relevant to the models outlined above.

BIBLIOGRAPHY

Aldenderfer, Mark
n.d. A Preliminary Survey of the Bald Eagle Valley. Manuscript on file in the Department of Anthropology, The Pennsylvania State University.

Ammerman, A. J. and M. W. Feldman
1978 Replicated Collection of Site Surfaces. American Antiquity 43(4):734-740.

Anderson, J. E.
1969 The Human Skeleton: A Manual for Archaeologists. National Museums of Man, Canada.

Asch, David L. and Nancy Asch
1977 Chenopod as Cultigen. Midcontinental Journal of Archaeology, Vol. 2, No. 1.

Asch, Nancy B., R. I. Ford, and D. L. Asch
1972 Paleoethnobotany of the Koster Site: The Archaic Horizons. Illinois State Museum Report of Investigations, No. 24, Springfield, Illinois.

Assmann, Ernest
1970 The Principles of Forest Yield Study. Oxford: Pergamon Press Limited.

Atwood, E. L.
1941 White-tailed Deer Foods of the United States. Journal of Wildlife Management 5:314-332.

Baker, Frederick S.
1950 Principles of Silviculture. New York: McGraw-Hill.

Baldwin, Robert Charles
1961 The Presettlement Forest Composition of Northeastern Potter Township, Centre County, Pennsylvania. Master's Thesis, Department of Forestry, The Pennsylvania State University.

Bass, Quentin
1977 Prehistoric Settlement and Subsistence Patterns in the Great Smokey Mountains. Master's Thesis, Department of Anthropology, University of Tennessee.

Bass, William M.
1971 Human Osteology: A Laboratory and Field Manual of the Human Skeleton. Missouri Archaeological Society, Columbia, Missouri.

Bebrich, Carl A.
1971 Prehistory at Sheep Rock Shelter: A Study in the Systematics of Lithic Artifact Analysis. Master's Thesis, Department of Anthropology, The Pennsylvania State University.

Bennett, Logan J., P. F. English, and R. L. Watts
1943 The Food Habits of the Black Bear in Pennsylvania. Journal of Mammology 24(1):25-31.

Bennett, M. K.
1955 The Food Economy of the New England Indians, 1605-1675. The Journal of Political Economy, Vol. LXVII, No. 5.

Bernabo, J. C. and T. Webb, III
1977 Changing Patterns in the Holocene Pollen Record of Northeastern North America: A Mapped Summary. Quaternary Research, 8:64-96.

Bilzi, A. F. and E. J. Ciolkosz
1977 Time as a Factor in the Genesis of Four Soils Developed in Recent Alluvium in Pennsylvania. Soil Science Society American Journal 41:122-127.

Binford, Lewis R.
1967 Smudge Pits and Hide Smoking: The Use of Analogy in Archaeological Reasoning. American Antiquity 32(1):1-12.

Binford, Lewis R.
1971 Mortuary Practices: Their Study and Their Potential. In James A. Brown (ed.) Approaches to the Social Dimensions of Mortuary Practices. Memoirs of the Society for American Archaeology, No. 25.

Binford, Lewis R.
1978 Dimensional Analysis of Behavior and Site Structure: Learning from an Eskimo Hunting Stand. American Antiquity, Vol. 43, No. 3.

Black, Meredith
1963 The Distribution and Archaeological Significance of the Marsh Elder, Iva Annua, L. Papers of the Michigan Academy of Science, Arts, and Letters, No. 48.

Bliss, George S.
1941 Supplementary Climatic Notes for Pennsylvania. In Climate and Man: Yearbook of Agriculture, USDA, Washington, D.C., pp. 1097-1098.

Braun, Emma Lucy
1974 Deciduous Forests of Eastern North America. New York: Hafner (Facsimilie of 1950 edition).

Brayton, Matthew
1860 A Narrative of the Adventures and Suffering .... Cleveland: Fairbank, Benedict and Co.

Brennan, Louis A.
1977 The Lower Hudson: The Archaic. In Amerinds and Their Paleoenvironments in Northeastern North America, Walter S. Newman and Bert Salwen (eds.), pp. 411-430. Annals of the New York Academy of Sciences, Vol. 288.

Bressler, James P.
1978 Excavations of the Bull Run Site in Loyalsock Township, Lycoming County, Pennsylvania. Williamsport: Valerie's Lettershop.

Britton, Nathaniel and Addison Brown
1970 An Illustrated Flora of the Northern United States and Canada. M. L. Fernald (ed.), 3 Vols., New York: Dover.

Brothwell, Don R.
1963 The Macroscopic Dental Pathology of Some Earlier Human Populations. In Dental Anthropology, Don R. Brothwell (ed.). Symposia of the Society for the Study of Human Biology, Vol. V., Oxford: Pergamon Press Limited, pp. 271-288.

