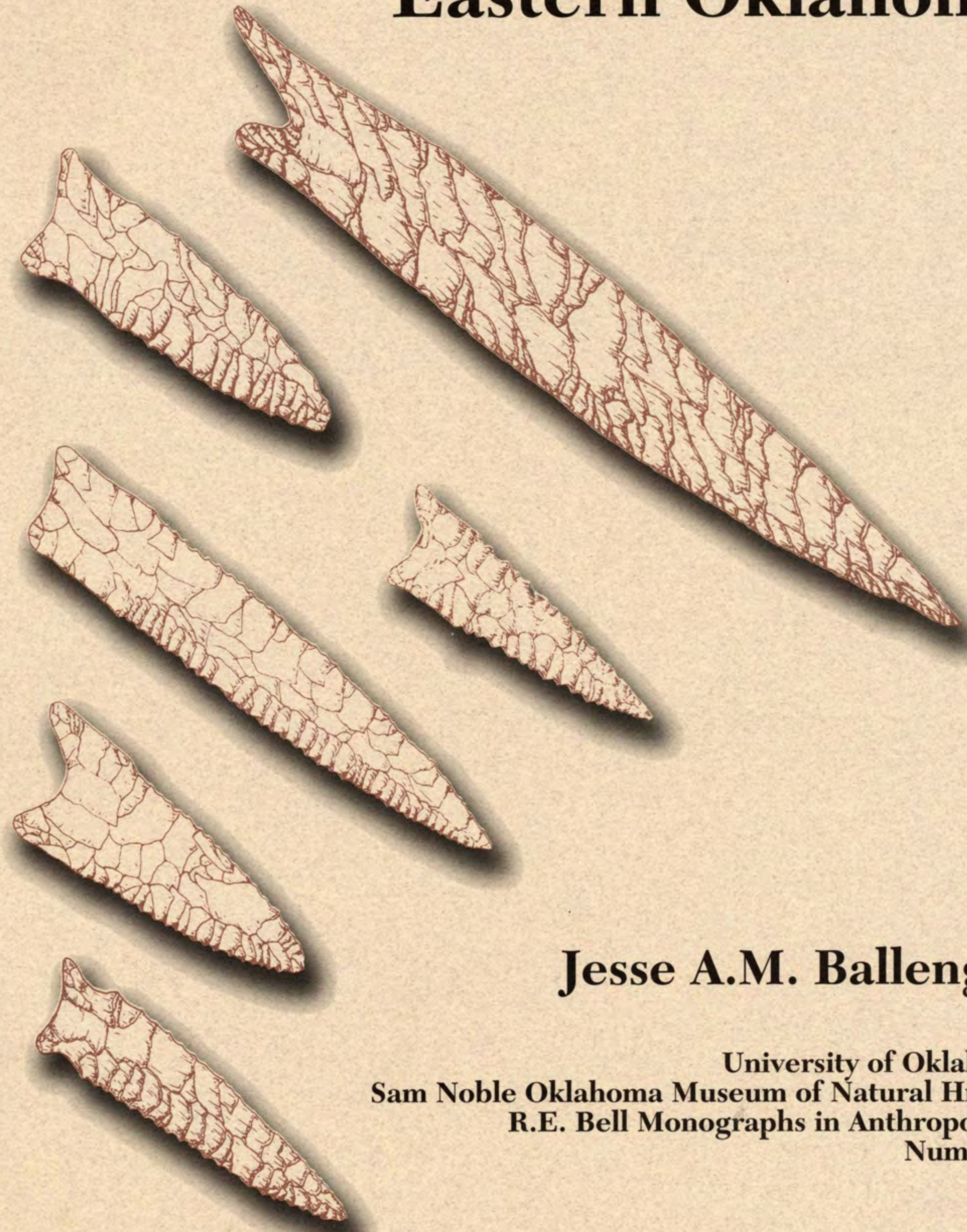
Dalton Settlement in the Arkoma Basin of Eastern Oklahoma



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DALTON SETTLEMENT IN THE ARKOMA BASIN OF EASTERN OKLAHOMA

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PREFACE

We are pleased to publish Jesse Ballenger's research as the second volume in the Robert E. Bell Monographs in Anthropology series from the Sam Noble Oklahoma Museum of Natural History. Written in partial completion of the M.A. degree in Anthropology at the University of Oklahoma, Jesse's study focuses on the sparsely documented artifacts of hunting-gathering people who inhabited eastern Oklahoma some 10,000 years ago. This evidence consists largely of surface finds of spearpoints, knives, drills, and a few other chipped stone tools that are distinctively stylized and similar to artifacts found in unmixed open camps or in stratified deposits from cave and rockshelter deposits in Arkansas, Missouri, Illinois, Tennessee, Alabama, and North Carolina. Archaeologists working in these places have sometimes questioned whether or not Dalton artifacts really occur as far west as Oklahoma. Based upon Jesse's compilations, the answer is definitely yes. Moreover, while Oklahoma Dalton materials are common to landscapes similar to where they are found farther east, pollen records indicate that Dalton people frequented Oklahoma landscapes when they were largely grasslands, not the deciduous forests usually associated with Dalton lifeways.

In several ways, this study is based on ideas advocated by Dr. R. E. Bell. First, Jesse sought out and utilized the artifact collections of responsible avocational archaeologists living in eastern Oklahoma. As the founder of the Oklahoma Anthropological Society, Dr. Bell always believed in the important role that private collections could play if their owners were careful to record the locations where these collections originated. In Jesse's case, he was able to find and document Dalton collections with proveniences in three different kinds of settings in the Arkoma Basin, that physiographic trough that separates the Ozark Plateau on the north from the Ouachita Mountains to the south. Because good records exist on where the artifacts were found, Jesse was able to compare the collections from different settings in order to study Dalton people's movements through and across the Arkoma Basin. He was also able to do this because he examined and recorded the kinds and sources of flint from which the Dalton tools were made. This study of flints, their diverse origins, and prehistoric people's preferential use of certain stone for particular tools was pioneered by Dr. Bell in his 1943 M.A. thesis at the University of Chicago.

In preparing this publication, we thank Mr. Jack Ray and Drs. Neal Lopinot and Jack Hofman for reviewing the manuscript and providing comments that improved it. We also thank Patrick Fisher and Paul King of the SNOMNH Department of Computing Systems for working on the cover design and programming assistance and Dr. Laurie Vitt, Associate Director of Research and Collections at SNOMNH, for guidance and advice. Finally, we acknowledge an anonymous donor whose financial support made this series possible.

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INTRODUCTION

This study examines Dalton adaptations in the Arkoma Basin of eastern Oklahoma. Recognized by their distinctive bifaces, Dalton groups were hunter-gatherers who flourished in the Eastern Woodlands and Midwest between 9,900 and 10,500 radiocarbon years ago (Goodyear 1982). This study aims to supplement a growing body of Dalton research by exploring the settlement mobility of Dalton groups in the early Holocene prairie of eastern Oklahoma.

The origin of the artifacts used here comprise an important aspect of this study. Archaeologists have long recognized that Dalton groups occupied eastern Oklahoma (Bell 1958). This evidence, however, is sparse and often overshadowed by large or well dated Dalton sites in the Ozark Mountains and central Mississippi River valley (i.e., Goodyear 1974; Kay 1982; Lopinot et al. 1998; Morse 1997). Rather than relying on the elusively buried evidence in eastern Oklahoma (i.e., Perttula et al. 1994; Wyckoff 1985), this study takes advantage of extant private collections. Collected from the surface by interested avocationalists, these resources play an increasingly important role in archaeology and the study of prehistoric land use. The collections used here come from three localities within the Arkoma Basin (Fig. 1) of eastern Oklahoma: 1) the Billy Ross collection from Sans Bois Creek; 2) the Vera McKellips collection from the shore of Late Eufaula along the North Canadian River; and 3) the Bill Nimitz, Mary Lawhorn, Jackie and Andy Part, and John, Larry, and Claxton Todd collections from upper Dirty Creek (Fig. 2). A total of 324 Dalton points from these collections are examined (Appendix A).

Several aspects of Dalton adaptation within the Arkoma Basin of eastern Oklahoma are discussed. Part 1 addresses the landscape of eastern Oklahoma, how it has changed over the past 10,000 years, and what the ecological character of that landscape was during Dalton times. Although none of the artifacts analyzed in this study were observed in a buried context, it is important that archaeologists recognize the drastic geological processes that have destroyed or buried Dalton evidence in the Arkoma Basin.

Perhaps one of the more interesting aspects of Dalton occupation in eastern Oklahoma is the evidence that Dalton groups frequented a prairie environment. Although Dalton subsistence strategies are often associated with a forest adaptation, pollen records from Oklahoma and Kansas indicate that the Arkoma Basin was vegetated with grasses during the Dalton period (Ferring 1994; Gruger 1973). If Dalton groups were exploiting prairie resources in eastern Oklahoma, while exploiting forest resources farther east, a distinction should be observed between these groups' settlement strategies and technologies. The recognition of clinal variation during Dalton times would demonstrate ecologically affected flexibility within the Dalton culture (Wyckoff et al. 1996). A shared technology and settlement strategy between these groups would, on the other hand, identify a uniform adaptive link between Dalton groups in prairie and forest environments.

Archaeologists have identified settlement and mobility strategies as an essential ingredient for understanding cultural adaptations within environmental, economic, and social constraints. The study of hunter-gatherer settlement and mobility is reviewed in Part 2. Although early taxonomies of hunter-gatherer mobility played an importaant role in the study of Dalton settlement (i.e., Beardsley et al. 1956), more attention is provided to the influential "forager" and "collector" subsistence and settlement continuum introduced by Binford (1980). The concepts of expedient and curated technologies (Binford 1973), design considerations (Bleed 1986), and tool utility (Kuhn 1989) are also reviewed.

The archaeology of the Dalton Horizon is reviewed in Part 3. Relative to other early Holocene adaptations in the Southeast, a rich history of Dalton research has generated a wealth of information relating to these groups' settlement and mobility. This review includes a discussion of how archaeologists conceptualize the Dalton Horizon. Both "Paleoindian" and "Archaic" are used to describe Dalton adaptations, and these adaptive types carry different expectations in terms of mobility. Further, recent studies propose that the Dalton Horizon "evolved" direct from the Clovis culture (Morse et al. 1996; O'Brien and Wood 1998). On the other hand, Ray (2000) proposes that Dalton probably developed from a Middle Paleoindian (i.e., Gainey) technology. The possibility that Dalton groups were the first localized adaptation to develop in the Arkoma Basin after Clovis or Gainey gives the Dalton Horizon significant research potential in hunter-gatherer studies. Evidence for the Clovis-to-Dalton transition is presented and critiqued.

Investigation into the technological organization of the Dalton Horizon began with Morse's (1971a) description of the Hawkins cache and has benefited from a number of subsequent studies. This study stresses raw material identificantion and how Dalton point variability can be used to address the relationship between tool maintenance and settlement mobility. The Dalton point stages developed by Morse (1971a) and Goodyear (1974) are critiqued and a modified version is presented. Although the hafted and sometimes serrated biface used by Dalton groups served as a knife, projectile, awl, and scraper, it is usually referred to as simply the Dalton "point" in my study. The role of the Dalton adz and the use of "Quince scrapers" by Dalton groups in eastern Oklahoma and Texas are also discussed.

Based largely on evidence from the central Mississippi River Valley, three models of Dalton settlement have been proposed. The Dalton settlement hypothesis developed by Morse (1971b) contends that Dalton microbands established territories within single watersheds and used logistically organized parties to bring resources to a central base camp. Schiffer (1975a), emphasizing seasonal resource availability, proposes an inter-watershed settlement pattern, and Ballenger (1998) has argued that Dalton groups in eastern Oklahoma moved between the Ozark and Ouachita mountains. Recently, Walthall (1998a) has devised a model emphasizing seasonal aggregation and dispersion. Daniel (1998), Gillam (1996) and Ray (1998) have further stressed the role of lithic source areas. In eastern Oklahoma, Wyckoff and Bartlett (1995) have suggested that two Dalton macrobands existed, one staging from the Ozarks and the other from the Ouachita Mountains. These models and interpretations, as well as other considerations, are reviewed in light of a growing body of research from the Eastern Woodlands. Test implications are constructed for three hypothetical Dalton settlement patterns in eastern Oklahoma.

Analysis of the Billy Ross, McKellips, and Dirty Creek collections is performed in Part 4. The collection localities are summarized in terms of their geographic and topographic settings. The raw material of 324 Dalton points is identified and is used to examine Dalton group range. The morphological diversity and breakage observed among the Dalton points from each collection is summarized. Finally, using the concept of tool utility (Kuhn 1989, 1994), the amount of tool mass invested in and removed from the points from each locality, and among different raw material types, is explored to address how Dalton groups moved within the Arkoma Basin.

The hypothetical settlement patterns presented in Part 3 are reviewed in light of the evidence recovered from the Billy Ross, McKellips, and Dirty Creek localities. Morse's (1971b) scenario of Dalton microbands residing within drainage-specific territories is not supported by raw material usage within the Arkoma Basin. The contention that Dalton groups traveled between uplands (Ballenger 1998; Schiffer 1975a) is also discounted based on raw material use and calculations of tool utility. Evidence that two Dalton macrobands existed in eastern Oklahoma is presented (i.e., Daniel 1998; Wyckoff and Bartlett 1995), and a model of seasonal aggregation in the Arkoma Basin and overwintering in the Ozark and Ouachita mountains is proposed (i.e., Walthall 1998a).

Part 1
THE ENVIRONMENTAL SETTING OF THE ARKANSAS BASIN

The study of landscapes and paleoenvironments plays an important role in recognizing settlement systems. Such efforts are especially warranted in ecotonal settings, which provide an opportunity to observe flexibility among regional adaptations. The presence of Dalton groups in eastern Oklahoma offers such a case study. Dalton groups apparently flourished in the early Holocene central Mississippi River valley and portions of the Midwest but, according to pollen records, they also exploited and adapted to a prairie setting in eastern Oklahoma. This section reviews the Arkoma Basin in terms of its ecological setting, depositional history, and early Holocene environment.

Physiographic Setting

The Arkoma Basin is an elongated geomorphic province that extends approximately 350 km between the Arbuckle Mountains of south-central Oklahoma and the Mississippi River Embayment in central Arkansas (Fig. 1). Developing with Pennsylvannian-age mountains on its southern edge, the Arkoma Basin experienced drastic downthrusting. Thick layers of mud and sand were laid down in the ancient sea that developed, as rivers and streams deposited additional alluvial and deltaic sediments. The deposits and plant communities they supported were buried, compressed, and cemented together to form shale, sandstone, limestone, and coal (Franks and Lambert 1994; Johnson 1988).

The principal area within the Arkoma Basin is the Arkansas River Valley subprovince, an east-west trending belt of gently folded and thrust-faulted upper Paleozoic rock (Madole et al. 1991:532). With its headwaters in the Southern Rocky Mountains of Colorado, the Arkansas River drains the Great Bend Lowlands and the Cherokee Prairie before reaching the Arkoma Basin. Within the Arkoma Basin, the Arkansas River is often confined to an 18-24 km wide valley that contains meander scars, oxbow lakes, sandbars, and backwater swamps and lakes (Foti 1974; Vogele 1990). Another prominent landform within the Arkoma Basin is the Sans Bois Mountains, located south of the Arkansas River Valley in Oklahoma. These Pennsylvanian-age sandstone and shale uplands have experienced significant erosion and are reduced to isolated ridges and cuestas which rarely extend more than 100 m above the surrounding floodplains (Curtis and Ham 1972; Madole et al. 1991). The average precipitation of the Arkoma Basin in eastern Oklahoma varies between approximately 120 and 110 cm, with mean temperatures ranging from 40 degrees F in the winter and 79 degrees F in the summer (Johnson and Duchon 1995).

The northern boundary of the Arkoma Basin is defined by the Boston Mountains, the rugged Pennsylvanian-age subprovince of the Ozarks that rises more than 250 m above the Arkansas River Valley. The Springfield and Ozark plateaus, located just north of the Boston Mountains, consist of eroded limestones, cherts, and dolomites that formed dur-

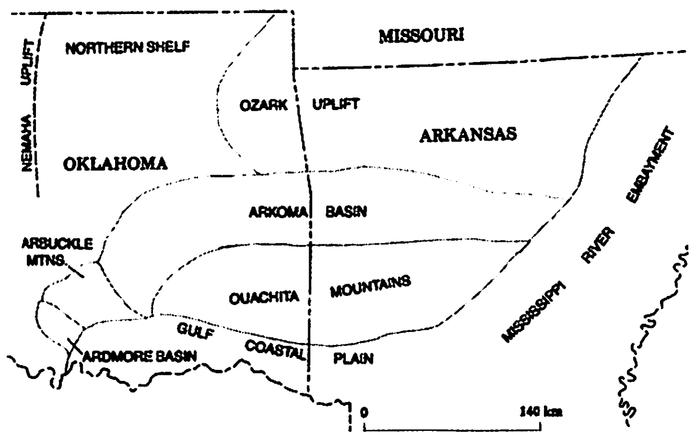


Figure 1. Arkoma Basin and adjacent geological regions. Adapted from Johnson 1988:Fig. 1.

ing the Cambrian, Ordovician, and Mississippian periods and gradually rise towards the St. Francois Mountains of Missouri (Bretz 1965; Fenneman 1938; Rafferty 1980). The high quality, knappable chert from the Ozarks (Banks 1990; Ray 1984) played an important role at the sites and localities examined in this study. Significant drainages include the Grand (Neosho) River, which drains the western flank of the Ozarks, and the Illinois River, which drains portions of the Ozark Plateau and Boston Mountains. Today, the most widely distributed plant association of the Boston Mountains and Ozarks is a dry, oak-hickory forest, with slopes and valleys supporting more mesic plant species (Blair and Hubbel 1938).

The southern extent of the Arkoma Basin is defined by the Ouachita Mountains. These elongated, east-west trending structures exhibit significant folding and faulting and provide the most rugged terrain of eastern Oklahoma and western Arkansas, with upland elevations rising as much as 450 meters above the river valleys. The geology of the Ouachitas consists of Devonian novaculite overlain by Mississippian and Pennsylvanain-age shales, sandstones, and occasional limestones (Sutherland and Manger 1979). Like the Ozarks, cherts and quartzites are common to the Ouachita Mountains and were targeted by Dalton groups in the Arkoma Basin. The Poteau River drains the northern Ouachitas and empties into the Arkansas River. The southern Ouachitas are drained by the Kiamichi, Glover, Mountain Fork, and Little rivers, which empty into the Red River of the Gulf Coastal Plain. Vegetation within the Ouachitas is similar to that observed in the Ozarks, but with greater frequencies of oak-pine associations (Blair and Hubbell 1938).

The eastern border of the Arkoma Basin, located approximately 180 km from the Oklahoma-Arkansas state line, is the Mississippi River Embayment. The Arkansas River meanders east and migrates to the southern edge of its valley before reaching the Mississippi River Alluvial Plain near Little Rock, Arkansas. The valley train terraces of the Mississippi River Valley are characterized as broad, low, and sandy. The bottomlands supported wet-meadows and hardwood forests before historic settlement, whereas oak-hickory forests and prairie openings occurred in the elevated terraces (Delcourt et al. 1997:106). Topographic relief within the Mississippi River Embayment is confined to relic braided channels and sand dunes (Saucier 1978), and these features rarely provide more than 10 m of relief.

The Arkoma Basin opens to the west into the Osage Savanna biotic district (Blair and Hubbell 1938), a large ecotone separating the grassy Southern Plains from the Southeastern Deciduous Forest. Underlain by Pennsylvanian-age sandstone and shale, the topography of the Osage Savanna is characterized by rolling prairies that have eroded to expose cuestas, some promontories, and many hills. These features sometimes exhibit rocky talus slopes and bluffs, with postoak-blackjack forests that support many of the major plant communities observed in the Ozark and Ouachita mountains. The most significant vegetative difference in the Osage Savanna is the increase in prairies in rolling and level areas. These plant communities have been significantly altered by over-grazing and farming during historic times, but tall and short grasses such as side-oats grama, buffalo grass, silver beardgrass, and other species typical of the Cherokee Prairie are common and afford a corridor for the eastward extension of prairie-adapted animals such as bison. Low areas in the Osage Savanna are similar to those of the Cherokee Prairie and support mesic forests that contain elm, oak, ash, willow, cottonwood, sycamore, and maple (Blair and Hubbell 1938). The western extreme of the Osage Savanna, referred to as the Cross Timbers, consists of thick stands of postoak and other scrubby trees that separate the Osage Savanna from the mixed grass prairie (Dysterhuis 1948). Major watersheds that drain the Osage Savanna include the Cimarron, North Canadian, and Canadian rivers, all of which originate in either the Southern Rocky Mountains or the High Plains and flow into the Arkansas River.