Broyles, Bettye J.
1971 Second Preliminary Report: The St. Albans Site, Kanawha County, West Virginia. West Virginia Geological and Economic Survey, Report of Archaeological Investigations, No. 3, Morgantown.

Butts, Charles and E. Moore
1936 Geology and Mineral Resources of the Bellefonte Quadrangle, Pennsylvania. U.S. Department of the Interior, Bulletin 855.

Calkin, Parker E. and Kathleen E. Miller
1977 Late Quaternary Environment and Man in Western New York. In Amerinds and their Paleoenvironments in Northeastern North America, Walter S. Newman and Bert Salwen (eds.), pp. 297-315. Annals of the New York Academy of Sciences, Vol. 288.

Carbonell, Virginia M.
1963 Variations in the Frequency of Shovel-Shaped Incisors in Different Populations. In Dental Anthropology, Don R. Brothwell (ed.). Symposia of the Society for the Study of Human Biology, Vol. V., Oxford: Pergamon Press Limited, pp. 211-234.

Clark, Alan
1977 Nutrient Intake of White-tailed Deer in Winter and Determination of the Feeding Capacity of Deer Range. Ph.D. Dissertation, The Pennsylvania State University.

Coe, Joffre L.
1964 The Formative Cultures of the Carolina Piedmont. Transactions of the American Philosophical Society, Vol. 54, Pt. 5, Philadelphia.

Coile, T. S.
1952 Soil and the Growth of Forests. Advances in Agronomy, Vol. 4, New York: Academic Press.

Dahlberg, A. A.
1951 The Dentition of the American Indian. In The Physical Anthropology of the American Indian, W. S. Luaghlin (ed.), Viking Fund, Inc., pp. 138-176.

Day, Gordon
1953 The Indian as an Ecological Factor in the Northeastern Forest. Ecology, Vol. 34.

Delorit, Richard J.
1970 An Illustrated Taxonomy Manual of Weed Seeds. River Falls: Agronomy Publications.

Desrosier, Norman W.
1970 The Technology of Food Preservation. Westport, Connecticut: Avi Publishing Co., Inc.

Ditch, Larry E. and Jerome C. Rose
1972 A Multivariate Dental Sexing Technique. American Journal of Physical Anthropology 37:61-64.

Doutt, J. Kenneth, C. A. Heppenstall, and J. E. Guilday
1973 Mammals of Pennsylvania. Harrisburg: Pennsylania Game Commission.

Downs, A. A.
1944 Estimating Acorn Crops for Wildlife in the Southern Appalachians. Journal of Wildlife Management 8(4):339-340.

Downs, A. A. and W. E. McQuilkin
1944 Seed Production of Southern Appalachian Oaks. Journal of Forestry 42:913-920.

Dragoo, Don W. and Stanley Lantz
1971 Archaeological Salvage of Selected Sites in the Allegheny Reservoir in Pennsylvania and New York: 1969-1971. Report Submitted to National Park Service, March, 1971.

Dragoo, Don W. and Stanley Lantz
1973 Archaeological Salvage of Selected Sites in the Allegheny Reservoir in New York: 1971-1972. Report Submitted to National Park Service, November, 1973.

Dragoo, Don W. and Stanley Lantz
1975 Archaeological Salvage of Selected Sites in the Allegheny Reservoir in New York: 1973-1974. Report Submitted to National Park Service, April. 1975.

Durnin, J. V. G. A. and R. Passmore
1967 Energy, Work and Leisure. London: Heinemann Educational Books.

Dutton, Richard Keith
1962 Summer Precipitation Distribution in Central Pennsylvania. Master's Thesis, Department of Meteorology, The Pennsylvania State University.

Eckhardt, Robert B.
1973 Hominoid Dental Variation and Hominid Origins. Occasional Papers in Anthropology, No. 8, The Pennsylvania State University, pp. 108-112.

Emerson, G. B.
1846 A Report on the Trees and Shrubs Growing Naturally in the Forests of Massachusetts. Boston: Dutton and Wentworth.

Erdtman, G.
1931 The Boreal Hazel Forests and the Theory of Pollen Statistics. Journal of Ecology, 19:158-163.

Erdtman, G.
1969 Handbook of Palynology: An Introduction to the Study of Pollen Grains and Spores. New York: Hafner Press.

Eveland, John F.
1973 Population Dynamics, Movements, Morphology, and Habitat Characteristics of Black Bears in Pennsylvania. Master's Thesis, Department of Wildlife Management, The Pennsylvania State University.

Faegri, K. and J. Iversen
1975 Textbook of Pollen Analysis. Second Edition. New York: Hafner Press.

FAO
1947 Energy Yielding Components of Food and Computation of Caloric Values. New York: United Nations.

Fenneman, N. M.
1948 Physiography of Eastern United States. New York: McGraw-Hill.

Fernald, M. L. and A. C. Kinsey
1943 Edible Wild Plants of Eastern North America. Grey Herbarium of Harvard University, Special Publications, Cornwall-on-Hudson: Idlewild Press.

Fowler, Melvin R.
1971 The Origin of Plant Cultivation in the Central Mississippi Valley: A Hypothesis in Prehistoric Agriculture. In Prehistoric Agriculture, Stuart Struever (ed.), Garden City, New York: Natural History Press.

Frayer, David W.
1978 Evolution of the Dentition in Upper Paleolithic and Mesolithic Europe. Publications in Anthropology, No. 10, University of Kansas.

French, C. E., et al.
1955 Nutritional Requirements of White-tailed Deer for Growth and Antler Development. Agricultural Experimental Station, Bulletin, No. 600, The Pennsylvania State University.

Funk, Robert E.
1976 Recent Contributions to Hudson Valley Prehistory. New York State Museum and Science Service, Memoir 22. The University of the State of New York, the State Education Department, Albany.

Garn, S. M. and K. Koski
1957 Tooth Eruption Sequences in Fossil and Recent Man. Nature 180:442-443.

Garn, Stanley Marion, Kalevi Koski, and Arthur B. Lewis
1957 Problems in Determining the Tooth Eruption Sequence in Fossil and Modern Man. American Journal of Physical Anthropology 15:313-331.

Gayton, A. H.
1948 Tulare Lake, Southern Valley, and Central Foothills Yokuts. Anthropological Records 10:1-140.

1948 Northern Foothills Yokuts and Western Mono. Anthropological Records 10:143-302.

Gilmore, M. R.
1931 Vegetal Remains of the Ozark Bluff Dweller Culture. Papers of the Michigan Academy of Science, Arts, and Letters, Vol. 14.

Goodyear, Albert C.
1975 A General Research Design for Highway Archaeology in South Carolina. The Institute of Archaeology and Anthropology, The University of South Carolina, The Notebook 7(1):3-38.

Green, George Rex
1933 Trees of North America (Exclusive of Mexico). Ann Arbor: Edward Brothers.

Grimm, William Carey
1962 The Book of Trees. New York: Hawthorn Books, Inc.

Gruber, Jacob W.
1971 Patterning in Death in a Late Prehistoric Village in Pennsylvania. American Antiquity 36:64-76.

Gruber, Jacob
n.d. An Archaeological Survey of Some Dam Areas in Berks, Carbon, Tioga, and Centre Counties, Pennsylvania. Report Submitted to U.S. Army Corps of Engineers.

Guilday, J. E., P. S. Martin, and A. D. McCrady
1964 New Paris No. 4: A Pleistocene Cave Deposit in Bedford County, Pennsylvania. Journal of the National Speleological Society, No. 26.

Gysel, Leslie W.
1957 Acorn Production on Good, Medium, and Poor Oak Sites in Southern Michigan. Journal of Forestry 55:570-574.

Harlow, W. H. and E. S. Harrour
1937 Textbook of Dendrology. New York: McGraw-Hill.

Harsh, E. S.
1962 Precipitation Line Motion as Related to Winds Aloft and Topography of Central Pennsylvania. Master's Thesis, Department of Meteorology, The Pennsylvania State University.

Hatch, James W. and Patrick S. Willey
1974 Stature and Status in Dallas Society. Tennessee Archaeologist 30:107-131.

Hay, Conran A., A. N. Snavely, T. E. Scheitlin, and T. O. Maher
1980 The New Hanover County Predictive Models Archaeological Research Project. Unpublished manuscript.

Heidenreich, Conrad
1971 Huronia: A History and Geography of the Huron Indians 1600-1650. Toronto: McClelland and Stewart.

Heisey, Henry W.
1971 An Interpretation of Shenks Ferry Ceramics. Pennsylvania Archaeologist, Vol. 41, No. 4.

Heisey, Henry W. and J. Paul Witmer
1964 The Shenk's Ferry People: A Site and Some Generalities. Pennsylvania Archaeologist 34(1):1-34.

Herbstritt, James
1977 Rock Shelters: An Archaeological Site Type in the Allegheny High Plateau. Paper Presented at the 43rd Annual Meeting of the Society for Pennsylvania Archaeology, Erie.

Hrdlicka, Ales
1920 Shovel-Shaped Teeth. American Journal of Physical Anthropology 3:446-451.

Hubbard, R. N. L. B.
1976 On the Strength of the Evidence for Prehistoric Crop Processing Activities. Journal of Archaeological Science 3(3):257-265.

Hunt, Edward E., Jr.
1960 The Continuing Evolution of Modern Man. Cold Spring Harbor Symposium on Quantitative Biology 24:245-254.