Landscape Evolution

The depositional history of the Arkoma Basin is not well understood or documented. Analogies are therefore made with areas north and south of the study area. This section reviews the depositional history of select watersheds along the prairie-forest ecotone. The geological character of these settings varies significantly, but similarities are observed with each of the Dalton localities examined in this thesis.

Southwest of the Arkoma Basin, in the Cross Timbers of north-central Texas, Ferring (1995) and Ferring and Yates

(1997) have documented the alluvial stratigraphy of the upper Trinity River Basin. Upland terraces of Pleistocene age contain surface and near-surface evidence of Paleoindian occupation. At the George King site, for example, 3 to 4 m of eolian sands cover Dalton and Cody artifacts (Ferring 1995:30-32). In the valleys, cultural materials are buried deeply in alluvium. The deepest deposit, defined as the Aubrey alluvium, consists of six to eight meters of gravel, sand, fine alluvium, and lucustrine sediments buried beneath the floodplain. These Clovis-bearing deposits contain evidence for ponding between 14,000-11,000 years ago. The Sanger alluvium, an early Holocene unit dated between 11,000-7500 years ago, indicates rapid alluviation during Dalton times. Middle Holocene deposits are not well defined and early Holocene sites are overlain by sediments deposited over the last 4500 years.

The Late Quaternary geology and geoarchaeology of the Ouachita Mountains region is documented along McGee Creek by Ferring (1994). The oldest terrace, of Pleistocene age, contains clastic sediments characteristic of a high-energy depositional environment overlain by an ancient stable surface. Paleoindian materials, including Dalton artifacts (i.e., Perttula et al. 1994), occur within this terrace and indicate abandonment of the floodplain during the late Pleistocene. The next alluvial deposit, recognized as the "red terrace," contains evidence of middle to late Holocene occupations. This poorly understood unit occurs piecemeal in the wider valley sections and reflects bedrock controls on deposition. Alluvium dated between 8000 and 5000 years ago is conspicuously absent, but stream-rolled artifacts diagnostic of this period occur in gravels below the "red" terrace and indicate significant erosion of middle and late Holocene sites. Farther east, at the Bell site located in the Pine Creek watershed of McCurtain County, a few Dalton and "Plainview" forms were recovered from silty loams buried more than 2 m below the surface (Wyckoff 1968:53).

Farther north, Mandel (1995) has documented the depositional histories of 65 localities in Kansas, Nebraska, Oklahoma, and Missouri, including portions of the Cross Timbers and Cherokee Prairie. Of particular significance to this thesis is the information gleaned from the Neosho, Verdigris, and Caney rivers, all of which are tributaries to the Arkansas River. Although Dalton-age deposits are not documented along the Neosho River by Mandel (1995), these certainly exist in the terraces adjacent smaller streams. Located along the first prominent terrace of Saline Creek, a tributary of the Grand/Neosho River, the Packard site demonstrates Dalton occupations buried 1.5 to 2.4 m below the surface (Wyckoff 1985).

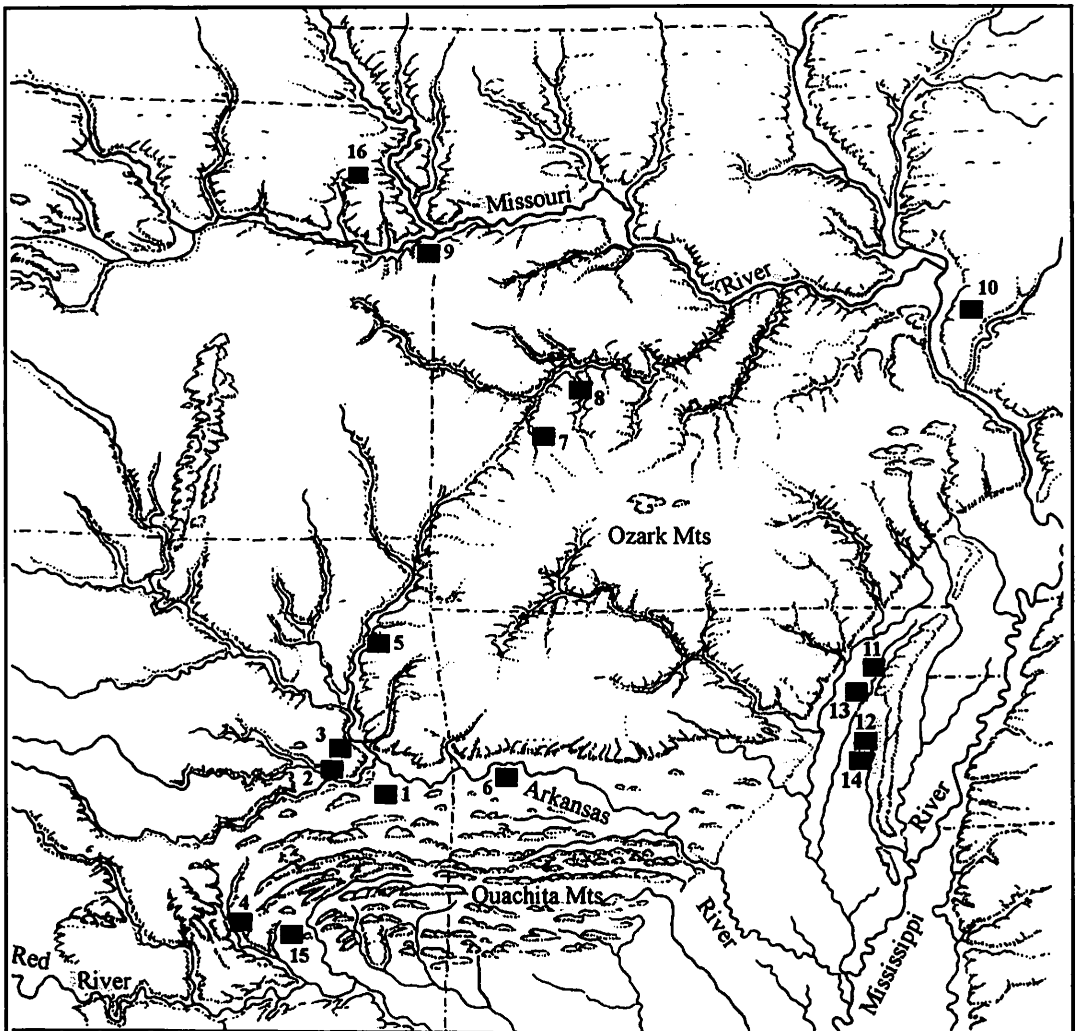
A long history of investigations along the lower Pomme de Terre River has described the deep burial of Paleoindian deposits on the western edge of the Ozarks in Missouri. As summarized by Kay (1983:65-66), the fluvial system of the Pomme de Terre River has experienced no less than eight cut-and-fill episodes during the Holocene. These events have buried or destroyed many Archaic and Paleoindian alluvial sites and deflated interfluvial, upland sites. At Rodgers Shelter, a small Dalton encampment was buried by more than 8 meters of alluvium and colluvium in what is recognized as the Rodgers terrace, or Terrace-1b (Haynes 1976; Kay 1982). Dalton and San Patrice artifacts are reported in a paleosol buried 2.9 to 3.2 m beneath the surface on an open terrace along the lower Sac River in Missouri (Hajic et al. 1998; Ray et al. 1998)

Of the Dalton-yielding localities examined in this study, only one has yielded an Archaic-age radiocarbon date from a buried alluvial sequence. At the Arrowhead Ditch site (34MS174), located in a cut-bank along Dirty Creek, a mid-Holocene, likely Calf Creek feature was buried beneath 3 meters of alluvium and yielded a radiocarbon date of 5730 ± 160 B.P. An additional 1.6 meters of alluvium occurs below the Calf Creek component, but cultural materials were not observed in these deposits. The paleotopography of the Arrowhead Ditch site is not documented and Archaic-age sites may have rested on a floodplain or a terrace (Wyckoff et al. 1994). The Dalton artifacts from the Dirty Creek locality (Fig. 2) were occasionally collected from within the creek's channel or from its banks, but most came from the eroded upland terraces overlooking the creek.

The Billy Ross locality, situated along Sans Bois Creek (Fig. 2), provides evidence of Dalton occupations buried underneath a floodplain. Because the artifacts were dredged, their original depth in the floodplain is unknown. Mr. Ross has stated that several meters of sediment were removed from the creek, and that Dalton materials showed up after the last episode of dredging. Farther upstream, a radiocarbon date of approximately 1650 B.P. was produced from a midden atop 3 meters of alluvium (Lintz 1978:68-75). Mid-Holocene Calf Creek artifacts are also documented along the creek and its first terrace, but their position in the deposition sequence is not demonstrated (Neal et al. 1994).

The McKellips locality (Fig. 2), once an upland terrace overlooking the North Canadian River, is today the shoreline of Lake Eufaula. Lake action has exposed 1-1.2 m of fine, eolian sands overlying pedogenic clayey sediments. Limited testing at the McKellips locality has yet to define the source of Dalton materials, but mid-Holocene Calf Creek evidence was recovered from approximately 1 m below the surface. Based on the depth of the eolian sands, and the position of a mid-Holocene artifact, Dalton materials are suspected to exist in or atop the underlying clayey sediments. The relationship of the clayey horizon at the McKellips locality and the terrace sequence of the Canadian River is not known.

Although geological processes vary along the prairie-woodland ecotone and along the western edge of the Ozark and Ouachita mountains, all of these settings demonstrate moderate to significant alluviation in low-lying areas where



Archaeological and Palynological Locations

1) Billy Ross locality
2) McKellips locality
3) Dirty Creek locality
4) Quince site
5) Packard site
6) Yell County collection
7) Big Eddy site
8) Rodgers Shelter
9) Bonner Springs locality
10) Lembke cache
11) Sloan site
12) Brand site
13) Hawkins cache
14) Lace site
15) Ferndale Bog
16) Muscotah Marsh

Figure 2. Select Dalton sites and localities and palynological sites. Redrawn from Morris et al. 1976.

significant Dalton occupations can be expected and deflation or eolian burial in upland settings. Until deep testing strategies are undertaken, archaeologists will have to rely on those assemblages exposed fortuitously by erosion or earth moving projects. It is not likely, however, that the abundance of Dalton and other early remains in the Arkoma Basin will ever be fully understood or appreciated. This fact has and will continue to affect our models of Dalton settlement and colonization.

Paleoenvironments

If asked to envision a Dalton camp setting, most archaeologists would immediately picture a forest backdrop. This characterization of Dalton as a forest adaptation has been ingrained by a history of spectacular research in the Mississippi River Valley. The study of early Holocene environments is therefore one of the more intriguing aspects of Dalton adaptations within the Arkoma Basin. The pollen evidence discussed here demonstrates that Dalton populations in eastern Oklahoma were equally familiar with grassy environments, a condition that would potentially influence economic pursuits and settlement strategies. Because late Pleistocene-early Holocene pollen records do not exist for the Arkoma Basin, this section summarizes the pollen records from Ferndale Bog in southeastern Oklahoma and Muscotah Marsh in northeastern Kansas (Fig. 2). Essentially north and south of each other, these two sites provide long records of vegetation change and stability along today's woodland-grassland border.

Ferndale Bog is located on the western edge of the Ouachita Mountains in southeastern Oklahoma (Fig. 2). Initially studied by Albert (1981), reinvestigation of the bog has produced a continuous pollen sequence ranging from late Pleistocene to modern times (Ferring 1994). Three radiocarbon dates bracket the Dalton period at depths ranging from 2.15 to 3.17 meters below the surface. Based on sedimentation rates at the bog (Ferring 1994:109), evidence of Dalton period environments is captured between approximately 2.59 and 2.80 meters below the surface (Fig. 3).

At 3.17 meters below the surface, the earliest date (11,805 ± 145 B.P.) is associated with sediments containing pollen of the last presence of boreal conifers in the region. Early Holocene conditions are reflected by a dramatic shift in pollen frequencies, including a decrease in oak, very little pine, and the complete elimination of spruce. This loss of arboreal elements occurred concomitant with increased frequencies of Ambrosia, which peaks at 87.4% at 3.05 meters below the surface. A family of intrusive weeds, Ambrosia pollen signal landscape disturbances and vegetative change during the late Pleistocene-early Holocene transition. During Dalton times, Ambrosia is steadily replaced by Poaceae, or grass pollen, which climax at 57.8% at 2.60 m below the surface. Oak pollen frequencies do not exceed 12% during the Dalton period, hickory is no more than 0.5%, and pine frequencies do not exceed 0.5%. Birch is moderately represented, with a pollen frequency of 3.9% recovered at

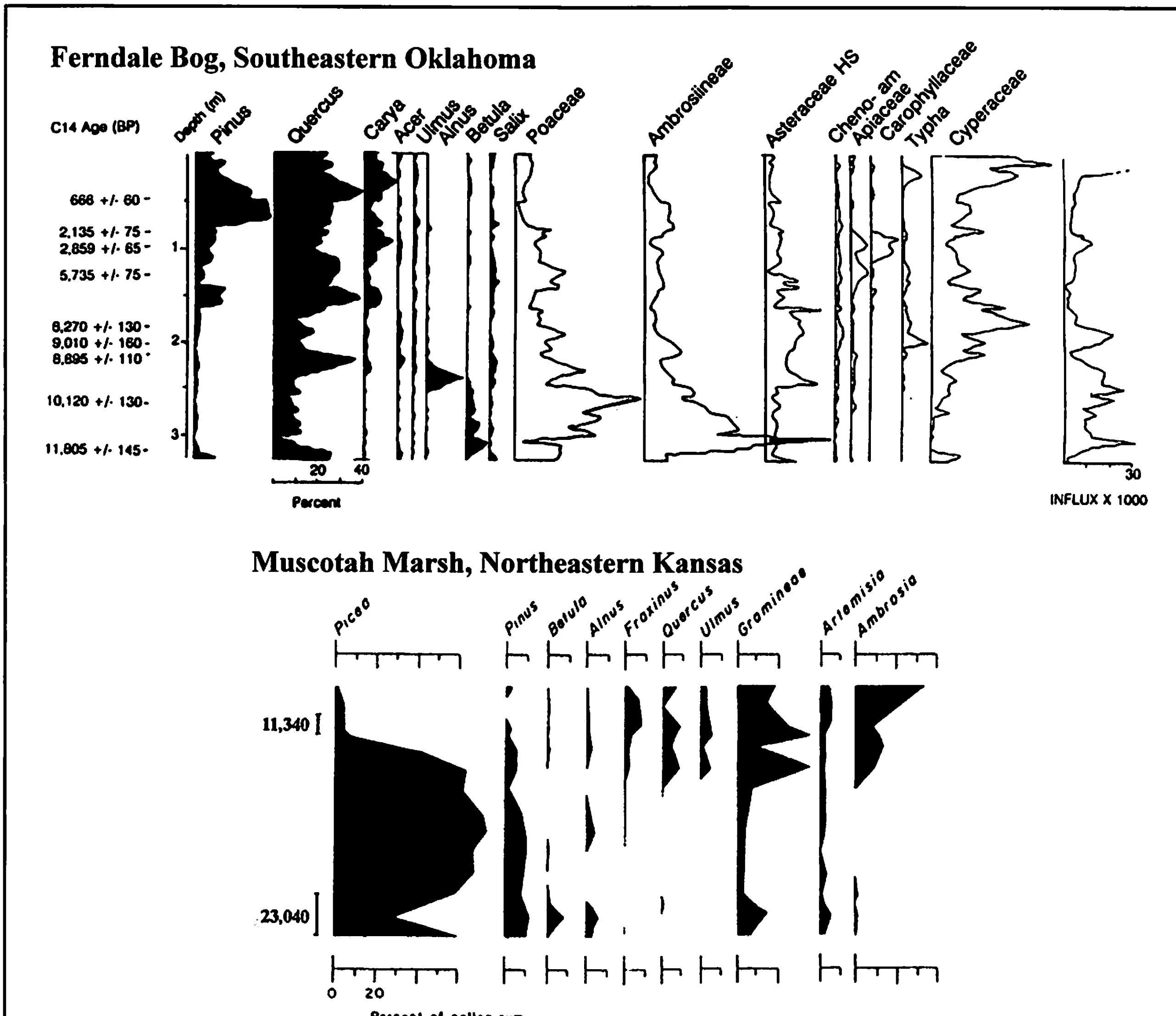


Figure 3. Radiocarbon dated pollen records from Ferndale Bog, southeastern Oklahoma, and Muscotah Marsh, northeastern Kansas. Figures adapted from Ferring 1994:Fig. 4.5 and Watts 1983:Fig. 15-8.

2.75 m below the surface (Fig. 3).

Located within the floodplain of the Delaware River, a tributary of the Kansas River in the bluestem prairie of northeastern Kansas (Fig. 2), Muscotah Marsh has witnessed a long history of study (Grüger 1973; Horr 1955; Horr and McGregor 1948). The marsh is supported by an artisian spring that is discharged atop stratified clay, sand, and gravels. Recovered from Cores A and B, Dalton-age pollen occurs between approximately 7.7 meters below surface (radiocarbon dated to 9930 ± 300 years ago) and 8.5 m below surface. A radiocarbon date of 11,340 ± 300 years ago was obtained from sediments buried 9.4 m below the surface (Fig. 3). Like Ferndale Bog, Muscotah Marsh attests to a low frequency of forest pollen and increasing grasses during the early Holocene (Watts 1983). Although the extraction of precise frequencies is hampered by a disconformity between Cores A and B, Ambrosia does not appear to fall below 70% during Dalton times (Fig. 3), whereas oak, hickory, and pine do not exceed 15% (Grüger 1973).

The Early Holocene prairie-forest boundary of Dalton times was clearly dominated by grassy, weedy steppes. The limited presence of oak pollen, a product of long distance transport, suggests that wooded areas were probably confined to drainages and perhaps scattered, well watered upland patches. The presence of Dalton groups in a prairie setting contrasts sharply with environmental data from the Mississippi River Valley in northeastern Arkansas, where Dalton groups apparently flourished in early Holocene woodlands. Based on pollen frequencies from Hood Lake, Powers Fort Swale, and Cupola Pond, Delcourt et al. (1997) summarize the vegetational character of northeastern Arkansas during Dalton times. The eastern Ozarks supported an oak-hickory savanna, with a denser beech-maple-basswood forest growing along its margins. A similar plant community probably existed on Crowley's Ridge, a chert-rich upland located between the Ozarks and the Mississippi River. Within the Mississippi Alluvial Plain, the braided stream terraces of the Eastern and Western Lowlands were vegetated with an oak-hickory forest. Unlike the early Holocene record of eastern Oklahoma, warm, moist environmental conditions were maintained in northeastern Arkansas during Dalton times.

The vegetation of the Arkoma Basin must have presented Dalton groups with opportunities and challenges unlike those in the Mississippi River Valley to the east. Wet valleys would have supported arboreal plant foods including acorns, walnuts, and other resources characteristic of oak-hickory stands. These settings would have supported deer as well as other small game associated with the Dalton diet (McMillan and Klippel 1981; Parmalee 1962). Grassy uplands in the Arkoma Basin would have attracted prairie species, perhaps even bison. At present, direct evidence is lacking that Dalton groups exploited bison in eastern or central Oklahoma but, based on early Holocene-age paleontological finds (i.e., Dalquest n.d.), the opportunity probably existed. Whether Dalton groups maintained a forest economy along the watersheds of the Arkoma Basin or mixed their subsistence with prairie resources cannot be resolved until sites are excavated that yield plant and animal remains. It is evident, however, that Dalton groups traversed the upland prairies of eastern Oklahoma (Wyckoff and Bartlett 1995).