Hunt, Edward E., Jr. and Izaac Gleiser
1955 The Estimation of Age and Sex of Preadolescent Children from Bones and Teeth. American Journal of Physical Anthropology 13:479-487.

Hurlbert, Janice
1962 Age as a Factor in the Social Organization of the Hare Indian of Good Hope. Department of Northern Affairs and National Resources, Northern Co-ordination and Research Centre, Ottawa.

Illick, J. S.
1925 Pennsylvania Trees. Pennsylvania Department of Forests and Waters, Bulletin 11.

Jenny, Hans
1941 Factors of Soil Formation: A System of Quantitative Pedology. New York: McGraw-Hill.

Johnson, D. W.
1931 Stream Sculpture on the Atlantic Slope. New York: Columbia University.

Johnson, William C., J. B. Richardson, III, and Allen S. Bohnert
1979 Archaeological Site Survey in Northwest Pennsylvania, Region IV. Report Submitted to Pennsylvania Historical and Museum Commission, Harrisburg.

Keene, Arthur
1979 Economic Optimization and the Study of Hunter-Gatherer Subsistence Settlement Systems. In Transformations: Mathematical Approaches to Culture Change, C. Renfrew and K. Cooke (eds.), New York: Academic, pp. 369-404.

Keepax, Carole
1977 Contamination of Archaeological Deposits by Seeds of Modern Origin with Particular Reference to the Use of Flotation Machines. Journal of Archaeological Science 4(3):221-229.

Kent, Barry C., Ira F. Smith, III, and Catherine McCann (eds.)
1971 Foundations of Pennsylvania Prehistory. Anthropological Series of the Pennsylvania Historical and Museum Commission, No. 1, Harrisburg.

King, L. J.
1966 Weeds of the World; Biology and Control. New York: Interscience Publishers.

King, Thomas R. and H. E. McClure
1944 Chemical Composition of Some American Wild Foodstuffs. Journal of Agricultural Research 69:33-46.

Kinsey, W. Fred III.
1960 Additional Notes on the Albert Ibaugh Site. Pennsylvania Archaeologist, Vol. 30, Nos. 3-4.

Kinsey, W. Fred III and Jeffrey R. Graybill
1971 Murry Site and its Role in Lancaster and Funk Phases of Shenks Ferry Culture. Pennsylvania Archaeologist, Vol. 41, No. 4.

Koontz, Katharine L.
1979 Examination of the Validity of Existing Typological Schemes for Central Pennsylvanian Late Woodland Ceramics. Paper on File in the Department of Anthropology, The Pennsylvania State University.

Kordek, Walter S.
1973 An Investigation of the Structure, Stability, and Movements of Pennsylvania Black Bear with Particular Emphasis on Pike County. Master's Thesis, Department of Wildlife Management, The Pennsylvania State University.

Koski, V.
1970 A Study of Pollen Dispersal as a Mechanism of Gene Flow in Conifers. Metsatutkimuslaistoksu julkasuja, No. 70.

Kovar, A. J.
1964 Pollen Analysis of the Bear Meadows Bog of Central Pennsylvania. Proceedings of the Pennsylvania Academy of Science, 38:16-24.

Kovar, A. J.
1967 Report on the Pollen Analysis of the Samples from the Sheep Rock Shelter. In Archaeological Investigations of Sheep Rock Shelter, Huntingdon County, Pennsylvania, J. W. Michels and I. F. Smith (eds.), Occasional Papers in Anthropology, The Pennsylvania State University, pp. 85-124.

Kozicky, Edward L.
1948 Life History and Management of the Wild Turkey (Meleagris gallopavo Silvestris) in Pennsylvania. Ph.D. Dissertation, Department of Zoology and Entomology, The Pennsylvania State University.

Krause, Aurel
1956 The Tlingit Indians: Results of a Trip to the Northwest Coast of America and the Bering Straits. Erna Gunther, trans., Seattle: University of Washington Press.

Krickeberg, Walter
1939 The Indian Sweat Bath. Ciba Symposia 1:19-25.

Kronfeld, R.
1954 Development and Calcification of the Human Deciduous and Permanent Dentition. In Basic Readings on the Identification of Human Skeletons, T. D. Stewart and M. Trotter (eds.), Wenner-Gren Foundation for Anthropological Research, New York, pp. 3-10.

Landsberg, Helmut
1958 Physical Climatology. DuBois: Gray Printing Company.

La Potherie
1722 Histoire de l'Amerique. Septentrionale, Paris.

Liscinsky, S.
n.d. Cutting Intensity Effect on Game Food Production in a 55 Year Oak Hardwood Stand. Pennsylvania Game Commission, Project Number W-48R, June, 1974.

Lucy, Charles L.
1971 Pottery Types of the Upper Susquehanna. In Foundations of Pennsylvania Prehistory, Barry C. Kent, Ira F. Smith, III, and Catherine McCann (eds.), Anthropological Series of the Pennsylvania Historical and Museum Commission, No. 1, Harrisburg.

Mann, A. E.
1970 The Paleodemography of Australopithecus. Dissertation (1968) in Anthropology, University of California, Berkeley.

Mann, A. E.
1975 Paleodemographic Aspects of the South African Australopithecus. Publications in Anthropology, Vol. 1, University of Pennsylvania.

Maran, B.
1944 Soil as a Foundation of Silviculture. Soc. Czech Forestors, Tabor.

Marquardt, W. H.
1974 A Statistical Analysis of Constituents in Human Paleofecal Specimens from Mammoth Cave. In The Archaeology of the Mammoth Cave Area, P. J. Watson (ed.), New York: Academic Press.

Martin, Alexander C., Herbert S. Zim, and Arnold L. Nelson
1951 American Wildlife and Plants: A Guide to Wildlife Food Habits. New York: Dover.

Mayer-Oakes, William J.
1955 Prehistory of the Upper Ohio Valley. Annals of Carnegie Museum, Vol. 34, No. 2, Pittsburgh.

McCann, Catherine
1971 Notes on the Pottery of the Clemson and Book Mounds. In Foundations of Pennsylvania Prehistory, Barry C. Kent, Ira F. Smith, III, and Catherine McCann (eds.), Anthropological Series of the Pennsylvania Historical and Museum Commission, No. 1, Harrisburg.

Michels, Joseph W.
1968 Settlement Pattern and Demography at Sheep Rock Shelter: Their Role in Culture Contact. Southwestern Journal of Anthropology 24:66-82.

Michels, Joseph W. and James S. Dutt
1968 Archaeological Investigations of Sheep Rock Shelter, Huntingdon County, Pennsylvania. Occasional Papers in Anthropology, Vol. 3, The Pennsylvania State University.

Michels, Joseph W. and Ira F. Smith, III
1967 Archaeological Investigations of Sheep Rock Shelter, Huntingdon County, Pennsylvania. Occasional Papers in Anthropology, Vols. 1-2, The Pennsylvania State University.

Miles, A. E. W.
1963 Dentition in the Assessment of Individual Age in Skeletal Material. In Dental Anthropology, Don R. Brothwell (ed.), Symposia of the Society for the Study of Human Biology, Vol. V, Oxford: Pergamon Press Limited, pp. 191-209.

Molnar, Stephen
1971 Sex, Age and Tooth Position as Factors in the Production of Tooth Wear. American Antiquity 36:182-198.

Montgomery, F. H.
1977 Seeds and Fruits of Plants of Eastern Canada and Northeastern United States. Toronto: University of Toronto Press.

Moorrees, Coenraad F. A., Elizabeth A. Fanning, and Edward E. Hunt, Jr.
1963 Age Variation of Formation Stages for Ten Permanent Teeth. Journal of Dental Research 42:1490-1502.

Morris, D. H.
1966 Morphological Analysis and Age in the Permanent Dentitions of Young American Indians. American Journal of Physical Anthropology 25:91-96.

Morris, R. T.
1924 Nut Growing. New York: McMillan.

Mueller, James W.
1974 The Use of Sampling in Archaeological Survey. Memoirs of the Society for American Archaeology, No. 28.

Muenscher, W. C.
1955 Weeds. New York: McMillan and Co.

Munson, Patrick J.
1969 Comments on Binford's "Smudge Pits and Hide Smoking: The Use of Analogy in Archaeological Reasoning." American Antiquity 34(1):83-85.

Munson, P. J., P. W. Parmalee, and R. A. Yarnell
1970 Subsistence Economy of Scovill, A Terminal Middle Woodland Village. American Antiquity, Vol. 36.

Myers, Joel Norman
1963 The Radar Climatology of Central Pennsylvania. Master's Thesis, Department of Meteorology, The Pennsylvania State University.

Newcombe, William W.
1956 The Culture and Acculturation of the Delaware Indians. Anthropological Papers, No. 10, Museum of Anthropology, University of Michigan.

Nie, Norman, C. Halda Hull, J. Jenkins, K. Stienbrenner, and D. Bent
1975 Statistical Packages for the Social Sciences. Second Edition. New York: McGraw-Hill.

Niles, Samuel
1837 History of the French and Indian Wars. Massachusetts Historical Society Collections, Vol. VI, 3rd Series, Boston.

Olson, Ronald LeRoy
1967 Tlingit in Alaska. Berkeley and Los Angeles: University of California Press.

Owsley, Douglas William
1975 A Demographic Analysis of Skeletons from the Larson Site (39Ww2) Walworth County, South Dakota. Master's Thesis, University of Tennessee.

Panshin, A. J. and Carl DeZeeuw
1964 Textbook of Wood Technology, Vol. 1, Structure, Identification, Uses, and the Properties of the Commercial Woods of the United States and Canada. New York: McGraw-Hill.