In summary, the Arkoma Basin provided Dalton groups with a choice of several resources. Significant drainages could be followed west into the prairie-plains, north and south into chert-rich and forested mountain settings, and east into the narrow Arkansas River Valley of Oklahoma and Arkansas. Plant and terrestrial animal communities varied from forest-edge to prairie resources in the hills. The Dalton groups who frequented this setting could have maintained a forest adaptation along the watersheds, but may have ventured into the grassy hills to hunt bison and other prairie game. Such choices would potentially influence Dalton group organization, technology, and settlement within the Arkoma Basin.

Part 2
HUNTER-GATHERER MOBILITY AND THE ORGANIZATION OF LITHIC TECHNOLOGY

Concepts of Hunter-Gatherer Mobility

The study of hunter-gatherer mobility and its relationship with lithic technology has traditionally focused on diachronic change or environmental variation. My study departs from that trend to explore the settlement mobility and lithic technology of a single archaeological manifestation – the Dalton Horizon. Because extant models of hunter-gatherer mobility and technology are often explained within a framework of temporal change, or borrow heavily from a common body of research, the underlying principles of hunter-gatherer mobility and technology merit review.

In anthropological terms, mobility is defined as the relative frequency and magnitude of human movement (Kelly 1992). The degree to which groups move is evaluated with two extremes of the mobility spectrum in mind. On the high end of the mobility spectrum is nomadism. Nomadism is fluid and denotes frequent and long-range movement. On the low end of the mobility spectrum is sedentism. Sedentary societies are viewed as being stationary for long periods of time. No ethnographically known groups are entirely nomadic (constantly moving) or absolutely sedentary (permanently fixed). Rather, groups emphasize nomadic and sedentary strategies according to ecological and social constraints. Because archaeological sites are created during times of sedentism, archaeologists must rely on the nature of those occupations to infer levels of mobility. Also, because all humans move to a greater or lesser degree, mobility is a quantitative rather than a qualitative concept (Kelly 1992:49).

Attempts to quantify the mobility of ethnographically known groups have left archaeologists with an assortment of mobility "types." In their perception of hunter-gatherer movement, Beardsley et al. (1956) recognize four such types: *free wandering groups,* who have no territorial boundaries; *restricted-wandering groups*, who are constrained by territorial boundaries; *center-based wandering groups*, who return seasonally to a central base camp; and *semi-permanent sedentary groups*, who occupy a central base year-round but move it every few years. This taxonomy played an important role in the development of Dalton settlement systems (Morse 1971b). The categories were modified by Murdock (1967) who recognized fully nomadic, semi-nomadic, semi-sedentary, and fully sedentary societies. Variants of this scheme remain popular in the literature (i.e., Kent 1989). As noted by Kelly (1992:44), these categories are analytically useful, but do not capture the dynamics of mobility. Because mobility is a property of individuals, much room exists for inter-group variation. Men may range further and more often than women, and the mobility of parents and the elderly may be more restricted than nonparents or youth. Furthermore, groups may be sedentary during some seasons, and highly mobile during others.

The relative measure of hunter-gatherer mobility has served as a useful tool for exploring the relationship between settlement systems and the environment. Notable among these efforts is Binford's (1980) definition of what he refers to as "collectors" and "foragers." Based on ethnoarchaeological evidence, Binford characterizes collectors as being "logistically organized" whereas foragers "map on" to resources. The principal distinction between these two systems is that the former moves the resources to the group via logistical task groups, whereas the latter moves the group to the goods via residential mobility (Binford 1980:15).

Based largely on ethnographic knowledge about the San, the forager system is characteristic of groups who live in "patchy" environments. These resource patches may be large (e.g., a tropical forest) or small (a series of niches), but they provide the bulk of the resources necessary for daily subsistence. In these types of settings foragers will "map on" to resource patches using an encounter strategy. Foraging groups are generic (non-specialized) in their food-getting forays and return daily to a central residential base. Once a patch is exhausted of its seasonal resources, foragers relocate their residential base to a new setting. If the resource patch is large, foragers may perform several residential moves within the patch. If the resource patches are small and dispersed, foraging groups may elect to decrease in size and exploit an extended area that includes several small patches.

Foragers use two types of sites: the residential base and the location (Binford 1980:9). The residential base is the hub of daily activities, including most processing, manufacturing, maintenance, and the consumption of resources. Residential bases may be occupied for varying lengths of time, depending on how long the patch can support the group. Other factors that affect how intensively a residential camp is occupied include the distribution of critical resources within the patch (Binford 1980:7). If resources are evenly distributed, then residential camps may not be relocated relative to locations of previous use. If, however, critical resources such as waterholes or quarries are clumped within the foraging patch, then groups may become "tethered" to those settings and the same residential base may be used redundantly from season to season (i.e., Taylor 1964). Locations are used by foraging groups for extractive tasks, or the procurement of "low bulk" resources. These ephemeral sites are created by task-specific groups and may be occupied for a matter of hours.

The residential mobility of foragers is contrasted with the logistical organization of collectors (Binford 1980:10-12). Logistical organization is better suited for environments with unevenly distributed resources. Rather than depending on an encounter strategy, task groups are organized to procure a specific resource at a distant location. The task specialization of collectors creates residential bases and locations, but also generates field camps, stations, and caches. Field camps are temporary operational settings where task groups eat, sleep, and maintain their tools while they are away from the residential base. Stations are used by task groups to exchange information and detect potential resources. Once a resource is procured, caches may be used to store equipment or portions of the resource that are too heavy to return to the residential base. The residential bases and locations of foragers and collectors are expected to differ in duration of occupation, since foragers move their residences at least seasonally and, in terms of intensity, since logistical task groups procure goods for groups far larger than themselves.

Shared by both foragers and collectors, the residential base is universal among all ethnographic groups. An alternative perspective focuses on how different adaptations use the space around the residential base (Binford 1982). Outside the immediate residential area is the foraging radius. Here, resources are exploited on a daily basis and returned to camp. Within the foraging radius are locations where resources are gathered. Beyond the foraging radius is the logistical radius, an area exploited by special task groups who stay away for one or more days and in doing so create briefly occupied camp sites. This perspective helps illustrate how logistical and residential movement can be integrated into a common settlement system.

To demonstrate the relationship between environmental forces and mobility strategies, Binford (1980) cross-tabulates the settlement data of Murdock (1967) and the environmental index provided by Bailey (1960). Bailey uses "effective temperature" (ET) as a measure of solar radiation, with high ET values (21-26) representing lush forests, moderate ET values (10-15) representing temperate settings, and low ET values (8-9) representing Arctic conditions. This exercise shows high levels of settlement mobility in lush forests and Arctic settings, and lower levels of mobility in temperate forests and deserts that experience pronounced seasonality. One of the causal factors in this relationship is the reliance on stored foods or waterholes in areas of extreme seasonal variation.

The ecological-settlement relationship demonstrated by Binford (1980) and Kelly (1995) is not unexpected. Where resources occur homogeneously or are highly diverse, nearly all of a group's needs can be "encountered" within the foraging radius on daily excursions. This intense level of exploitation, however, quickly depletes local resources and the residential base must be moved. Where resources are more scattered, foraging is most profitable when centralized aggregations are made and specialized groups are dispersed to retrieve those resources. In this case the foraging radius is maintained and the residential base occupation prolonged. Because resources become more clustered in space and more constrained in their seasonal availability from the equator to the Arctic, the patterns observed between ecological settings and settlement systems reflect the logical relationship between the forager-collector continuum and resource distributions (Kelly 1995:120).

Concepts of Lithic Technology and Its Organization

The study of lithic technological organization is a body of research dedicated to the acquisition, manufacture, use, transport, reuse, and discard of stone tools. Together, these behaviors constitute an organization that is responsive to environmental conditions affecting resource predictability, distribution, periodicity, productivity, mobility, size and patchiness of resource area, and risk. This line of study assumes that the interplay between technological organization, people, and the environment encourages problem solving strategies that best support human subsistence and is therefore closely associated with evolutionary ecology and optimal foraging theory (Nelson 1991:57-60). Critics of the study of technological organization (i.e., Odell 1996) have focused on the vague nature of certain concepts, which, in the evolution of their use, have become convoluted and even contradictory.

The traditional strategy for evaluating technological organization is the dichotomy between curated and expedient tool use (Nelson 1991:62). The curation concept was introduced by Binford (1973:242-244) to explain the functional relationship between tool use and discard. Binford's definition of curation denotes tool transport, preservation for future use, and efficiency. The concept has expanded over the years with archaeologists substituting and integrating such terms as transportability, longevity, conservation, and maintainability. Widespread use and interpretation of the concept has left many researchers without a clear understanding of curation (Chatters 1987:341).

Curation is generally accepted to denote caring for tools via transport, reshaping, and caching (Nelson 1991:63), and maximizing the utility of tools by carrying them between successive settlements (Binford 1979:263). Curated tools indicate that specific resources and tool needs are anticipated. A central feature of curated tools is argued to be advanced manufacture, which anticipates that raw material and/or production time will not be available at future sites. Advanced manufacture is the production of tools before planned tool-using activities. Because every tool must be made before it can be used, advanced manufacture must be approached as an issue of scale. For example, a distinction can be made between tool-requiring problems that are at hand and tool-requiring problems that are anticipated but not yet manifest. Odell (1996:54-56) suggests that lithic workshops and caches be considered when assessing levels of advanced manufacture. Caches are a reasonable expression of curation. Put away for future use, they demonstrate long-range planning as a risk abatement strategy (Binford 1979:257). Lithic workshops, recognized by an abundance of debitage and the relative absence of finished tools, are a less practical measure since it is difficult to distinguish refuse generated for expedient tools from refuse generated for curated tools, both of which may occur at the same site during a single occupation (Stevenson 1985).

The transport of implements from location to location in anticipation of tool-using activities also captures Binford's definition of curation. Bamforth (1986), on the other hand, argues that it is not the task but raw material availability that drives people to curate tools. The transport of stone tools is heavily influenced by the relationship between raw material sources, which are fixed in space, and other resources that require stone tools but may be located away from the raw material source. This basic problem would require any group to transport their tools to a greater or lesser extent (Nash 1996:85).

To address the universal aspect of curation, archaeologists have adopted the concept of utility to measure levels of curation within and between assemblages. Utility is an abstract concept and can be used by archaeologists only to refer to physical properties of a tool such as mass and functional versatility (Nash 1996:95). These efforts realize that curation may be employed more or less extensively, different types of tools elicit different levels of curation, and various aspects of curation (e.g., transport and reuse) may be emphasized depending on the situation (Nelson 1991:88). For example, Shott (1989:24) measures curation by the ratio of realized to potential utility, whereas Kuhn (1989) distinguishes between expended and residual utility. Both of these measures recognize stone tools as containers of a physical property that is quantifiable. The expended utility of a tool is that which has been realized. The residual utility is the tool's potential. The amount of residual utility left in a tool when it is discarded signals the end of its potential and is a relative measure of "curation."

Expedient tool use is defined as the manufacture, use, and discard of tools at the same use location and is associated with foragers using an encounter strategy. The rationale behind this relationship is that in lush environments there exists an equal chance of encountering a variety of resources and less need to predict what tools will be needed (Ebert 1992:34). Nelson (1991:64) summarizes three conditions that must be met for expediency to be practical:

1) Availability of raw material via quarries or caches;
2) Available time to manufacture tools; and
3) Long-term occupation or regular reuse of sites to exploit resource availability.

These conditions stress the roles of time and raw material availability in tool use. Binford's (1979:258) argument that lithic acquisition is a low-cost affair embedded into the subsistence strategy is contrasted by Bamforth's (1986) emphasis on raw material availability as the principal conditioner of tool use (see also Andrefsky 1994; Gould and Saggers 1985). The fact that both settlement strategies and scarcity-induced economizing behavior may encourage stone tool conservation is a fundamental problem, but Odell (1996:76) suggests that the latter condition may be recognized by the use of broken tools.

Again, as we witnessed with Binford's (1980) collector and forager taxonomy, expedient and curated technologies are not mutually exclusive but are planned options that suit different needs (Nelson 1991:65). An example of the interplay between curated and expedient technologies is seen in Nelson's (1991) first condition. Caches are characteristic of curating, yet they can be used expediently. Consider the bifacial cores used by Plains groups (Boldurian 1991; Hartwell 1995). These are curated sources of raw material, but the flakes they produce can be made, used, and discarded at one location. On the other hand, an informal tool can be made and used at one place, but if the individual decides to carry that tool with him or incorporate it into his toolkit, then it becomes a curated item (Nelson 1991:65).

To better describe the variables that distinguish curated and expedient technologies archaeologists have begun to recognize tool design. Design theory assumes that various constraints will be solved via technological means (Pye 1964), and that by exploring the design variables emphasized by different tools archaeologists can better recognize the problems perceived by the tool's user. Design variables are conceptual aides that refer to physical qualities of the tool and include portability (Hayden 1987; Parry and Kelly 1987; Nelson 1991; Shott 1986; Torrence 1983), reliability and maintainability (Bleed 1986; Torrence 1989), flexibility and versatility (Shott 1986; Nelson 1991), and longevity and replacement (Hayden 1987; Kuhn 1989). The constraints realized by hunter-gatherers included task constraints (e.g., time available), raw material and technological constraints (e.g., repair, resharpening, and replacement costs), sociological constraints (e.g., mobility), and prestige and ideological constraints (Hayden et al. 1996:10). Each of these constraints should stress certain design variables and de-emphasize others, thus providing a range of tool-using options rather than the curated/expedient dichotomy.

The emphasis on maintainable or reliable tool designs is argued by Bleed (1986) to reflect the predictability of resources. Maintainable designs are geared toward a variety of conditions and are expected in generalist forager situations or when tool size and weight are important constraints. The logic behind this expectation is that foragers exploit relatively unpredictable resources on a continuous schedule and can afford to miss food-getting opportunities because of tool failure. Maintainable systems are characterized by light, easily repaired tools with modular parts that are expected to fail in specific ways and can be retooled to function in a variety of tasks. Evidence of tool maintenance may be the ratio of haft to blade length (Shott 1986:44) or, more reliably, alternate beveling (Odell 1996:59-62). Shott (1986:19) describes the multifunctional characteristic of maintainable tools as versatility, which is traditionally measured by the number and type of edge forms on an individual tool (i.e., Knudson 1983), but can be extended to include any phenomenon (e.g., breakage types, use wear) that reflects the potential for more than one application.

Reliable designs are associated with logistically organized groups whose subsistence pursuits are intermittent and high-risk (Bleed 1986:743). Because high-risk environments provide brief windows of opportunity that only occur seasonally, a hunter's tools must function appropriately. Reliable systems are characterized by sturdy, "overdesigned" tools with standardized back-up parts that are labor expensive and relatively heavy. The heavy design of reliable tool systems may cause decreased portability and encourage caching (Nelson 1991:68).

Portable designs are expected when raw material sources do not complement task locations and tools must be transported to the site. By relaxing carrying costs, portable designs release energy for other pursuits. Portable tools are described as lightweight, small, and resistant to breakage

(Nelson 1991:74). It is argued that tool portability and residential mobility are directly related, and that portable toolkits are recognized by the ratio of tool production debris to tool maintenance debris at a site (Binford 1979). However, Torrence (1989:61-62) notes that portability is influenced by the daily routine in addition to residential moves and Hayden et al. (1996:41) observe that virtually all chipped stone tools are small and lightweight.

Versatility and flexibility refer to applications of individual tool classes and generally equate to multifunctional tools or to a tool's utility (Shott 1986:19), 35). The number of distinct functional attributes or segments can be a meaure of a tool's verstility. Flexibility increases as the number of task applications increase and denotes a wider range of applications than versatility. For example, a scraper with two edge units designed for different mediums is more versatile than a scraper with only one edge unit or several edge units of the same type. A flexible design differs in that through simple and easy tool modification it can accomplish more than one task (Nelson 1991:70). In this case, a tool that can be used as a projectile point as well as a scraper would be more flexible than a tool that is designed to function only as a scraper. A common example of a flexible design is the bifacial core capable of producing a variety of formal tools (Nelson 1991:74). High residential mobility should favor a decrease in the number of formal tool classes needed to perform a variety of tasks and an increase in tool versatility and flexibility. Hayden and others (1996:13) consider the concepts of versatility and flexibility too vague and recommend that archaeologists refer to these properties with the more established term, multifunctionality.

Kuhn (1989, 1994) has formulated a model of artifact discard and replacement that complements tool longevity and curation. By describing tool use-life in terms of potential, residual, and expended utility, an index of residentially mobile and logistically organized hunter-gatherers is created. Potential utility is the amount of work planned into a tool's design. Residual utility is the amount of work perceived to remain in a tool. The expended utility is that which has been used. How much residual utility a tool possesses when it is discarded reflects the mobility strategy within which the tool was used, but may also be influenced by raw material availability. Residentially mobile foragers are expected to replace their tools on a "replace when exhausted" schedule because their mobility limits how many back-up tools can be kept on hand (e.g., Shott 1986). Logistically organized groups procure food via task groups who are not required to carry their total artifact inventory and can afford to keep spares, backups, and preforms in abundance. Further, because logistically organized groups are associated with high-risk environments, they are expected to replace their tools using a "fear-of-failure" strategy (see also Bousman 1993:77).

Kuhn (1989:43) notes that this relationship may seem to contradict existing concepts of hunter-gatherer mobility and technological organization. In particular, Binford (1977) presents logistically organized groups as users of "curated" technologies, whereas Kuhn (1989) argues that residentially mobile groups prolong the use-lives of their tools to a greater extent. As Odell (1996:75) points out, this contradiction was also encountered by Shott (1986:43), who characterized Plainview assemblages as curated although their users were certainly more residentially mobile than the Nunamiut. However, in Kuhn's (1989) perspective, the frequent replacement of stone tools may better insure tool longevity than using them until they wear out. The individual implements of logistically organized groups will show less renewal and repair because they were replaced earlier in their use-lives.

The concepts of technological organization reviewed here have focused on diachronic culture change or have compared hunter-gatherer technologies from drastically different environments. This study attempts to narrow the scope of such lithic analyses to address Dalton interassemblage variability and settlement. Morphological variation and breakage patterns demonstrate the multifunctional nature of Dalton points. The Dalton adze and Quince scraper are discussed in terms of tool portability. Finally, the concept of potential, expended, and residual utility (Kuhn 1989, 1994) is applied to Dalton stone tool use and discard in eastern Oklahoma.

Part 3
THE ARCHAEOLOGY OF THE DALTON HORIZON

The Dalton Horizon

The Dalton Horizon is represented primarily by a projectile point or hafted knife form that occurs throughout the southeastern United States and in portions of the Midwest and eastern prairie (Goodyear 1982:382; Morse 1997:124). The chronological position of the Dalton Horizon is traditionally placed between 10,500 and 9900 years ago (Goodyear 1982). The timing of the Dalton Horizon is challenged by recent studies that suggest that Dalton populations and technology developed directly out of the Clovis or Gainey cultures (Morse et al. 1996:327). The hunter-gatherer populations who used Dalton material culture around the Ozark Mountains and within the Mississippi River Valley were well established in their local environments and are known to have hunted deer, squirrel, raccoon, turkey and other game, as well as riverine resources such as turtles and fish. Plant foods such as hickory nuts and acorns were also collected in upland settings (McMillan and Klippel 1981;

Parmalee 1962). Investigation of the Dalton Horizon has emphasized the settlement patterns used by these groups. This chapter reviews the geographic distribution of the Dalton Horizon, evidence of its temporal position, constructs of Dalton settlement, and the study of Dalton technology, each of which relate to the settlement mobility of Dalton groups in eastern Oklahoma. Finally, test implications are constructed for three hypothetical Dalton settlement models.

Geographic Distribution

First recognized in Missouri by Chapman (1948), the distribution of the Dalton Horizon now extends into Arkansas, Louisiana, Mississippi, Alabama, Florida, Tennessee, Kentucky, Georgia, South Carolina, North Carolina, Illinois, Kansas, Oklahoma, and Texas (Anderson and Sassaman 1996; Bense 1994; Johnson 1989; Story 1990). The diversity of landscapes and environments used by Dalton populations indicates that the Dalton Horizon cannot be approached as a single adaptation, but rather as a myriad of local adaptations that used a similar but sometimes regionally distinctive material culture (Ensor 1987). Dalton site distributions weigh heavily upon the study of Dalton origins and settlement and introduce the potential for significant clinal variation within the Dalton Horizon.

The distribution of Dalton and other early remains has been used by Anderson (1990) and Gillam (1996) to explore the Paleoindian colonization and adaptive chronology of the central Mississippi River Valley. In short, Anderson (1990:185-196) identifies the central Ohio, lower Cumberland, and central Tennessee river valleys as "staging areas" for the colonization of the southeastern United States. As founding populations increased, group fission occurred and adjacent areas were colonized. Gillam (1996) has recognized the Crowley's Ridge area of northeast Arkansas as another staging area. There, early and middle Paleoindian populations relied on a small region surrounding their primary source of tool stone. According to Gillam (1996:281), "This core cultural area represents a 'springboard' from which the occupation of adjacent areas originated." The Dalton "efflorescence" that followed is seen as a time of increased populations and more effective use of local plant, animal, and mineral resources.

The distribution of Paleoindian artifacts provides an opportunity to observe long-term change in human land-use and construct scenarios for pilgrimage. Gillam (1996) argues that Crowley's Ridge served as a staging area for the colonization of the surrounding area. If the availability of lithic resources was the primary criterion for early Paleoindian settlement in a region, then appreciable numbers of fluted points should be expected around the chert-rich Ozark and Ouachita mountains. To the contrary, only a handful of early Paleoindian finds are reported from eastern Oklahoma (Hofman and Wyckoff 1991), whereas several hundred Dalton points are documented from a small number of collections (Wyckoff and Bartlett 1995; Wyckoff and Lail n.d.). O'Brien and Wood (1998:73) and Lopinot et al. (1998:295) report extraordinary numbers of Dalton points from Missouri as well, perhaps even more so than have been documented from northeast Arkansas. Sampling issues aside, this generalization could be used to argue that significant early Paleoindian occupations did not occur in the Ozark and Ouachita mountains and that Dalton populations in eastern Oklahoma originated from a founding population in the central Mississippi River Valley or elsewhere. There is a lack of local, dated evidence to suggest this is the case (i.e., Wyckoff 1985, 1989), but the possibility is supported by a large body of outside research findings (i.e., Anderson 1990, 1996).

The origin of the Dalton groups who settled in eastern Oklahoma would influence their adaptive character. An *in situ* development of the Dalton Horizon in eastern Oklahoma would favor an adaptation that was familiar with both the forest and prairie resources of the region. On the other hand, if forest-adapted Dalton groups migrated into eastern Oklahoma, then strong adaptive parallels should exist between Dalton groups from eastern Oklahoma and others farther east. The origin of the Dalton populations that inhabited eastern Oklahoma is beyond the scope of this thesis, but there is increasing interest in the ethnicity and boundary maintenance among Paleoindian groups along the prairie-forest border (i.e., Johnson 1989; Lopinot et al. 1998a; Wyckoff and Bartlett 1995; Wyckoff 1999). The colonization model offered by Anderson (1990) adds the frontier concept and its role to the study of Dalton groups who occupied the prairie of eastern Oklahoma, Kansas, and Texas.

Temporal Position

As summarized by Goodyear (1982:385-389), radiocarbon dates for the Dalton Horizon have come from a number of mixed cave deposits that also contained notched projectile points. Based on such sites as Graham Cave and Arnold Research Cave in Missouri (Crane and Griffin 1956:667, 1968:69), and the Stanfield-Worley rockshelter in Alabama (DeJarnette et al. 1962), archaeologists during the 1950s and 1960s accepted that the Dalton Horizon occurred between 10,000 and 8000 years ago. This time frame was challenged when several hearths were unearthed from an alluvially buried terrace in front of Rodgers Shelter in Missouri. Two radiocarbon dates of 10,530 +/- 650 B.P. and 10,200 +/- 330 B.P. were reported (Crane and Griffin 1972:159). In his overview of the chronological position of the Dalton Horizon, Goodyear (1982) accepted 10,500 B.P. to represent the approximate beginning date for the earliest Dalton manifestations. According to Goodyear (1982:389), the well-documented contents of pure side-notched and corner-notched assemblages and their radiocarbon dating indicate that by approximately 9900 B.P. Dalton points were probably no longer made.

Although the radiocarbon dates from Rodgers Shelter do not suffer from the severe post-depositional processes characteristic of cave deposits, they do exhibit unreliably large sigmas. Ray et al. (1998:77) have published a more securely bracketed radiocarbon date of 10,185 $^{+}$ 75 B.P. associated with Dalton and San Patrice points from the Big Eddy site, another deeply alluviated terrace site in southwestern Missouri. More recently, Hajic et al. (1998:Table 7) report a total of six radiocarbon dates, ranging from 10,470 ± 80 to 10, 185 ± 75 B.P., from the Dalton and San Patrice-bearing paleosol at Big Eddy.

Despite these new radiocarbon dates that support Goodyear's (1982) placement of the Dalton Horizon between 10,500 and 9900 years ago, a growing number of scholars contend that the Dalton Horizon developed out of an eastern form of Clovis (Story 1990:190) or "evolved" directly from the Clovis or Gainey technologies (Anderson et al. 1996:14; Morse et al. 1996:327; O'Brien and Wood 1998:361). The notion that Dalton technologies may have developed out of fluted point complexes has a long history (i.e., Chapman 1948). Early comparisons, however, were generally based on a shared lanceolate point form and did not explicitly link Dalton and Clovis technologies. In the absence of radiocarbon dates, archaeologists have used cross-dating and lithic technology to infer the close relationship between Clovis and Dalton.

According to Morse (1997:134) and Morse et al. (1996), the pursuit of modern species by Dalton groups indicates that the Dalton Horizon must date after 10,900 to perhaps 10,800 years ago. The end of the Dalton Horizon is marked by the appearance of side-notched biface technologies. Driskell's (1996) reinvestigation of Dust Cave in northwest Alabama has yielded a series of early radiocarbon dates, ranging from 10,490 ± 360 B.P. to 10,330 ± 120 B.P., from the side notched-bearing levels. According to Morse et al. (1996:330), Dalton materials do not occur with early side-notched points in northeastern Arkansas and southeastern Missouri and must therefore be older. In short, because Dalton groups did not exploit megafauna, and because Dalton technologies must predate early side-notched forms[1], Anderson et al. (1996:14), Morse (1997:134), and Morse et al. (1996:330) place the Dalton Horizon between 10,800-10,700 and 10,200 years ago. O'Brien and Wood (1998:80) suspect that the Dalton Horizon began still earlier, around 10,900 years ago. It is important to note, however, that Driskell (1996) contends that the early side-notched component at Dust Cave dates no earlier than 10,000 years ago, and that the earlier dates are a result of localized deflation in some areas of the site (Boyce Driskell, personal communication, 1999).

The technology of Dalton and Clovis projectile point manufacture is also cited as evidence that Dalton developed directly from Clovis. According to Bradley (1997:57), the larger Dalton points from the Sloan site resemble Clovis points in outline, size, and margin grinding. Significant variation exists, however, in the later stages of projectile point manufacture and reuse. Most importantly, Dalton points are pressure rather than percussion flaked, are not morphologically fluted, and exhibit distinctive beveling and serration. Although Bradley (1997:57) argues for an *in situ* technological development of Dalton points directly out of a Clovis technology, he notes that Paleoindian styles on the High Plains, such as Goshen/Plainview and Folsom, may also share a Clovis origin. In this light, the Dalton Horizon may share no more of a relationship with Clovis than do a number of Paleoindian complexes in North America.

The Dalton materials studied in this thesis were not recovered from datable contexts. Without more compelling evidence, however, this thesis assumes that they were deposited during the traditional time frame of 10,500 to 9900 years ago (i.e., Goodyear 1982). The only radiocarbon dated Dalton component from eastern Oklahoma is the Packard site (Wyckoff 1985), where a single AMS date of 9630 +/- 100 B.P. was obtained from the lower part of the Dalton-bearing deposit (Wyckoff 1989). Although the potential exists that Dalton occupations are slightly younger in Oklahoma than they are at Rodgers Shelter or the Big Eddy site in Missouri, this has not been demonstrated by a series of reliable radiocarbon dates.

Adaptation Type

The intermediate temporal position of the Dalton Horizon has, in part, influenced how archaeologists conceptualize Dalton adaptive strategy. In his overview of Dalton research in northeast Arkansas, Morse (1997:125) expresses that the history of investigations he led were an attempt to go beyond the "were Dalton points Archaic or Paleoindian?" rut to interpret Dalton behavior. Since that time, the Dalton Horizon has maintained an ambiguous position between Paleoindian and early Archaic adaptations (Goodyear 1982:382). Because this thesis addresses settlement and mobility, and because human settlement and mobility strategies are historically associated with adaptation types, it is necessary to review the position of the Dalton Horizon in the Paleoindian to Archaic transition.

The study of long-term prehistoric settlement and mobility patterns has focused on the transition from highly nomadic hunter-gatherers to semi-sedentary horticulturalists, with human mobility generally decreasing through time. Two processes that have significantly influenced settlement practices over the past 12,000 years include the transition from late Pleistocene to early Holocene biotic communities and, approximately 9000 years later, the intensification of horticulture. The shift away from Pleistocene environmental conditions is afforded a causal role in the development of regional adaptations that focused on local resources (i.e., Braidwood and Willey 1962). Traditionally, this shift is recognized archaeologically in terms of the transition from "Paleoindian" to "Archaic" adaptations, both of which are used to describe the Dalton Horizon.

The Paleoindian characteristics of the Dalton Horizon include a continuation of lanceolate biface forms (Mason 1962:233), the selection of high-quality lithic raw materials (Gillam 1996:280), and the use of ochre in mortuary practices (Morse 1997:51). Further, similarly dated complexes on the Plains, such as Folsom, Plainview, and Cody, are considered to represent fully Paleoindian adaptations. The Archaic traits of the Dalton Horizon include a reliance on small, modern animals (McMillan and Klippel 1981; Parmalee 1962), an emphasis on bifacial knives rather than fluted missiles (Goodyear 1982:383), and the development of regional territories (Morse 1997). Early side-notched forms that were partly contemporaneous with Dalton (i.e., Driskell 1996; Wyckoff 1985) are considered to represent early Archaic technologies.

The late Pleistocene-early Holocene adaptations of the eastern United States are discussed by Meltzer (1988) and Meltzer and Smith (1986). Those works explicitly address the "Paleoindian" and "Archaic" concepts in relation to the eastern fluted point tradition. A distinction is made between plains and tundra adaptations that involved a specialized subsistence pattern and forest adaptations that used a generalized subsistence pattern (i.e., Dunnell 1980:81). Specialization occurs only in certain ecological settings that are characterized by low diversity, species-poor environments where there is an abundance of individuals of a single taxon. Further, specialized hunters require a prey that is large, abundant, gregarious, and predictable and provides a high energy content per unit of weight (Jochim 1981:39). All of the 16 ethnographically known specialists of North America (i.e., Murdock 1967) lived in treeless, monotypic, low-diversity environments such as the Great Plains. Generalist adaptations can use a resource independent of its reproductive strategy, social behavior, size, abundance, or predictability, and a group's success is relatively independent of a single resource (Hayden 1981:347). Highly diverse and species-rich environments, such as forests, lend themselves to generalist adaptations (Meltzer 1988:5-6).

The specialist adaptations observed on the Plains, where lanceolate projectile point complexes are associated with extinct megafauna (i.e., Frison 1991), represent the hallmark of big-game hunting, "Paleoindian" adaptations. As reviewed by Kelly and Todd (1988), the use of exotic stone, transportable toolkits, and the highly mobile nature of their prey indicates that Paleoindians were "technology-oriented." As megafauna populations declined and groups settled into their local environments, a "place-oriented" strategy developed. The relationship between hunter-gatherer populations and megafauna is less pronounced in the Eastern Woodlands where human associations with mastodon (Graham et al. 1981; Brush and Smith 1994), ice-age bison (Clausen et al. 1979), and giant tortoise (Webb et al. 1984) are rare. In contrast to Plains settings, Meltzer and Smith (1986:3) suggest that Paleoindian and Archaic-age subsistence strategies in the Eastern Woodlands demonstrate more continuity than discontinuity (see also Meltzer 1988). As summarized by Anderson (1990:202-204), it is difficult to accept that lithic sources, biotic patches, and potential aggregation sites on the landscape did not influence recurrent occupations, and the demonstrated reuse of critical physiographic features by Paleoindian and early Archaic-age groups suggests that these populations were indeed "place-oriented."

According to Meltzer and Smith (1986:19), without evidence that discontinuity exists in the subsistence patterns of late Pleistocene-early Holocene groups in the Eastern Woodlands, little can be gained from characterizing Dalton as a distinct specialized or transitional adaptation. Their argument, however, is a generalization about subsistence patterns and does not apply directly to settlement strategies. In those terms, Dalton adaptations were transitional between fluted point complexes and those people using early side-notched forms. An increase in range and the use of upland settings are recurring aspects of late Paleoindian and early Archaic-age settlement in the eastern United States (Anderson 1990:201), and the Dalton Horizon was part of early and significant changes in land use (Gillam 1996; Walthall 1998b). For these reasons, it is useful to recognize the Dalton Horizon as a pivotal adaptation during the transition from Paleoindian to Archaic settlement strategies.

Dalton Settlement and Mobility

As noted by Schiffer (1975a:103), the study of Dalton settlement patterns in northeast Arkansas constitutes an early reaction to the concept that Paleoindians could be classified as simply "free wanderers" or "nomads" until the sudden emphasis on plant foods encouraged more sedentary lifestyles (i.e., Childe 1951). Before this, archaeologists in the Southeast were influenced by Caldwell's (1958) "primary forest efficiency" argument which, borrowing from evidence on the Plains, characterized Paleoindian and Early Archaic groups as unsettled hunters who lived in a plant-rich environment but had not learned how to use the available resources. Dalton site distributions in northeast Arkansas also served as a platform for the combination of ethnographic analogy and one of the benchmark classifications of hunter-gatherer mobility (Beardsley et al. 1956). Contrary to previous constructs that emphasized hunting, the character and distribution of Dalton sites encouraged archaeologists to recognize the now familiar dichotomy between relatively long-term residential sites and short-term activity camps (Smith 1986:16).

The investigation of Dalton settlement systems began in 1961 when James Ford initiated a survey of early sites in the Arkansas-Mississippi delta and identified 436 Dalton points (Ford 1961; Redfield 1971). A brief hiatus of investigation ensued and ended in 1967 with the creation of the Arkansas Archeological Survey (Morse 1975a). Under the direction of Dan Morse, approximately 250 early sites were documented in northeast Arkansas and by 1969 a model of Dalton settlement (Fig. 4) was developed (i.e., Morse 1971b).

The original Dalton settlement hypothesis was based on work done in the L'Anguille Basin in northeastern Arkansas. The hypothesis was intended to provide direction for research and generate predictions relevant to the relationship between tool classes and site function (Morse 1975a:113). The largest site recognized in the basin was the Lace site (Fig. 2) where Dalton artifacts were numerous and diverse (Redfield and Moselage 1970). The magnitude of the Lace site suggested intensive use over a long period of time. More often, Dalton sites in the area were much smaller and only produced a part of the total inventory observed at Lace. An example of the more common Dalton site was Brand (Goodyear 1974), where tools implied an emphasis on hunting and butchering activities. According to Morse (1971b:7), this scenario was better characterized as a combination of "restricted" and "central-based" wandering (i.e., Beardsley et al. 1956:136-138).

The settlement pattern envisioned for Dalton groups was ethnographically supported by Campbell's (1968) description of the late 19th century Tuluaqmiut populations of Alaska. Morse (1971b:7) acknowledged the drastic ecological differences between the Arctic prairie and the Lower Mississippi River Basin, but his emphasis was on the territorial organization of the Tuluaqmiut and their use of residential base camps and smaller, seasonal extraction camps. The Dalton equivalent was a use of base settlements, hunting or butchering camps, food collecting and processing camps, quarries, and cemeteries (Morse 1977:156, 1997:130; Morse and Morse 1983:81). Base settlements were expected to be large and diverse locations, where most or all members of a single band lived for part or most of the year. Activities at base camps should involve tool manufacture and whole kin, or domestic, affairs. The presence of adzes at base camps may reflect the construction of relatively permanent structures or dugouts (Morse and Goodyear 1973:320). In contrast, extraction-oriented camps were expected to reflect male or female task groups. The only tools manufactured at these satellite sites should relate to, for example, the procurement of game, in which case end scrapers, adzes, preforms, or new tools associated with skin preparation, woodworking, or general tool manufacture should be absent.

Morse (1975a:115; 1977:150) emphasized that plant and animal foods were available year-round, and that the decision of which resource to exploit would be resolved by using task groups rather than frequent subsistence-driven residential moves. According to Morse (1975a:116), "A relatively permanent year-round settlement base from which 'work parties' originated would seem to be more logical than shifting nuclear families." Summer-only base settlements are not deemed feasible as resources occur rather

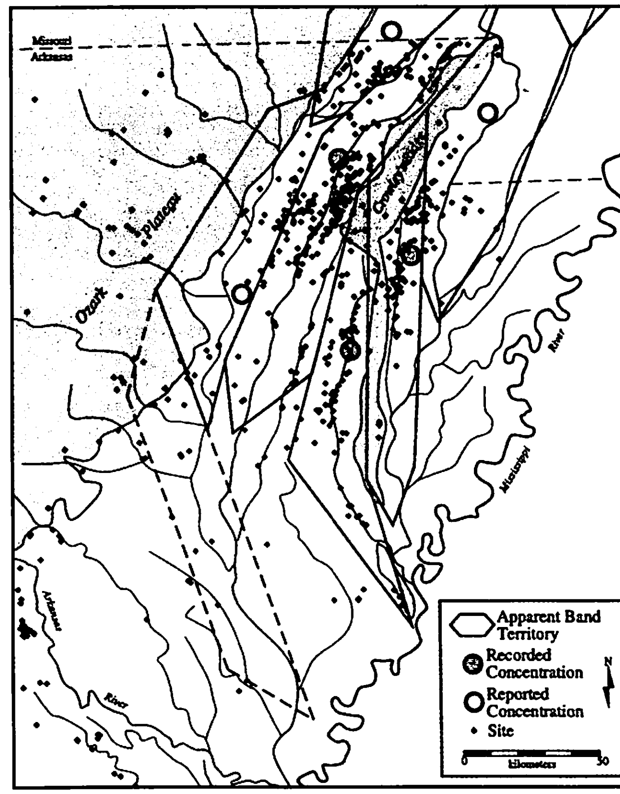


Figure 4. Northeast Arkansas Dalton sites and Morse's concept of Dalton band territoriality. Adapted from Gillam 1996:Fig. 4.

ubiquitously, and winter aggregations are not expected when resources are scarce (Morse 1977:155).

The distribution of large/diverse and small/specialized sites (within each major drainage), and the use of cemeteries further led Morse (1971b:10) to propose a series of territories in northwest Arkansas. Because rivers in the region are oriented north-south and are separated by swamps, Morse (1975a:113, 1977:153) argued that northeast Arkansas' topography favored north-south rather than east-west travel and that, ethnographically, drainages strongly conditioned movement and settlement arrangement (i.e., Anderson and Hanson 1988; Flannery 1976; Jochim 1976). In other words, drainages were seen as natural cultural boundaries within which distinct Dalton bands were supported year-round (Morse 1975a:114). Morse (1975a:114,118) did not see the logic of an entire group moving to a new base camp unless a significant harvest was predicted that required male and female cooperation. However, Morse (1975a:118) tests the limits of this drainage-specific hypothesis when constructing examples: "There may have been seasonal trips from the Black River floodplain up a stream valley of the adjacent Ozark Highlands. The Strawberry River, for instance, is a prolific stream for fish, and bass and sunfish spawn in its upper reaches around May and June."

According to O'Brien and Wood (1995:166), little evidence supports Morse's Dalton settlement hypothesis.

Researchers have challenged the drainage-specific scenario based on raw material availability and the distribution of raw material types, particularly Pitkin chert from the Ozarks, across the Mississippi River Basin (House 1975; Price and Krakker 1975; Schiffer 1975a). But, according to Morse, each major drainage contains portions of Crowley's Ridge and the movement of Pitkin chert "is irrelevant to a discussion of band territories since individuals can cross territories to obtain such a resource" (Morse 1975a:117, 1977:153). Trade and visitation could also move quantities of Ozark chert from the Dalton "hinterland" (Morse 1977:153) into the lowlands and would blur any perceptible differences between different Dalton groups (Morse and Morse 1983:82).