Peltier, Louis
1949 Pleistocene Terraces of the Susquehanna River. Topographic and Geologic Survey, Pennsylvania Geological Survey Bulletin, G23.

Pianka, E. R.
1974 Evolutionary Ecology. New York: Harper and Row.

Popper, Karl
1959 The Logic of Scientific Discovery. New York: Harper and Row.

Powers, S.
1877 Tribes of California. Contributions to North American Ethnology 3:1-635.

Quimby, George I.
1946 The Possibility of an Independent Agricultural Complex in the Southeastern United States. In Human Origins: An Introductory General Course in Anthropology, Selected Readings Series #36, University of Chicago.

Ralph, E. K., H. N. Michael, and M. C. Han
1973 Radiocarbon Dates and Reality. MASCA Newsletter 9(1):1-20.

Redman, Charles and P. J. Watson
1970 Systematic Intensive Surface Collection. American Antiquity 35:279-291.

Reich, Edward George
1966 A Rain Study of a Small Drainage Basin in Central Pennsylvania. Master's Thesis, Department of Meteorology, The Pennsylvania State University.

Ritchie, William A.
1969 The Archaeology of New York State. Garden City, New York: Natural History Press.

Ritchie, William A.
1971 A Typology and Nomenclature for New York Projectile Points. The University of the State of New York, The State Education Department, Albany.

Ritchie, William A. and Robert E. Funk
1973 Aboriginal Settlement Patterns in the Northeast. New York State Museum and Science Service Memoir 20, Albany.

Ritchie, William A. and Richard S. MacNeish
1949 The Pre-Iroquoian Pottery of New York State. American Antiquity 15(2):97-124.

Robinson, C. W.
1939 Huntsman Finds Rare Indian Pot. Mineral Industries - The Pennsylvania State College, Vol. 8, No. 5.

Roper, D. C.
1976 Lateral Displacement of Artifacts Due to Plowing. American Antiquity 41(3):372-375.

Rowley, J. R.
1955 A Study of Recent Pollen at Lake Ithaca Biological Station. Proceedings of the Minnesota Academy of Science, Vol. 23, pp. 50-60.

Rudolph, J.
1977 Experimental Replication of the Effects of Agriculture on an Archaeological Site. Master's Thesis, Southern Illinois University.

Sanders, William T., J. R. Parsons, and R. S. Santley
1979 The Basin of Mexico: Ecological Processes in the Evolution of a Civilization. New York: Academic Press.

Saraydar, Stephen and Izum Shimada
1973 Experimental Archaeology: A New Outlook. American Antiquity, Vol. 39, No. 3.

Scheirer, Robert S.
1969 The Productivity of Eastern Wild Turkey. Master's Thesis, Department of Wildlife Management, The Pennsylvania State University.

Schindler, D. L., J. W. Hatch, C. A. Hay, and R. C. Bradt
In Prep. Aboriginal Thermal Alteration of a Central Pennsylvania Jasper: A Materials Science and Lithic Technology Approach.

Schoener, T.
1969 Optimal Size and Specialization in Constant and Fluctuating Environments: An Energy-Time Approach. In Diversity and Stability in Ecological Systems, Brookhaven Symposium in Biology, No. 22.

Schoenfelt, Robert C.
1975 Evaluation of Winter Deer Habitat in Southwestern Pennsylvania Using Tame, White-tailed Deer. Master's Thesis, Department of Animal Nutrition, The Pennsylvania State University.

Schoenwetter, James
1974 Pollen Analysis of Human Paleofeces from Upper Salts Cave. In The Archaeology of the Mammoth Cave Area, P. J. Watson (ed.), New York: Academic Press.

Schoenwetter, James
1974 Pollen Analysis of Sediments from Salts Cave Vestibule. In The Archaeology of the Mammoth Cave Area, P. J. Watson (ed.), New York: Academic Press.

Schorger, A. W.
1966 The Wild Turkey: Its History and Domestication. Norman: University of Oklahoma Press.

Schroeter, Charles
1966 The Dentition of Man: An Atlas of Tooth Morphology. Seattle and London: University of Washington Press.

Sears, P. B.
1935 Glacial and Postglacial Vegetation. The Botanical Review 1:37-51.

Sharp, W. M.
1958 Evaluating Mast Yields in the Oaks. Agricultural Experimental Station, Bulletin, No. 635, The Pennsylvania State University.

Simmonds, W.
1964 The Grain Chenopods of the Tropical American Highlands. Economic Botany, Vol. 19.

Skinner, Alanson
1912 Notes on the Eastern Cree and Northern Saulteaux. New York: American Museum of Natural History.

Skinner, Alanson
1921 Material Culture of the Menomini. Museum of the American Indian, Heye Foundation, Indian Notes and Monographs, No. 20.