Morse's (1971b) Dalton settlement construct played a significant role in the Cache River project where Schiffer (1975a,b) was able to suggest an alternative explanation for the distribution and character of Dalton sites in northeast Arkansas. Of particular interest to Schiffer was the use of ethnographic analogy, seasonal resource distributions, and site formation processes. A model of seasonal movement across major physiographic boundaries challenged the Dalton settlement hypothesis of virtually sedentary bands occupying specific drainages (Fig. 5).

In contrast to Morse's (1971b) use of a single ethnographic analog, Schiffer (1975a) proposed that Dalton

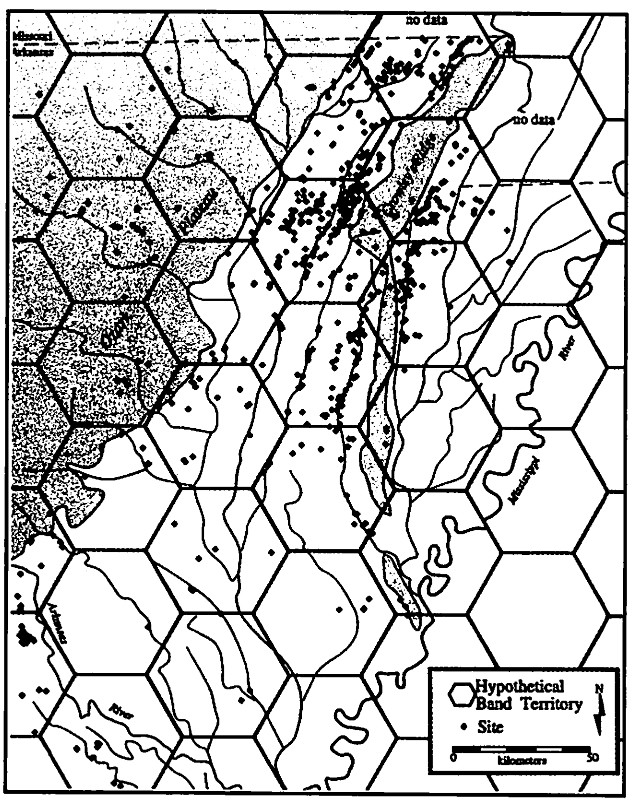


Figure 5. Northwest Arkansas Dalton sites and Shiffer's concept of Dalton band territoriality. Adapted from Gillam 1996:Fig. 5.

settlement systems could be better examined by considering a composite of ethnographically known hunter-gatherers. Because contemporary foraging groups do not occupy environments similar to northeast Arkansas during the early Holocene, archaeologists must identify and use the general principles of forager behavior in different settings.

Two questions challenge Morse's (1971b) model: 1) does each river basin (or territory) provide similar resources that would support a band's annual needs, and 2) would seasonal variation support a relatively fixed base camp? In regard to the first question, Schiffer (1975a:105-106) argues that lithic resources do not occur within each drainage and that the presence of both Ozark and Crowley's Ridge chert in the L'Anguille Basin (i.e., House 1975:90) demonstrates that Dalton groups had access to both regions. Further, the diversity of plant and animal remains recovered from upland sites such as Rodger's Shelter and the Stanfield-Worley rockshelter would have required scheduling and contrasts the emphasis on meat implied by Morse's (1971b) hunting/butchering and extraction sites, which Morse (1997:128) believes account for approximately 95% of the Dalton sites recorded in northeastern Arkansas.

Seasonal variation in Dalton settlement and organization was argued by Schiffer (1975a:107) to involve summer-fall foraging by Dalton microbands practicing residential mobility as they exploited seasonally available plant foods and hunted deer and other small game in upland and lowland settings. The base camps occupied during these seasons would have moved frequently as local patches became exhausted or when favored resources became available elsewhere. Subsistence options would be more limited during winter and spring. Deer and other small game would be available, as well as migratory waterfowl, riverine resources, and cached goods. Schiffer (1975a:107) expects that Dalton microbands would aggregate near major rivers during these lean seasons and conduct maintenance activities, ceremonies, and local (logistically organized) extractive tasks. Winter-spring base camps would be moved infrequently depending on hunting success and the surplus of stored foods.

In short, Schiffer's (1975a) model recognizes a combination of residential and logistic mobility patterns for Dalton groups. Seasonal variation is seen to create two types of base camps. Relatively brief summer-fall base camps are expected to occur in both upland and lowland settings, whereas more permanent winter-spring base camps would focus on the lowlands along major rivers. In terms of site formation processes, upland summer-fall sites may reflect seasonally specific activities. Lowland sites used for both summer-fall and winter-spring adaptations are expected to reveal a seasonally mixed assemblage.

Walthall (1998a) developed an alternative to the seasonal settlement model posited by Schiffer (1975a). Of particular importance is the premise that hunter-gatherers throughout the world developed mobility strategies that include "an annual cycle characterized by periods of [population] concentration and dispersion" (Conkley 1980:609), and that archaeologists in the eastern United States have mistimed the seasonal aggregation and dispersion of early Holocene hunter-gatherers. Rather than occupying long-term base camps during the winter (i.e., Anderson and Hanson 1988:266; Schiffer 1975b:253), Walthall (1998a) argues that winter seasons were characterized by group dispersion and that aggregation would be best planned during the fall.

Borrowing liberally from ethnographic examples, Walthall (1998a:5-8) establishes a pattern of autumn aggregation and winter dispersal in the Eastern Woodlands. Late winter and early spring are periods of food stress in the region, limiting plant food availability and creating a reliance on hunted meat. Group dispersion during the lean season would prolong resource patch productivity and lessen the frequency of residential moves (Hayden 1981:360). The primary meat resource taken by Dalton groups, probably deer, would not provide sufficient nutrients during the winter season. In response to this risk, early Holocene hunter-gatherers would broaden their diet to include bear, raccoon, beaver, turkey, and other fatty game (Walthall 1998a:12).

Human aggregations are expected to occur during the fall and would have provided the opportunity for mate selection and information exchange, ceremony, windfall resource use, and solidarity (Anderson and Hanson 1988:280; Hofman 1994:345-348). Deer populations would also be in prime condition during the rut season. According to Walthall (1998a:14-15), fall aggregations would provide hides and a surplus of meat for body fat storage. Such a schedule would allow small Dalton groups to depart into their respective overwinter territories well fed and well equipped for winter. The archaeological record demonstrates that Dalton groups were the first hunter-gatherer adaptation in the Eastern Woodlands to recurrently use rockshelters, and Walthall (1998b) suspects that these upland sites represent some of the ephemeral, short-term residences used during a Dalton overwintering schedule. In sum, Walthall (1998a,b) offers a model of high residential mobility during most of the annual cycle, fall population aggregations that probably lasted a period of weeks, and an overwinter dispersal. Accordingly, lithic sources were embedded into the settlement round (Walthall 1998b:234).

Daniel (1998) offers additional insight into early Archaic settlement and mobility in his study of the Hardaway site in the North Carolina Piedmont, where the band-macroband model (Anderson and Hanson 1988) has characterized early Archaic settlement. In the band-macroband model, two levels of settlement organization are recognized. At the local level, individual bands numbering between 50 to 150 people are thought to have occupied eight major river basins along the South Atlantic Coast. These bands were incorporated at a regional level by periodic trips into adjacent drainages. Base camps were scheduled during the winter, when plant foods were scarce and deer were aggregated (Anderson and Hanson 1988:266). From these base camps logistical task groups originated to procure resources. Residential mobility and perhaps dispersion occurred during the spring, summer, and fall. Bands moved out of the middle reaches of their drainage territories and towards the coast for spring, back into the uplands for summer and fall, and eventually back down to the intermediate base camp for winter.

Using raw material identification, Daniel (1998:194-202) develops a settlement model arguing that raw material availability, rather than watersheds, formed the geographical focus of early Archaic territories. Two macrobands are postulated, one staging from the Allendale chert source area and the other from the Uwharrie rhyolite source area. These groups moved across major watersheds using a forager strategy of residential mobility (i.e., Binford 1980). Between the Allendale and Uwharrie territories, Daniel (1998:Fig. 8.3) recognizes an aggregation range where relatively equal frequencies of each lithic resource occur at technologically diverse sites (i.e., Michie 1996). The role of lithic resource areas is also demonstrated by Gillam (1996) in his Geographic Information System (GIS) survey of Dalton sites in northeastern Arkansas. There, Dalton sites tend to cluster within 25 km of Crowley's Ridge, an important source of knappable gravels in the region. Both of these efforts borrow from the Flint Run settlement model advocated by Gardner (1977) who argued that early hunter-gatherers became "tethered" to critical resources such as tool stone.

In their discussion of Paleoindian interactions along the Woodlands-Plains border, Wyckoff and Bartlett (1995:48) suggest that a similar situation occurred in eastern Oklahoma. Based on raw material identification, at least two Dalton macrobands are hypothesized. One of these groups may have staged their activities from the Ozark Mountains and is recognized by the relatively strict use of Ozark cherts. Another group, staging from the Ouachita Mountians, used stone tools made from cherts and quartzites from that region and the adjacent Gulf Coastal Plains. Between these physiographic regions, in the Arkoma Basin, Dalton artifacts are made from a combination of Ozark and Ouachita raw materials. Using Daniel's (1998) logic, the Arkoma Basin of eastern Oklahoma would qualify as an aggregation range where Dalton groups staging from the Ozark and Ouachita mountains periodically came together. Brooks (1973) has documented the potential for significant Dalton occupations in the Arkansas River Valley of Yell County in western Arkansas as well (Figure 3). Another possibility is explored by Ballenger (1998) who, examining raw material use at the McKellips and Billy Ross localities, argues that residential mobility occurred between the Ozark and Ouachita mountains.

Dalton Technological Organization

The study of technological organization has played a minor role in Dalton settlement modeling. Important advances include the recognition of a Dalton biface life cycle (Goodyear 1974; Morse 1971a) and the relationship between tool diversity and site function (Ahler 1971; Goodyear 1974; Morse 1975a; Schiffer 1975a). These efforts, however, predate several important contributions emphasizing the relationship between technological organization and mobility (i.e., Binford 1980; Bleed 1986; Kuhn 1994; Shott 1986).

An explicit attempt to study toolkit design and Dalton mobility is made by Walthall and Holley (1997). This provides a springboard for the discussion of Dalton technological organization. Although based on few tools, their analysis discusses important implications of Dalton technological strategies. Located in the uplands bordering the Mississippi River Valley in southwestern Illinois, the Lembke cache (Fig. 2) contained a single Dalton point, a single adz, six end scrapers, and two flake knives. The cache was left at an apparent habitation site and was associated with a basin-shaped pit stained with red ochre that Walthall and Holley (1997:158) interpret as a hide processing feature.

Caches play a prominent role in the study of Dalton stone tool use. The most widely cited example, the Hawkins cache of northeastern Arkansas (Fig. 2), contains 11 "preforms," 18 points in various stages of completion or reduction, 3 adzes, a "chisel," an end scraper, 2 abraders, and a few informal tools (Morse 1971a). Whether the Hawkins assemblage was cached for future recovery and use or deposited with a burial is not known. Differences exist, however, in the quality, size, and contents of the Hawkins cache and the Sloan cemetery "caches" (Morse 1997). In either case, the assumption is that the Hawkins implements represent an individual's toolkit (Goodyear 1974:20).

The use of caches by Dalton groups implicates the redundant occupation of strategic locations as well as raw material or carrying constraints (i.e., Bamforth 1986; Torrence 1989). The Lembke cache, located in a chert-poor region, contained Burlington and Salem cherts which occur approximately 40 km from the site (Walthall and Holley 1997:159). Although Walthall and Holley (1997:159) observe a relationship between the Lembke cache and Kuhn's (1994) model of mobile toolkits, caches are noted as immobile toolkits that, for various reasons, were stashed rather than carried. According to Walthall and Holley (1997:159), the Dalton toolkit was built around a large, portable biface, the adz. However, the observation that an artifact was transported does not necessarily ensure that it was part of a mobile toolkit (Kuhn 1994:427). Heavy implements, such as the hammers, anvils, and choppers stacked together at the Brand site (Goodyear 1974:65), could be carried to a locality and afterwards used as site furnishings (Binford 1979:264).

Dalton Adzes and "Quince Scrapers"

The adz and its role in the Dalton toolkit has received considerable attention (Gaertner 1994; Goodyear 1974; Morse and Goodyear 1973; Morse and Morse 1983; Yerkes and Gaertner 1997). Use-wear studies support the contention that these implements functioned as woodworking tools and may have been used to fell trees and perform other heavy-duty tasks (Yerkes and Gaertner 1997:59-66). The most intriguing interpretation of the Dalton adz is that it was used for the manufacture of dugout canoes (Morse and Morse 1983:78; Morse et al. 1996:329; Walthall and Koldehoff 1998:262). More common uses may have included the felling of trees for fuel and the manufacture of containers and utensils, temporary shelters, and drying racks (Gaertner 1994:98).

The Dalton adz (Fig. 6) is an example of what Bleed (1986) refers to as an "overdesigned" tool. Based on the Lembke cache, a large adz may be 20 times heavier than the average Dalton point. The disadvantage of this bulk is argued to have been outweighed by the role exhausted adzes played as bifacial cores (i.e., Goodyear 1974:42-43). Although Walthall and Holley (1997:159) emphasize the role of the Dalton adz as a bifacial core, it must be stressed that the typical Dalton adz does not equal in size or utility the large bifaces associated with Plains groups (e.g., Boldurian 1991; Hartwell 1995). More likely, the expended Dalton adz served for the production of expedient tools. It is noteworthy that the adz was not used as a multifunctional tool until it was broken or expended, thus emphasizing the fact that it cannot be characterized as a general purpose, bifacial core. The use of adzes as cores probably reflects raw material scarcity rather than a planned source of raw material.

A significant contribution by Walthall and Holley (1997:158-160) is their recognition of gender-specific activities and tools and the implications for group organization. According to Hayden (1992:35), cross-cultural studies have identified "the almost universal role of women" in scraping and preparing hides in societies without specialists. The Lembke cache is interpreted as a female hideworker's toolkit, with end scrapers for dressing the hide, bifacial and flake knives for trimming and lash cutting, an adz for the construction of drying racks and fuel-gathering, and red ochre remains from the curing process. If this is the case, an argument can be made that nuclear families rather than male or female task parties were occupying small, upland sites. Walthall and Holley (1997:160) envision Dalton groups gearing-up near lithic source areas and transporting sufficient quantities of finished tools to perform specific tasks during periods of residential mobility, then caching those tools for site reuse.

A distinctive expression in eastern Oklahoma and Texas is the rarity of Dalton adzes and the limited but

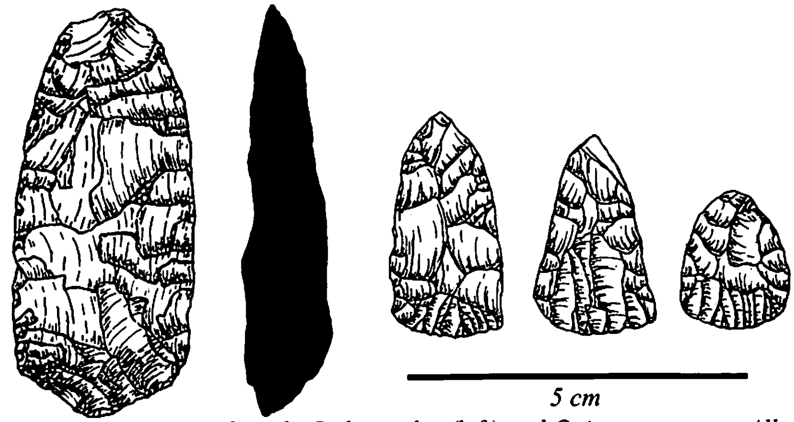


Figure 6. Examples of a Dalton adze (left) and Quince scrapers. All are bifacially flaked. Adapted from Wyckoff 1999:Fig. 10.

unique use of "Quince scrapers." Named from tools recovered from the Dalton/late Paleoindian component at the Quince site in southeastern Oklahoma (Pertulla et al. 1994), and first recognized with a "Meserve" assemblage at the Snapping Turtle site in northeastern Texas (Lorrain and Hoffrichter 1968), Quince scrapers (Fig. 6) may be exclusive to Dalton technologies along the prairie-woodland border (Story 1990:197). The few Dalton adzes and Quince scrapers available for study, and the uncertain context of these finds, preclude a formal analysis. A contrast is observed, however, between the design considerations of these implements.

The function of the Quince scraper has not been demonstrated by contextual information or use-wear analysis. LeRoy Johnson (in Story 1990:197) describes "a polish on the bit [that] wraps around both faces of the cutting edge, and is accompanied by striations parallel to the long axis of the scraper." The bit is not planar like the typical unifacial end scraper but bifacially beveled and sharply undulating. Given the delicate design of the Quince scraper, a functional comparison cannot be made with the heavy-duty adz. On the other hand, the edge morphology of Quince "scrapers" would not lend these implements to, for example, hide preparation. According to Gallager (1977:411), scraper maintenance is not performed to sharpen the implement, but rather to remove small jagged or uneven edges or nicks "which dig into the surface of the leather, ruining the smooth surface or even cutting it." Quince scrapers are characterized by sharp, jagged edges along the working bit and seem unnecessary in toolkits that already possess formal, unifacial end scrapers.

Morphologically, the Quince scraper shares more in common with the adz than it does end scrapers. In fact, it is sometimes difficult to distinguish a small adz from a large Quince scraper (Figs. 6 and 18). In terms of toolkit design and mobility, the possibility that Quince "scrapers" represent miniature adzes used for light-duty woodworking tasks generates a number of implications. Whereas Walthall and Holley (1997:159) characterize the Dalton adz as a portable biface, large examples such as the Lembke adz (weighing 198 g.) would impose significant cost if transported in numbers. A total of 72 adzes were recovered from the Brand site (Goodyear 1974:41). If all of those adzes were the same size as the Lembke example when they arrived at Brand, then the adz assemblage alone at the Brand site may have weighed as much as approximately 14 kg. (32 lbs.). The average weight of utilized but functional adzes at the Sloan site is approximately 62 g. (Morse 1997:33; Yerkes and Gaertner 1997:70). The few adzes in transported toolkits such as the Hawkins and Lembke caches demonstrates that only a piecemeal number of these implements could be carried. Rather, adzes are expected to be more numerous at residential bases where shelters would be constructed and fuel needs would be long-term (Kimball 1996:162). Quince scrapers, usually weighing less than 10 g., are lightweight by any standard and would relax carrying constraints. Large adzes would still be necessary for tree felling and other heavy-duty tasks, but smaller adzes could be kept on-hand to perform light-duty woodworking tasks (i.e., Gaertner 1994:98). The prairie character of eastern Oklahoma (restricting the distribution of wood resources) may have further affected Dalton economies and decreased their reliance on timber and wood related tools (Ballenger 1998:5).

Analysis of Dalton Points

This thesis relies primarily on Dalton point variation to address settlement mobility. The Dalton points collected from three localities in the Arkoma Basin are used to address how each locality, as well as the Arkoma Basin itself, functioned in the settlement pattern of Dalton groups in eastern Oklahoma. Raw material availability and use identifies Dalton group range. Functional variability is explored using Dalton point diversity, with the frequency of specific tool forms and breakage types indicating what activities were stressed at each locality. Finally, a model of Dalton point utility is defined that measures how much tool mass was planned, used, and discarded or lost at each of the localities. Test implications are composed that predict how raw material use and tool utility should be expressed for three Dalton settlement models.

Dalton Point Diversity

Efforts to identify Paleoindian site function via stone tools often rely on the frequency, character, and condition of formal and informal tool classes such as projectile points, end scrapers, and expedient flake implements. Toolkit diversity is also used as a measure of settlement mobility (i.e., Shott 1986). Because Dalton points were used for a variety of tasks (Fig. 7), the opportunity exists to use a single tool class to explore tool diversity, inter-assemblage variability, and site function.

The function of Dalton points is addressed in several works, each of which stress its role as a serrated knife (Michie 1973; Morse and Morse 1983; Yerkes and Gaertner 1997). The right-sided beveling characteristic of many Dalton points has been argued to reflect handedness (Morse and Morse 1983:72), physical constraints (Galm and Hofman 1984:53), and social identification (McGahey 1996:363), but likely relates to the motion of the tool in relation to the task (Bradley 1997:56). The recognition that exhausted, drill-like forms (Fig. 7) were functionally different from serrated knives (Goodyear 1974:32; Morse 1971a:10) is also understood. Other variations to the Dalton point include the creation of end scrapers, burins, and spokeshaves (Goodyear 1974:33-39; Morse and Morse 1983:72). Further, the design and breakage observed on serrated Dalton knives indicates that they were used as projectile points as well. The retooling of Dalton points attests to the multiple functions of these tools and provides an opportunity to observe functional variation within and between Dalton point assemblages.

Yerkes and Gaertner (1997:66) have analyzed 23 Dalton points recovered from the Brand and Sloan sites, including 4 preforms and 19 points in all stages of reuse. Of the 9 specimens that displayed some type of wear, 7 of which were moderately reused, only 4 had been used as knives to cut fresh meat or hide. Five examples showed impact fractures and were evidently used as missiles, and 2 of these also belonged to the knife class. A single exhausted form retained a weakly developed dry hide polish on its distal tip, suggesting that it had served as an awl. Ballenger (1998:5) also demonstrates the significant frequency of impact-fractured Dalton points and illustrates a trend for relatively pristine forms to be most commonly associated with impact damage. Another interpretation is offered by O'Brien and Wood (1998:96) who, citing Wilson (1898), argue that the alternate beveling observed on Dalton points served an aerodynamic purpose and stabilized the dart during flight. If this were the case, reused forms would be most commonly impact fractured. Intentional burin breaks are distinguished from coincidental impact events by macroscopic rounding and polish located along the fractured surface, a signature that Yerkes and Gaertner (1997:68) did not observe on the 3 "burinated" Dalton specimens they examined.

The discovery of the Sloan site identified a variety of Dalton bifaces now referred to as "Sloan points." As defined by Morse (1997:17), Sloan points measure in excess of 19 cm in length and may range up to 38 cm in length. According to Morse and Morse (1983:75), Sloan points are exceptionally thin and lack evidence of utilitarian use. Walthall and Koldehoff (1998) have presented large Dalton points within a framework of ceremonial exchange. Based on the distribution of Dalton bifaces measuring in excess of 11 cm, a 700 km stretch of the central Mississippi River Valley is hypothesized to represent the core area of a Dalton alliance network. The manufacture of these bifaces required use of the Cresent quarries near St. Louis, Missouri, a bedded outcrop of Burlington chert known for producing unusually large blocks of chert. According to Walthall and Koldehoff (1998:262), dugout canoes were used along the central Mississippi River Valley and increased the likelihood of interband contact. Sloan points, perhaps signifying a

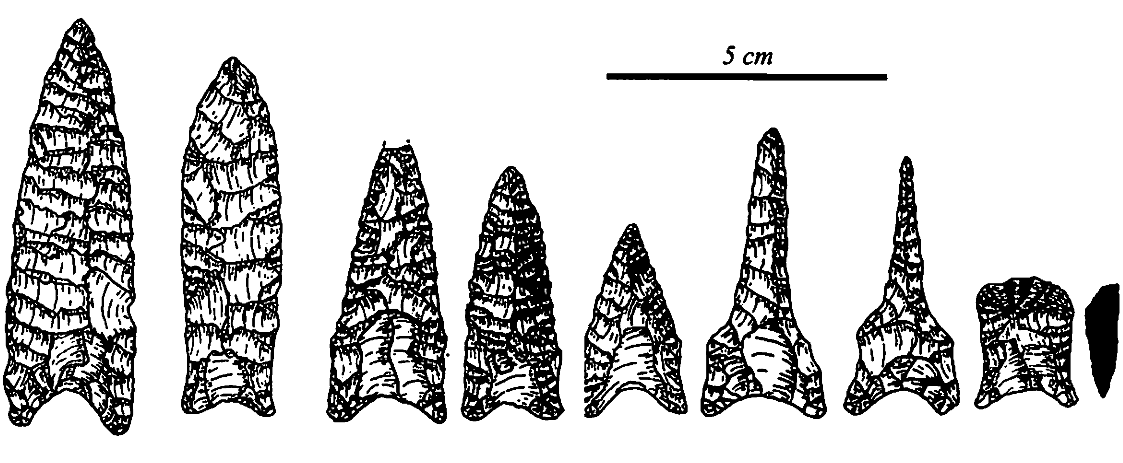


Figure 7. Eastern Oklahoma examples of Dalton points at various stages of blade resharpening and use. Adapted from Wyckoff 1999:Figs. 6, 7, and 9.

male cult, may have been exchanged during seasonal aggregations (Walthall and Koldehoff 1998:269).

Dalton Point Utility

The discovery of the Hawkins lithic cache (Morse 1971a) provided archaeologists with the opportunity to examine the Dalton point as a system. Contrary to views that various forms were distinct "types," the Hawkins cache demonstrated the effects of tool resharpening on artifact form and function. Why Dalton groups emphasized alternate beveling on their points is an interesting problem. Alternate beveling is demonstrated to prolong the use-life of stone tools, but its relationship to curation and raw material availability is unknown (Odell 1996:61). It is perhaps telling that this phenomenon was developed and stressed by groups who were beginning to venture further and further from the chert-rich environments that so heavily influenced early Paleoindian settlement strategies (Gillam 1996).

Based on the trimodal clustering of blade widths in the Hawkins cache, Morse (1971a) proposed a series of stages that a point undergoes as it was made and subsequently resharpened. This production/reduction model was refined by Goodyear (1974:19-32) in his study of the Brand site assemblage to include Preforms, Completed Preforms, Initial, Advanced, and Final stage points. In general, Preforms are defined as percussion-flaked bifaces that resemble finished Dalton points. Completed Preforms have achieved the desired form and exhibit pressure flaking, but are not basally ground or serrated. Initial stage points are finished tools, but possess excurvate lateral edges or a continuation of an almost straight line from the shoulder to the serrated body. Advanced stage points are defined as being identical to Initial stage points, but have been resharpened at least one time. In some cases, Advanced stage points exhibit a dramatic break between the shoulder and the resharpened body. Final stage points are characterized by their drill-like appearance and biconvex cross-section of the blade.

The use-stages developed by Morse (1971a) and Goodyear (1974) have proved to be a useful analytic tool for describing morphological change in Dalton points, but are problematic in some contexts (Goodyear 1974:20). First, because the Hawkins cache was likely made and used by a single individual, each specimen had a greater chance of beginning its use-life at a common width and experiencing a similar method of reduction. This is not true for larger assemblages that were made and used by numerous individuals who produced wide and narrow forms. A simple measurement of blade width does not consider this level of variability and has the potential to group Dalton points that have experienced very different use-life trajectories. In other words, blade width alone will reflect how much raw material is available, but it does not recognize how much has been used. Secondly, by measuring blade widths "half-way down the length of the body" (Goodyear 1974:20), the investigator is assuming that blade length does not influence tool longevity. Certainly, a tool with 40 mm of blade length possesses more utility than one with only 20 mm of blade length.

An alternative is offered as an index of Dalton point utility (Fig. 8). By creating a ratio that considers blade width in relation to base width, tool utility can be assessed for diverse assemblages. This method is not intended to generate clusters that reflect the number of resharpening episodes a point has experienced (i.e., Morse 1971a), but creates a continuum of values that can be treated as continuous variables or arbitrarily classed (Ballenger 1998). This may be helpful since so much variation exists within the "Advanced" stage. Also, blade width is taken at a rather arbitrary but standardized location on each tool. By measuring blade width at 30 mm above the base (usually high enough to be above the haft element) a Dalton point with 20 mm of blade length will be rightfully assessed as possessing less utility than one with 40 mm of blade length. This model attempts to identify the potential, expended, and residual utility of Dalton points (i.e., Kuhn 1989, 1994).

Base width (Figs. 8 and 9) is used as an index of original point width or potential utility (Kuhn 1994). The resharpening techniques practiced by Dalton groups would influence wide Dalton points to possess more potential utility than narrow Dalton points and experience longer use-lives (Goodyear 1974:30). Base width would be principally influenced by hafting constraints. The Dalton points examined in this analysis exhibit base widths that range from approximately 16 mm to 33 mm. The lower and upper limits of this range are considered to reflect the physical constraints imposed by hafting, and 16 mm is used here as the minimum essential width for securely attaching a Dalton point to its

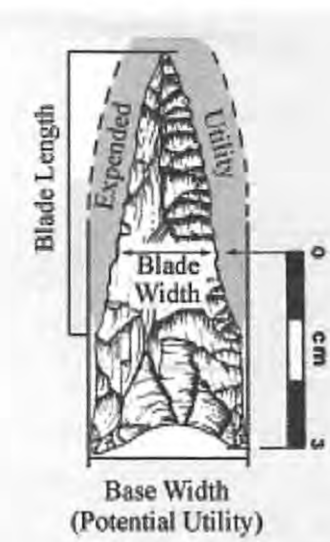


Figure 8. Variables used to determine potential, expended, and residual utility of Dalton points.

haft. The range between these size limits provides 17 mm of potential utility that an individual could exploit or forfeit. Because newly manufactured Dalton points are slightly convex along the lateral edges of the blade, the excurvature of the original blade, as well as blade length, would affect the amount of available tool material. Based on the morphology of numerous "pristine" Dalton points at the Sloan site (Morse 1997), the amount of material available outside the width of the base is not considered to be significant. Any technique for determining original point length would be problematic and is discounted. The formula for estimating potential utility is expressed as:

Potential Utility =
Base Width - Minimum Essential Base Width

If potential utility reflects how much tool material was desired, expended utility measures how much tool material was used (Figs. 8 and 9). Base width usually does not vary throughout a tool's use-life and is a reasonable index of potential utility. Estimates of expended utility, however, must measure something that no longer exists. Expended utility is defined as the difference between base width and blade width. Blade widths are measured 30 mm above the base. Again, blade excurvature and length are discounted. The formula for expended utility is expressed as:

Expended Utility = Base Width / Blade Width

The Dalton point stages of Morse (1971a) and Goodyear (1974) were developed to identify the number of resharpening events a tool had experienced and are therefore theoretically similar to the concept of expended utility. Goodyear (1974:19-32) defines Preforms, Completed Preforms, and Initial, Advanced, and Final stage points. The variability observed in the Advanced stage is significant and ranges from points that have been resharpened once to forms that are nearly in the Final stage (Goodyear 1974:26). The methods used here differ slightly to classify variation within the Advanced stage. Furthermore, functionally distinct forms are not used to define use-life stages. Goodyear (1974:30) recognizes Final stage forms by their

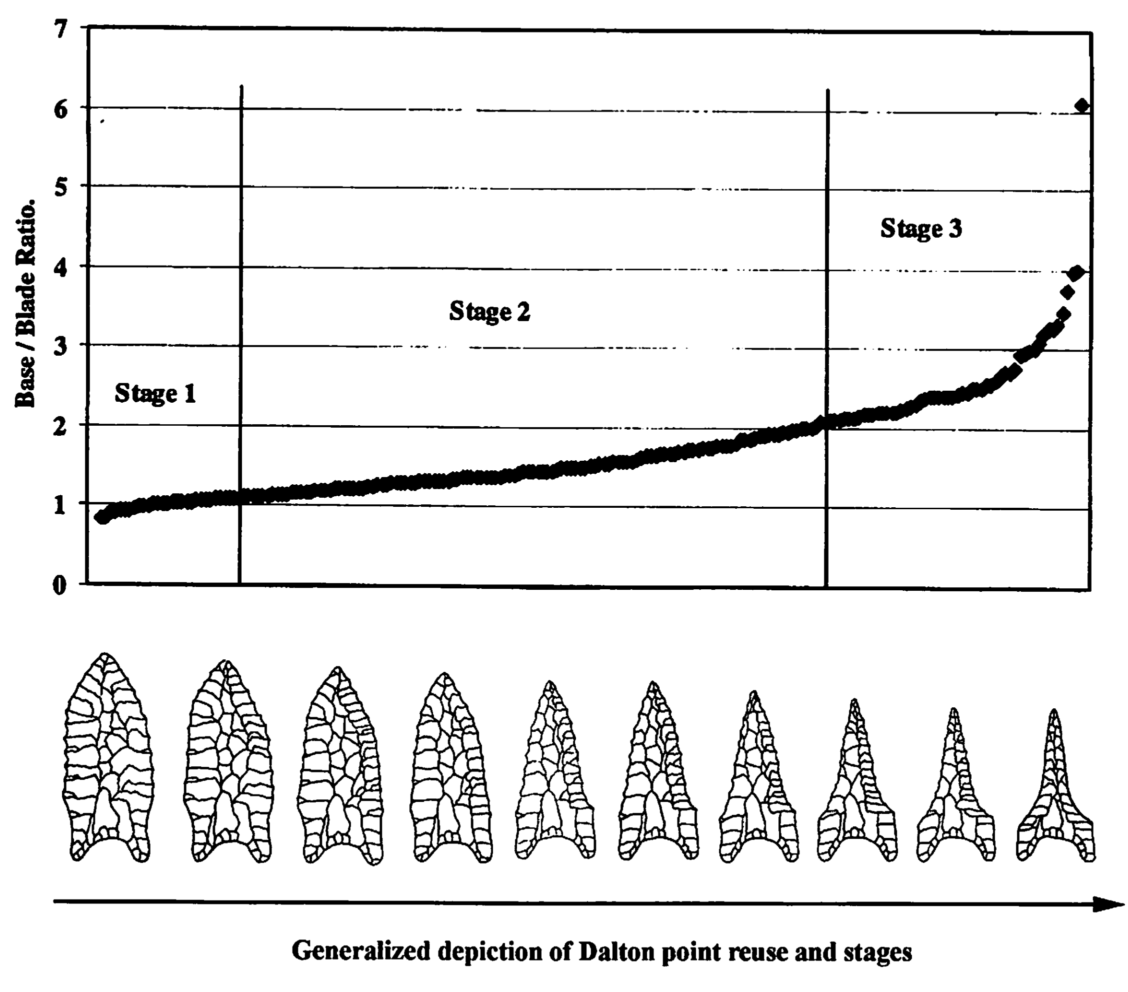


Figure 9. Base/blade ratio (expended utility) continuum of Dalton points.

Table 1. Expended utility stages and values for Dalton points.

Expended Utility Stage	Expended Utility Value
Stage 1	<1.10
Stage 2	1.10 - 2.10
Stage 3	>2.10

drill-like, nonbeveled blades. Although Dalton points must experience a significant amount of maintenance before they reach the Final stage, the difference between beveled, serrated blades and nonbeveled, drill-like blades is a functional distinction. Whether a point was discarded once it reached the late Advanced stage, or taken one step further and retooled into an awl, would be influenced by task requirements rather than stone tool conservation. Therefore, recognizing that late Advanced and Final stage forms experienced nearly equal levels of maintenance is necessary. The expended utility formula creates a continuum of values, with scores increasing in relation to the amount of material removed from the tool (Fig. 9). Three stages are established (Table 1). In terms of the Morse/Goodyear approach, Stage 1 forms represent Initial and early Advanced stage specimens, Stage 2 represents middle Advanced stage forms, and Stage 3 represents late Advanced and Final stage forms.

Whereas potential and expended utility reflect the amount of stone material planned and used, residual utility measures the absolute amount lost or discarded (Figs. 8 and 9). Methodologically, the Morse/Goodyear approach identified residual utility. Blade width and length define residual utility. Blade length could not be used to estimate potential or expended utility because it is impossible to know the original length of Dalton points that have experienced maintenance. Original length is not an issue when determining residual utility. The only concern here is the amount of tool stone that was not used. Blade length is defined as the amount of material between the shoulder and the distal tip of the point. The formula for determining residual utility is expressed as:

Residual Utility = Blade Width (x) Blade Length

The recognition of morphological change in the Dalton point use-life trajectory and the quantification of that change provide a host of possibilities in the study of technological organization. Variation in point utility across the landscape may signal technological responses to settlement organization and raw material availability. Additionally, breakage patterns and the retooling of Dalton points can be used to examine functional diversity within and between assemblages. This approach carries weight in the study of multi-component, surface collected assemblages. These constitute a significant portion of the Dalton record in some regions.

Morse's Dalton Settlement Hypothesis

The Dalton settlement hypothesis proposed by Morse (1971b, 1975, 1977, 1997) posits that Dalton populations in northeastern Arkansas were organized into a few bands that exploited drainage-based territories (Fig. 4). Centered within each territory was a base camp locality. Occupied for much or all of the year, these semi-permanent to permanent base camps served as staging areas for logistically organized task groups who foraged within each territory and, in doing so, created smaller extraction camps. These territories, symbolically reinforced by cemeteries (Morse 1997), provided the essential resources, including lithic raw materials, needed by Dalton groups.

Before outlining the material expectations of Morse's construct, eastern Oklahoma should be noted for providing an environment unlike that observed in northeastern Arkansas. First, environmentally homogeneous, parallel watersheds similar to the Cache, Black, and St. Francis rivers of northeast Arkansas are rare in eastern Oklahoma. Rather, eastern Oklahoma is drained by several watersheds that may or may not contain critical resources such as tool stone. Assuming that a prairie steppe environment existed in eastern Oklahoma during Dalton times, major east-west trending drainages may have also lacked important arboreal resources. On the other hand, the Arkansas River is fed by a few north-south trending watersheds that would have supported individual bands with wooded environments and access to uplands and lithic raw materials (Fig. 10).

If Dalton populations in eastern Oklahoma used a settlement strategy similar to that advocated by Morse, then at least two expectations should be fulfilled in Dalton lithic assemblages. First, each watershed should have one or more centrally located and significant base camps (Fig. 10). From these base camps logistical task groups could move into upland areas to procure, for example, tool stone and into lowland areas to hunt, fish, and forage. Because rivers would define these territories (i.e., Morse 1975a), logistical parties would be confined to either Ozark or Ouachita mountain resources. The occupation of a single watershed, with lithic raw material sources only occurring near its headwaters, would influence Dalton groups to leave the uplands with toolkits in good condition and arrive at lowland sites with more exhausted tools.

Because of the environmental differences observed between northeastern Arkansas and eastern Oklahoma, fair treatment of the Morse model is complicated. A more generalized construct, still emphasizing the salient aspects of Morse's model, is that a single Dalton band occupied the

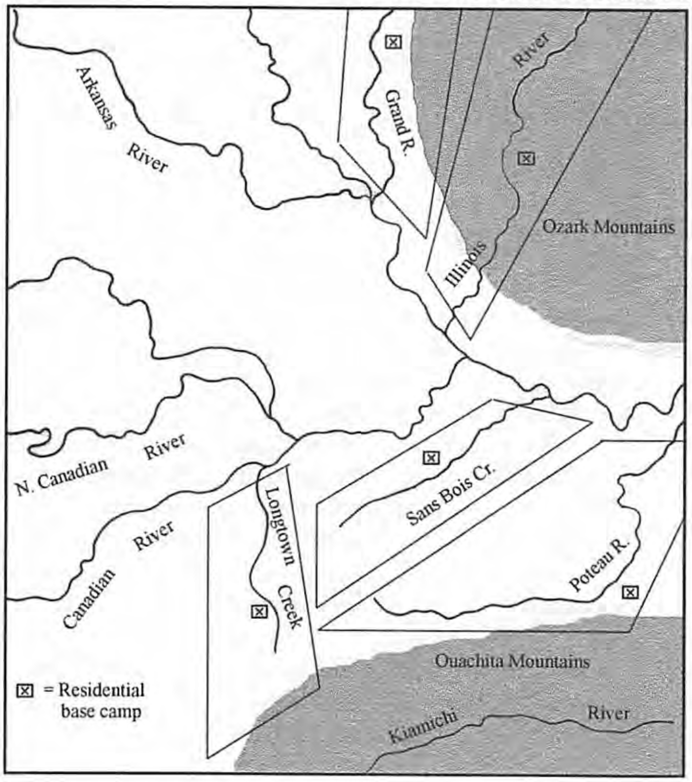


Figure 10. Hypothetical Dalton territories in the Arkoma Basin in eastern Oklahoma using Morse's model of Dalton settlement.

Arkansas River Valley and relied on logistical task groups to exploit critical resources. In this case, a small number of base camps can be expected along the Arkansas River between its confluence with the Grand River in Oklahoma and Ft. Smith, Arkansas. Logistical task groups may have had access to the Ozark and Ouachita mountains, and high-quality cherts from both regions could be moved to base camps. The type of raw material emphasized at each base camp would be influenced by its proximity to the Ozark and Ouachita mountains. Base camps located south of the Arkansas River would contain greater frequencies of Ouachita Mountain cherts and quartzites. Base camps located along the Arkansas River or further north would contain greater frequencies of Ozark chert.