Smallshaw, James
1953 Some Precipitation-Altitude Studies of the Tennessee Valley Authority. Transactions, American Geophysical Union, Vol. 34, pp. 83-88.

Smith, Eric A.
1979 Human Adaptation and Energetic Efficiency. Human Ecology 7(1):53-74.

Smith, Ira F., III
1966 Raystown Reservoir Archaeological Salvage and Survey Program. Final Report Submitted to National Park Service, Northeast Region.

Smith, Ira F., III
1973 The Parker Site: A Manifestation of the Wyoming Valley Culture. Pennsylvania Archaeologist 43(3-4):1-56.

Smith, Ira F., III
1976 A Functional Interpretation of Keyhole Structures in the Northeast. Pennsylvania Archaeologist 46(1-2): 1-12.

Steinbock, Ted R.
1976 Paleopathological Diagnosis and Interpretation: Bone Diseases in Ancient Human Populations. Springfield, Illinois: Charles C. Thomas.

Steward, Julian H.
1955 Theory of Culture Change. Urbana: University of Illinois.

Steward, Julian
1977 The Concept and Method of Cultural Ecology. In Evolution and Ecology, J. Steward and R. Murphy (eds.), Urbana: University of Illinois, pp. 43-57.

Stewart, Marilyn C.
1975 A Typology of Pits on the Engelbert Site. Ph.D. Dissertation, State University of New York at Binghamton.

Stewart, Marilyn C.
1977 Pits in the Northeast: A Typological Analysis. In Current Perspectives in Northeastern Archaeology: Essays in Honor of William A. Ritchie, Robert E. Funk and Charles F. Hayes, III (eds.). Researches and Transactions of the New York State Archaeological Association, Volume 17, No. 1, Rochester and Albany.

Stewart, Robert B.
1974 Identification and Quantification of Components in Salts Cave Paleofeces. In The Archaeology of the Mammoth Cave Area, P. J. Watson (ed.), New York: Academic Press.

Stewart, T. B.
1933 Untitled. Pennsylvania Archaeologist 3(5):6.

Stewart, T. B.
1938 Archaeology of the West Branch. In Report of the Susquehanna River Expedition, W. K. Moorehead (ed.), Andover, Massachusetts.

Struever, Stewart
1971 Implications of Vegetal Remains from an Illinois Hopewell Site. In Prehistoric Agriculture, Struever (ed.), Garden City, New York: Natural History Press.

Struever, Stuart and Kent Vickery
1972 The Beginnings of Cultivation in the Midwest-Riverine Area of the United States. American Anthropologist, No. 75.

Swanton, John R.
1946 The Indians of the Southeastern United States. Bureau of American Ethnology Bulletin, No. 137, Washington.

Swartz, Deborah B.
1979 The Fisher Farm Site Ceramics. Master's Paper, Department of Anthropology, The Pennsylvania State University.

Swift, R. W.
1948 Deer Select Most Nutritious Forages. Journal of Wildlife Management 12:109-110.

Talmage, Valerie and Olga Chester
1977 The Importance of Small, Surface, and Disturbed Sites as Sources of Significant Archaeological Data. Cultural Resource Management Studies, Office of Archaeological and Historic Preservation, National Park Service, U.S. Department of Interior.

Taylor, P. J.
1977 Quantitative Methods in Geography. Boston: Houghton Mifflin Co.

Taylor, W. P.
1956 The Deer of North America. Harrisburg: Stackpole.

Tibbles, William
1912 Foods: Their Origin, Composition, and Manufacture. London: Bailliere, Tindall, and Cox.

Tolstoy, P. and S. K. Fish
1975 Surface and Subsurface Evidence for Community Size at Coapexco, Mexico. Journal of Field Archaeology 2:97-104.

Turnbaugh, William H.
1977 Man, Land, and Time. The Lycoming County Historical Society, Wiliamsport, Pennsylvania.

USDA
1948 Woody Plant Seed Manual. USDA Miscellaneous Publications, No. 654.

USDA
1951 Soil Survey Manual. USDA Handbook No. 18, USGPO, Washington.

USDA
1966 Soil Survey, Clinton County, Pennsylvania. Soil Conservation Service, USGPO, Washington.

USDA
1968a Soil Survey, Centre County, Pennsylvania. Department of Agriculture, Washington, D.C.

USDA
1968b Soil Maps for Area Development, Vol. 2, Centre County, Pennsylvania. Soil Conservation Service, USGPO, Washington.

USDA
1975 Soil Taxonomy. Soil Conservation Service, USGPO, Washington.

USDA
1978 Soil Survey of Huntingdon County, Pennsylvania. Soil Conservation Service, USGPO, Washington.

USDA
n.d. Soil Survey Interpretations for Centre County, Pennsylvania. USDA Soil Conservation Service.

Veatch, J. O.
1932 Soil Maps as a Basis for Mapping Original Forest Cover, Trans. Michigan Academy of Science, Arts, and Letters 15:267-273.

Voegelin, E. W.
1938 Tubatulabal Ethnography. Anthropological Records 2:1-84.

Wainio, Walter W.
1940 The Chemical Composition of the Mast Food Products of the Forests of Pennsylvania. Master's Thesis, Department of Animal Nutrition, The Pennsylvania State University.

Wakefield, G. C.
1969 Movement, Habitat, and Population Characteristics of the American Black Bear in Pennsylvania. Master's Thesis, Department of Forestry and Wildlife, The Pennsylvania State University.

Walker, P. C. and R. T. Hartman
1960 The Forest Sequence of the Hartstown Bog Area in Western Pennsylvania. Ecology 41:461-474.

Wallis, Wilson D. and Ruth Sawtell Wallis
1955 The Micmac Indians of Eastern Canada. Minneapolis: University of Minnesota Press.

Watson, P. J.
1974a Flotation Procedures Used on Salts Cave Sediments. In The Archaeology of the Mammoth Cave Area, P. J. Watson (ed.), New York: Academic Press.

Watson, P. J.
1974b Prehistoric Horticulturalists. In The Archaeology of the Mammoth Cave Area, P. J. Watson (ed.), New York: Academic Press.

Watts, C. R.
1964 Forage Preference of Captive Deer While Free Ranging in a Mixed Oak Forest. Master's Thesis, School of Forest Resources, The Pennsylvania State University.

Webb, C. H.
1944 Dental Abnormalities as Found in the American Indian. American Journal of Orthodontics and Oral Surgery 9:474-486.

Webster, David L., Mark Aldenderfer, James W. Hatch, and Conran Hay
1977 The Milesburg Site: A Hunting Camp in Central Pennsylvania. Pennsylvania Archaeologist 47(4):37-47.

Westerfeld, Walter F.
1961 An Annotated List of Vascular Plants of Centre and Huntingdon Counties. Castanea, Vol. 26, No. 1.

Wheeler, Russell C.
1962 An Atlas of Tooth Form. Third Edition. Philadelphia: W. B. Saunders Co.

Wilde, S. A.
1958 Forest Soils: Their Properties and Relation to Silviculture. New York: Ronald Press.

Willey, Gordon R., W. R. Bullard, J. B. Glass, and J. C. Gifford
1965 Prehistoric Maya Settlements in the Belize Valley. Peabody Museum Papers, Vol. 54, Harvard University, Cambridge.

Williams, Roger
1643 A Key into the Language of America. London: Gregory Dexter.

Winters, Howard D.
1969 The Riverton Culture. The Illinois State Museum Reports of Investigations, No. 13, Springfield.

Winton, Andrew L. and Kate Barber Winton
1932 The Structure and Composition of Foods. New York: John Wiley and Sons.

Wishart, David
1978 Clustan User Manual. Program Unit Library, Edinburgh University.

Witthoft, John
1954 Pottery from the Stewart Site, Clinton County, Pennsylvania. Pennsylvania Archaeologist 24(1):22-29.

Witthoft, John and S. S. Farver
1952 Two Shenk's Ferry Sites in Lebanon County, Pennsylvania. Pennsylvania Archaeologist 22(1):3-32.

Witthoft, John and W. Fred Kinsey, III (eds.)
1959 Susquehannock Miscellany. Pennsylvania Historical and Museum Commission, Harrisburg.

Wobst, H. M.
1974 Boundary Conditions for Paleolithic Social Systems: A Simulation Approach. American Antiquity 39(2):147-178.

Wolpoff, Milford H.
1971 Metric Trends in Hominid Dental Evolution. Studies in Anthropology, Case Western Reserve University, Cleveland.

Wright, John K.
1937 Some Measures of Distributions. Annals of the Association of American Geographers, Vol. 27, No. 4, pp. 177-211.

Yarnell, Richard A.
1964 Aboriginal Relationships Between Culture and Plant Life in the Upper Great Lakes Region. Museum of Anthropology, University of Michigan Papers, No. 23.

Yarnell, Richard A.
1971 Early Woodland Plant Remains and the Question of Cultivation. In Prehistoric Agriculture, S. Struever (ed.), Garden City, New York: Natural History Press.

Yarnell, Richard A.
1974a Intestinal Contents of the Salts Cave Mummy and Analysis of the Initial Salts Cave Flotation Series. In The Archaeology of the Mammoth Cave Area, P. J. Watson (ed.), New York: Academic Press.

Yarnell, Richard A.
1974b Plant Food and Cultivation of the Salts Caves. In The Archaeology of the Mammoth Cave Area, P. J. Watson (ed), New York: Academic Press.