Schiffer's Dalton Settlement Hypothesis

The Dalton settlement model advanced by Schiffer (1975a,b) argues that Dalton bands redundantly occupied winter-spring base camps in lowland areas and practiced residential mobility in upland as well as lowland areas during summer and fall. Favored base camps were used during both seasons and were supported by logistical task groups during winter-spring aggregations. According to Schiffer's model, Dalton groups were not confined by major physiographic barriers and moved between uplands to exploit seasonally available resources. I have argued that Dalton groups moved back and forth between the Ozark and Ouachita mountains in eastern Oklahoma (Ballenger 1998). The nature of the Schiffer construct allows for many implications. Based on the presence of both Ozark and Crowley's Ridge chert at Dalton sites located in the Mississippi Embayment, Schiffer (1975a) suggests that residentially mobile groups visited both chert sources. Assumedly, those groups moved back and forth in a rather linear pattern since popular base camps were repeatedly occupied during both winter-spring and summer-fall residences. If a similar pattern occurred in eastern Oklahoma, with Dalton groups moving between the Ozark and Ouachita mountains, then evidence for such a routine would vary according to the directness of such movements. For example, a relatively linear route between the Ozark and Ouachita mountains, with significant base camps located mid-way within the Arkansas River Valley, would result in a few large sites distributed a short distance east-to-west within the valley. On the other hand, if Dalton groups exploited a more circular route, then lowland base camps would be distantly spaced east-to-west along the Arkansas River Valley.

In a simplified model of stone tool acquisition, use, and discard, Dalton tools discarded along a linear route between the Ozark and Ouachita mountains would be made from nearly equal frequencies of Ozark and Ouachita mountain raw materials. Points made from Ozark chert should show increased maintenance as they were

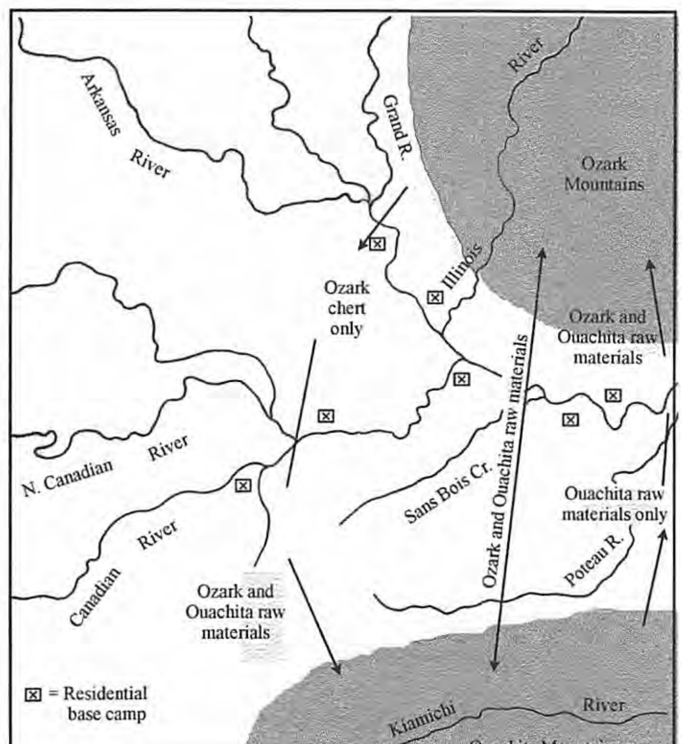


Figure 11. Hypothetical Dalton movements and occupations in the Arkoma Basin of eastern Oklahoma using Shiffer's model of Dalton settlement.

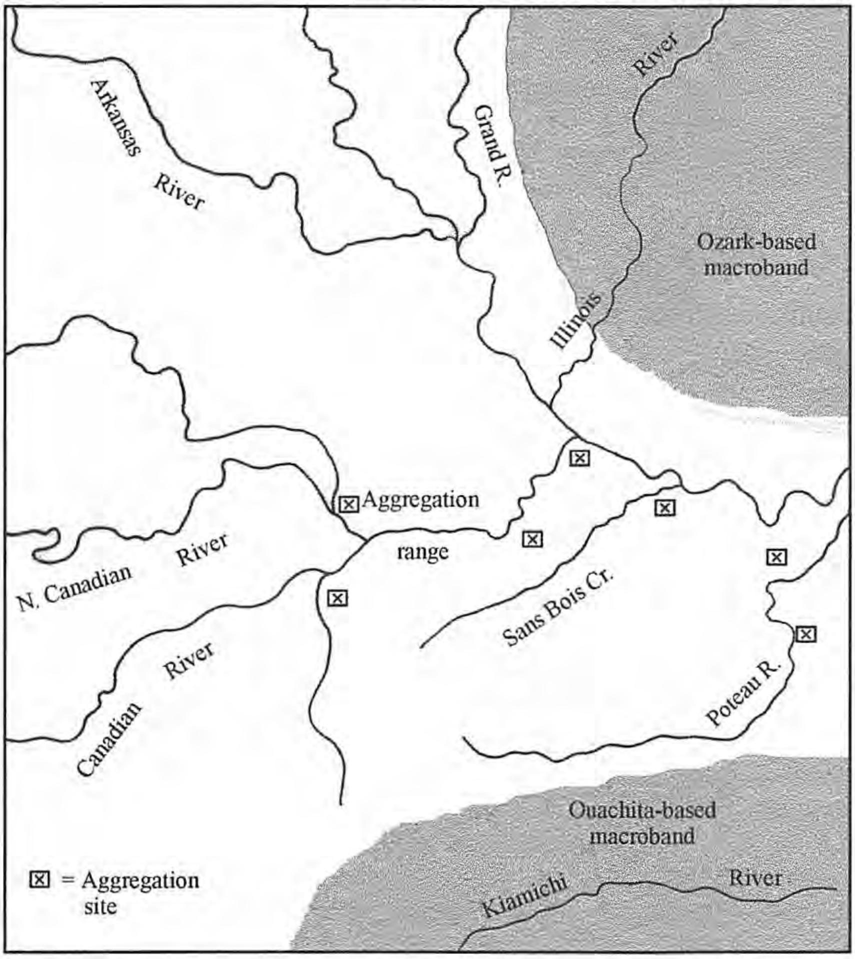


Figure 12. Hypothetical Dalton macroband territories and aggregation range in the Arkoma Basin.

counterclockwise route beginning in the Ozarks would generate sites between the Ozarks and lowland residential bases that are dominated by Ozark chert. Once settled in a base camp, Dalton task groups would supplement their toolkits with the nearest raw material source. A base camp located closer to the Ouachita Mountains could therefore contain a mixture of the Ozark materials that were carried in, and Ouachita Mountain resources that were obtained via logistical forays. Small sites located between the residential base and the Ouachita Mountains will be mixed with whichever raw material was procured during the residential stay and Ouachita Mountain cherts and quartzites. If Ouachita Mountain lithics were exploited from the residential base, then Ouachita materials may dominate assemblages between the residential base and the uplands. A similar relationship in lithic use should exist at sites created during the movement back towards the Ozarks.

carried south towards the Ouachita Mountains. Points made from Ouachita Mountain raw materials should show increased maintenance from south to north, with points being nearly exhausted by the time they reached the Ozark Mountains (Fig. 11). Schiffer (1975a) also incorporates summer-fall residential mobility between lowland base camps and the use of winter special purpose forays. If tool acquisition and hunting activities both occurred during winter logistical trips, then the frequency of Ozark and Ouachita raw materials may be less equal at seasonally reoccupied sites. Although both raw material types would be found at lowland base camps, the nearest raw material source would be best represented.

Rather than the back-and-forth movement implied by Schiffer (1975a), the seasonal "rounds" followed by ethnographically-known hunter-gatherers allow for increased recovery time and encounter a greater breadth of resources (i.e., Kelly 1992). If Dalton groups moved between the Ozark and Ouachita mountains following a large, circular route, then lowland base camps would not only be more widely distributed along the Arkansas River Valley,but would also exhibit distinctive raw material patterning (Fig.11). A

Ozark-Ouachita Macroband Hypothesis

Several studies have laid the foundation for the Ozark-Ouachita macroband hypothesis. Similar to Daniel's (1998) Uwharrie-Allendale model for early Archaic settlement in the Carolina Piedmont area, Wyckoff and Bartlett (1995) have suggested that two Dalton macrobands inhabited the Ozark and Ouachita mountains of eastern Oklahoma. Gillam (1996) has demonstrated that Dalton groups in the Mississippi River Valley "mapped on" to significant raw material sources there as well. In eastern Oklahoma, Ozark-based and Ouachita-based Dalton macrobands performed residential mobility in their perspective ranges throughout most of the year (Fig. 12). Small, upland sites were occupied during winter-early spring dispersals, whereas late spring and summer residences may have occurred along large watersheds such as the Illinois River in the Ozarks and the Kiamichi River in the Ouachita Mountains. Fall aggregations of Ozark and Ouachita-based macrobands were made in the Arkoma Basin to prepare for winter dispersal and to fulfill social obligations (Walthall 1998a,b).

Assuming that Dalton macrobands coalesced in the Arkoma Basin for brief periods, then significant but dispersed base camps are expected mid-way between the Ozark and Ouachita mountains (Figure 12). Raw materials from both regions should be represented at these base camps and in equal stages of reuse, as well as small amounts of exotic stone obtained during summer contact with neighboring groups (i.e., Perttula et al. 1994:263). Exceptionally well-crafted tools and ornaments may have been displayed and exchanged, including Dalton long blades (Walthall and Koldehoff 1998). Hunting and foraging parties would exploit the local uplands and lowlands to sustain the aggregated population. Depending on the duration of the aggregation, the nearest raw material source would be used to supplement depleted toolkits and should be slightly more common. Winter to summer camps in the Ozarks should contain few tools made from Ouachita cherts or quartzites, and vice-versa.

Part 4
Arkoma Basin Dalton Sample Descriptions and Analysis

In this section I examine 324 Dalton points from three localities in the Arkoma Basin of eastern Oklahoma (Appendix A). The topographic setting of each locality is briefly discussed, as well as the circumstances of artifact exposure and collection. Raw material identification is performed to distinguish Ozark and Ouachita mountain cherts and quartzites. Tool diversity and utility is examined to identify variability within and between each assemblage in order to address the question of Dalton settlement mobility in the Arkoma Basin.

The Billy Ross Collection

First documented by Galm and Hofman (1984), the Billy Ross locality is situated in Haskell County along Sans Bois Creek, a northeast flowing tributary that drains the Sans Bois Mountains to the Arkansas River (Fig. 13). In the vicinity of the Billy Ross locality, Sans Bois Creek meanders between sandstone cuestas rising as much as 100 meters (260 meters amsl) above the floodplain. At lower elevations, well-incised drainages have exposed the underlying shales characteristic of the region (Fenneman 1938). The Billy Ross locality is approximately 20 km upstream from the confluence of Sans Bois Creek and the Arkansas River and 10 km north of the Sans Bois Mountains. The collection locale occurs at an elevation of approximately 150 meters amsl.

The Billy Ross collection was brought to light by channelization performed by the Corps of Engineers during the construction of Robert S. Kerr Reservoir in the early to mid-1970s. Measuring 75 to 100 meters in width, the improved channel required the Corps to remove 4-5 meters of sediments that had accumulated within the Sans Bois Creek floodplain. The dredged materials were dumped on an adjacent slope, and this spoil pile routinely produced stone tools for a number of years. The oxidized nature of the dredged sediments demonstrates that they came from deep in the Sans Bois Creek floodplain. Galm and Hofman (1984) speculate that Dalton and other early Holocene artifacts were buried between .6 and 1.8 meters below the surface in a light gray silty loam, but the actual depth of Dalton materials in the floodplain is unknown.

The analysis performed by Galm and Hofman (1984) recognized 136 Dalton points. Another 24 Dalton points were documented by Richard Drass. The latter were not included in Galm and Hofman's (1984) analysis. Since then, the number of points that can be confidently described as Dalton has increased to 195. All of these artifacts were collected from a 40 acre spoil bank. Other point styles recovered from the Billy Ross locality include Plainview, Packard, Cody, Kirk, Graham Cave Side-Notched, and a few, varied Late Archaic, Woodland, and Late Prehistoric forms.

The McKellips Collection

Located along the shoreline of Lake Eufaula in McIntosh County, the McKellips site is situated along a high terrace that once overlooked the North Canadian River Valley and is approximately 2.2 km north of its channel (Fig. 13). Local tributaries include the Deep Fork River, which spills into the North Canadian River approximately 3 km to the west, and Fife Creek, which flows approximately 200 meters to the east. The Deep Fork River parallels the North Canadian River and drains the prairie-plains of central and east-central Oklahoma, whereas Fife Creek drains the south face of the Arkansas-Canadian river divide (Fig. 13), or the southern end of the historic Cherokee Prairie. Local relief near the site ranges between 180 meters amsl in the floodplain to more than 230 meters amsl in the adjacent sandstone hills. The McKellips site is exposed at an elevation of approximately 195 meters amsl. The stratigraphy of the site is characterized by compact fine sandy clays overlain by loose fine sands. The clayey horizon, believed to contain Dalton-age deposits, is exposed at the shoreline and is buried beneath 1-1.2 meters of eolian sand on a grassy terrace. Within 100 meters of the McKellips site is a spring and many active sand dunes that contain mixed archaeological materials.

The McKellips collection consists of 91 Dalton points collected from the eroded shoreline since 1973. Ninety percent of the Dalton points in the collection were recovered from a 100 meter stretch of beach, but evidence of more ephemeral Dalton occupations occurs along the shoreline for several hundred meters. It should be noted that several collectors frequent the McKellips locality and that the McKellips collection is only a portion of perhaps hundreds of Dalton points that have been taken from the site. Other projectile point types represented in the collection include Plainview, Cody, Packard, Graham Cave Side-Notched, Calf Creek, and several Late Archaic, Woodland, and Late

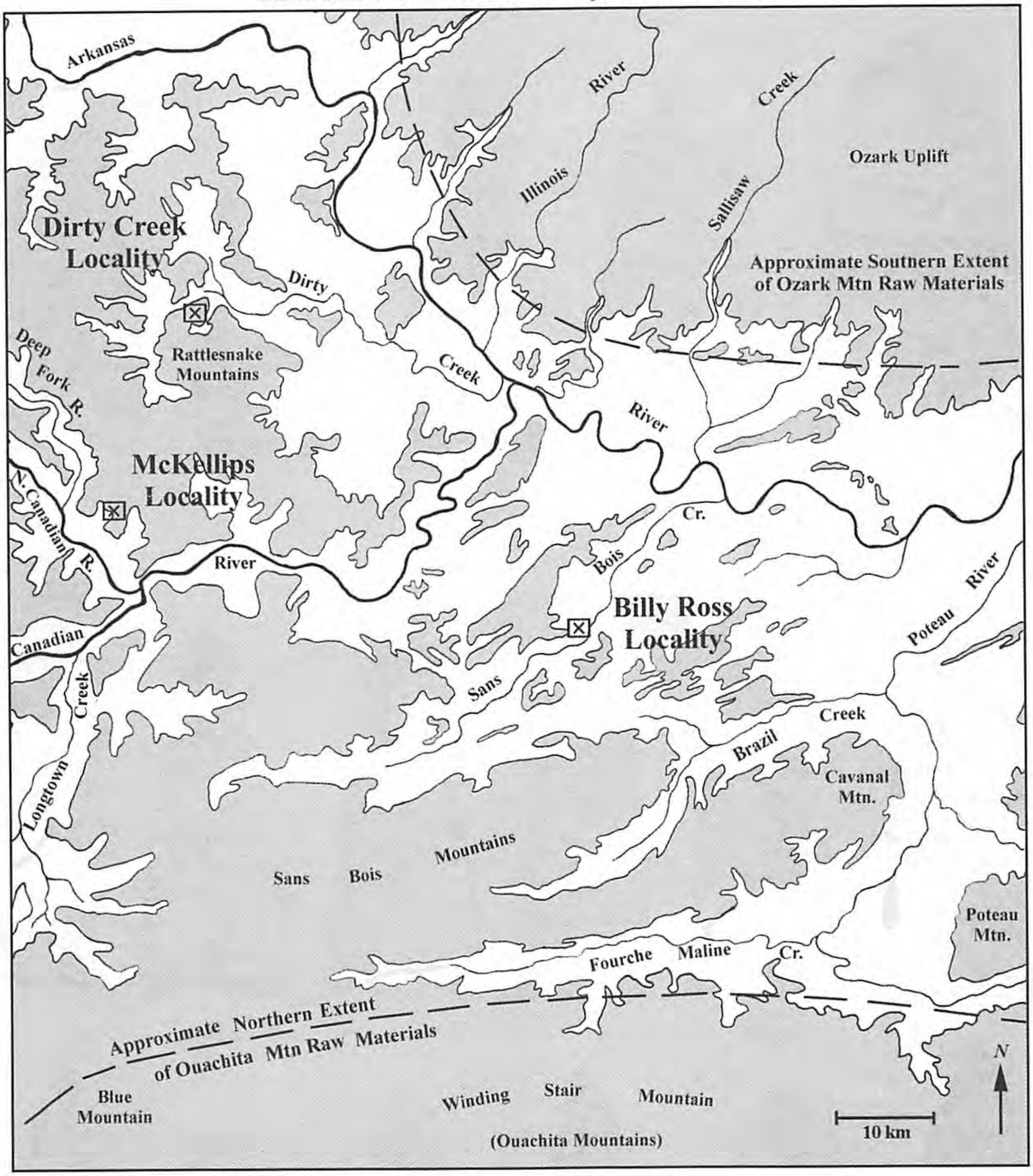


Figure 13. The studied Dalton localities in the Arkoma Basin of eastern Oklahoma.

Prehistoric forms.

The Dirty Creek Collection

Located on the north side of the Arkansas-Canadian river divide, Dirty Creek surrounds and drains the Rattlesnake Mountains (Fig. 13), a network of high sandstone hills. Dirty Creek spills into the Arkansas River between 1-2 km upstream from the Arkansas-Canadian river confluence. The several minor tributaries of Dirty Creek include Shady Grove Creek, Elk Creek, Timberly Creek, and Lawhorn Creek. The Upper Dirty Creek locality is characterized by deep clay to silt loam alluvium that has been incised by Dirty Creek to expose shale bedrock. The Dirty Creek collection is the smallest sample used in this analysis and, unlike the Billy Ross and McKellips collections, came from upland hills that may have supported several ephemeral camps. Artifact concentrations typical of long-term base camps do not occur. A total of 52 Dalton points (Appendix A) were recovered from eroded slopes and terraces ranging in elevation between 300 and 350 meters amsl. The Dirty Creek collection results from approximately 20 years of collection efforts by avocational archaeologists. Other projectile point forms represented in the Dirty Creek collections include Plainview, Graham Cave Side-Notched, Calf Creek, and various Late Archaic,

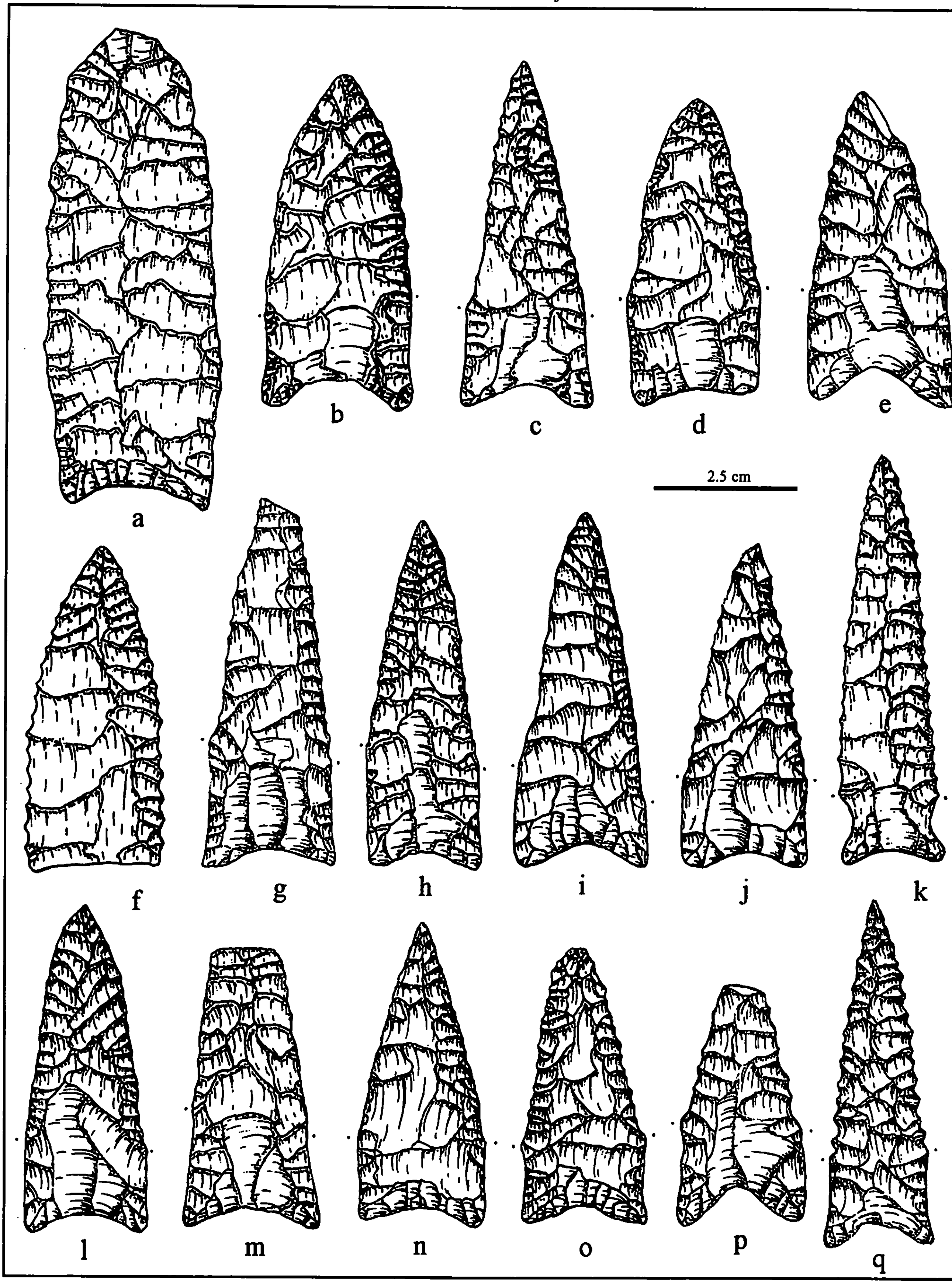


Figure 14. Selected Dalton points from the McKellips locality, McIntosh County, Oklahoma. Dots indicate extent of lateral edge grinding.

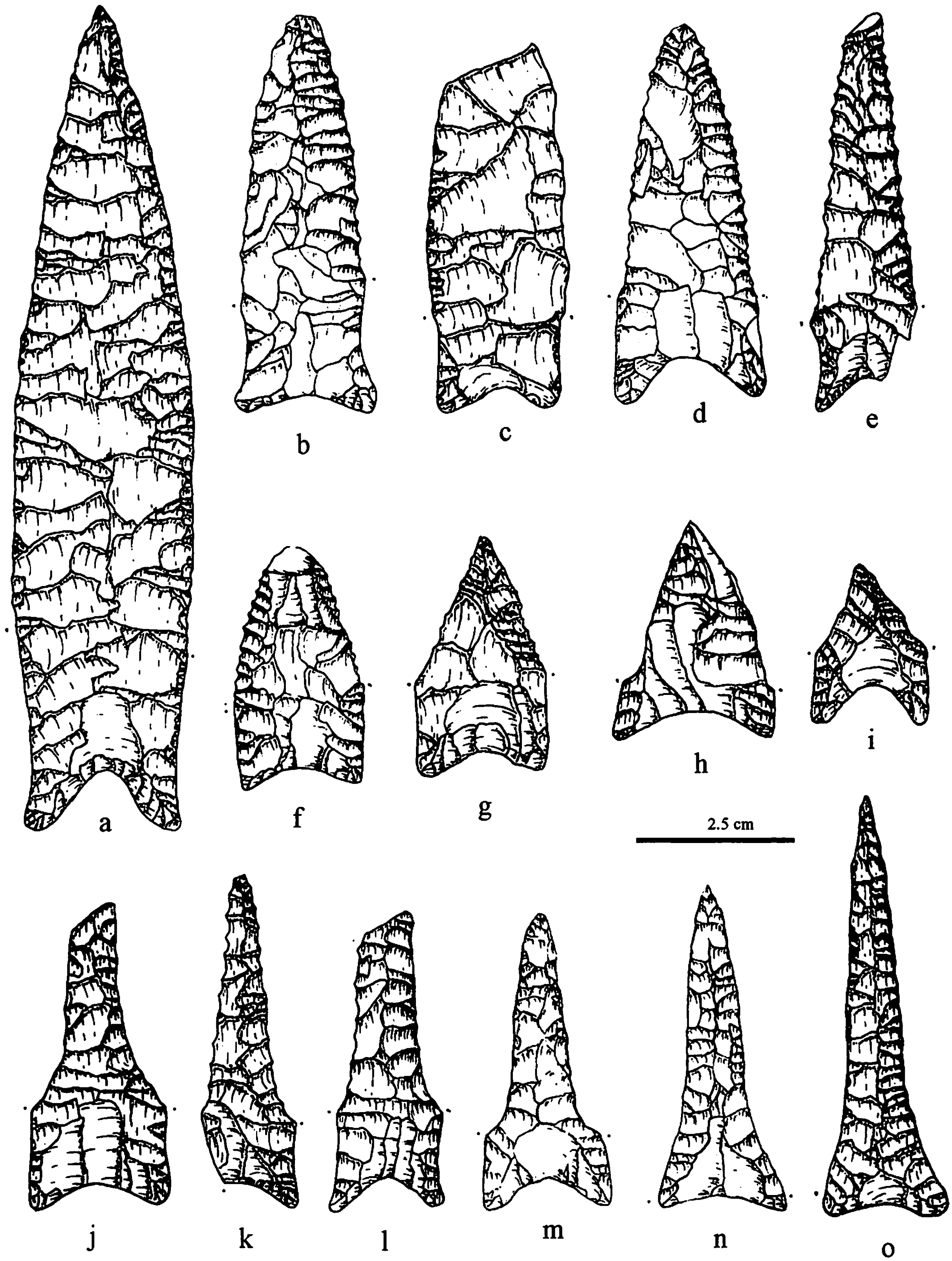


Figure 15. Selected Dalton points from the McKellips locality, McIntosh County, Oklahoma. Dots indicate extent of lateral edge grinding.

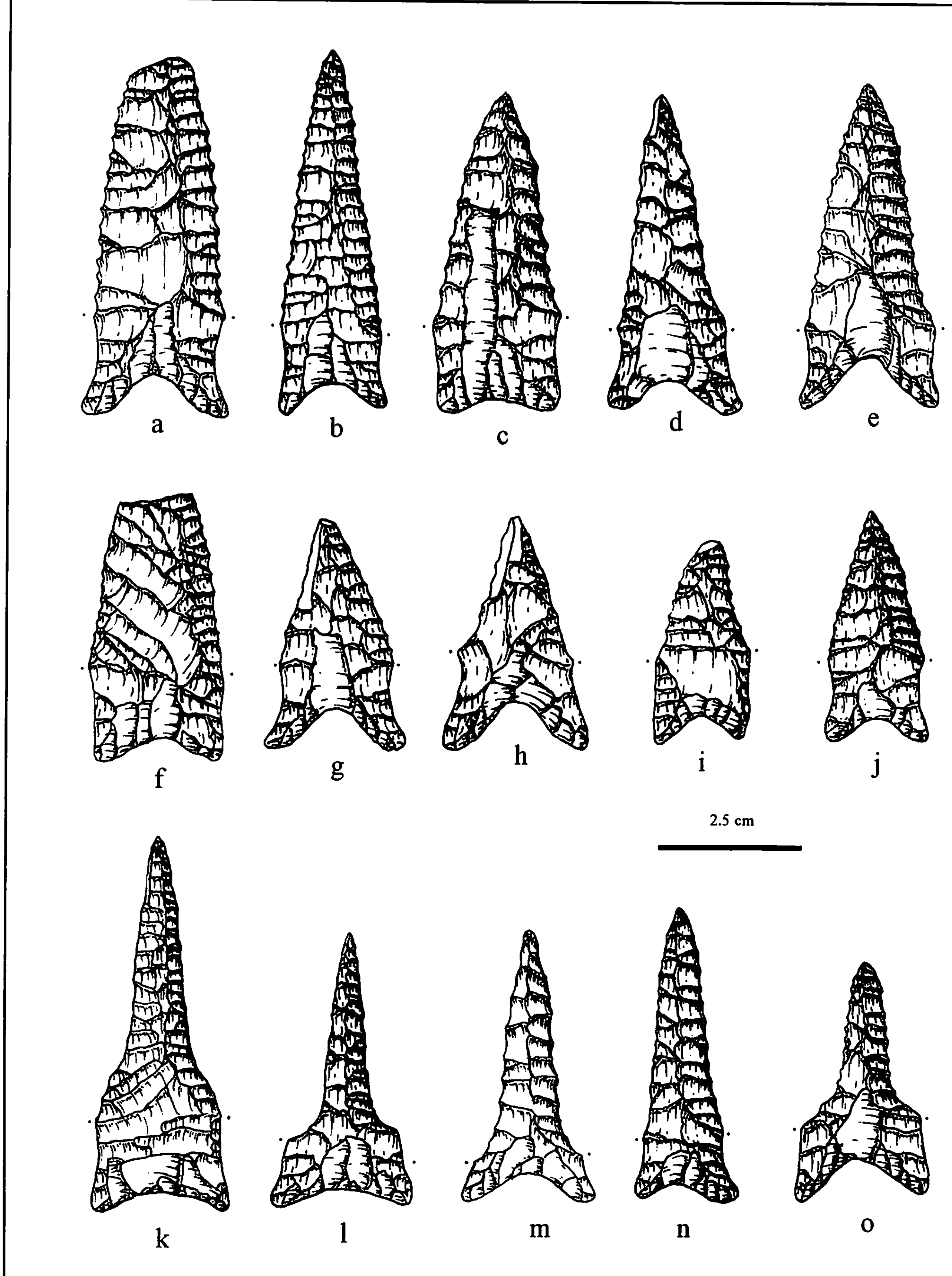


Figure 16. Selected Dalton points from the Billy Ross locality, Haskell County, Oklahoma. Dots indicate extent of lateral edge grinding.

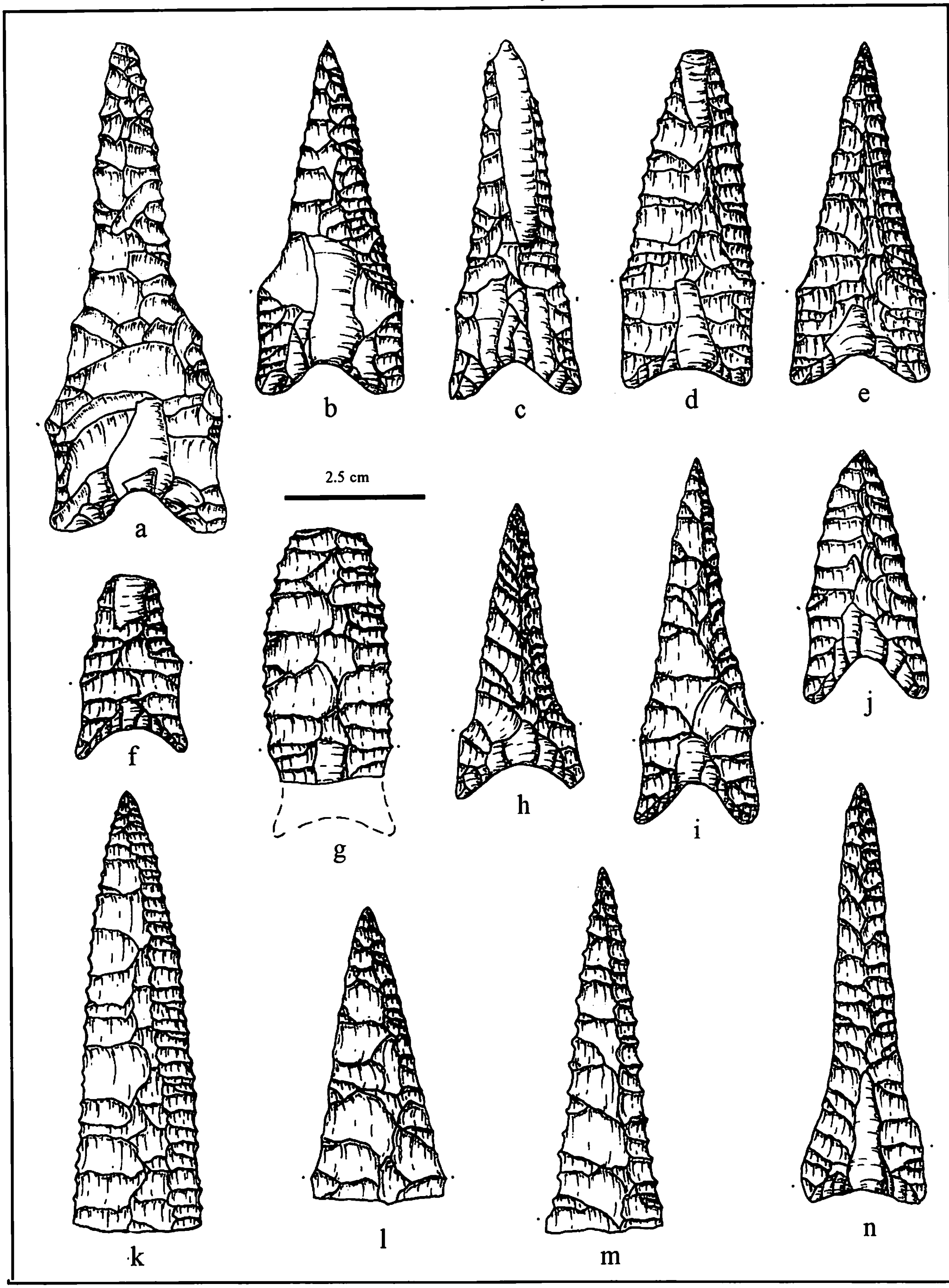


Figure 17. Selected Dalton points from the Dirty Creek locality, McIntosh County, Oklahoma. Dots indicate extent of lateral edge grinding.

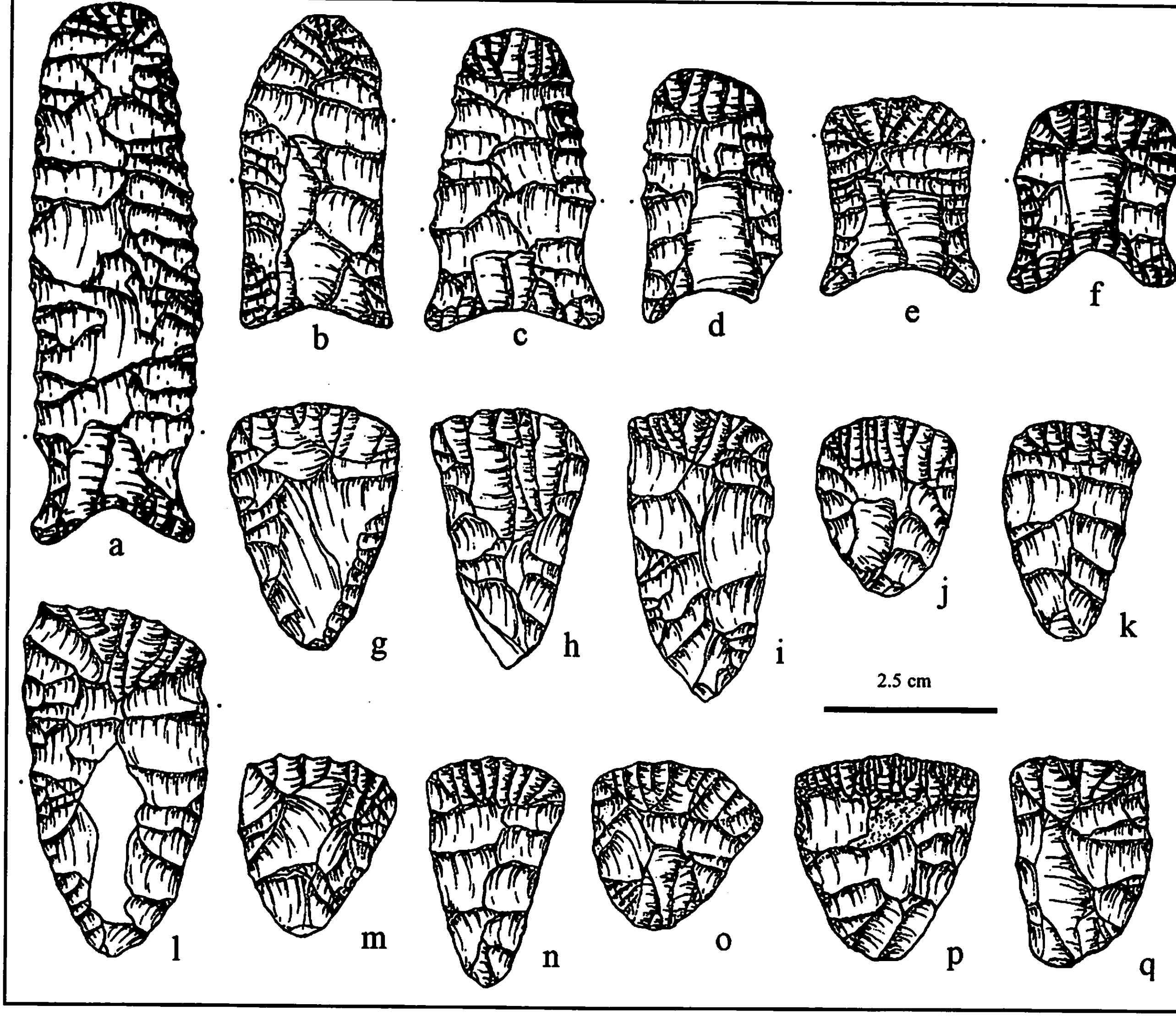


Figure 18. Selected Dalton point scrapers (a-f), Quince scrapers (g-k, m-q), and small adz (l) from the Dirty Creek, McKellips, and Billy Ross localities, eastern Oklahoma. Dots indicate extent of lateral edge grinding.

Woodland, and Late Prehistoric forms.

Raw Material Use

This analysis examines raw material use at the Billy Ross, McKellips, and Dirty Creek localities and discusses the physical accessibility of each material type. These localities are situated between two major lithic sources in eastern Oklahoma, the Ozark and Ouachita mountains. Both of these geological features contain high-quality raw materials, whereas the Arkoma Basin between these uplands is a lithic poor region. The nearly wholesale use of stone from these two sources provides insight into the magnitude and nature of Dalton movements.

Raw material identification was performed twice on each collection, and these analyses occurred several months apart. The second analysis involved direct comparison to a large collection of Ozark and Ouachita chert and quartzite samples housed at the Oklahoma Archeological Survey. Analysis of ultraviolet light reaction (see Banks 1990) was performed when necessary. The Ozark chert varieties described here follow those described by Dickson (1991). The range of variation that can occur in cherts from a single outcrop (Banks 1990:24) and the selection of redeposited river cobbles by Dalton groups (Wyckoff 1985:5) precludes an analysis of intra-mountain range.

Billy Ross

The Billy Ross locality is nearly centered between the southern limit of Ozark cherts and the northern limit of Ouachita Mountain cherts and quartzites (Figure 13). The total number of Dalton points made from Ozark raw materials is 136, comprising 70% of the sample (Fig.19). The overwhelming majority of these resemble the Reeds Spring variety. The only non-chert specimens are made from Webbers Falls siltstone from the Cookson Hills north of the Arkansas River, and these are rare. Ozark chert sources are easily accessible from the Billy Ross locality. The Arkansas River is approximately 20 km downstream from the Billy Ross locality along Sans Bois Creek, and the Ozark Uplift begins approximately 10 km up Sallisaw Creek. Sallisaw chert is noted by Banks (1990:19) to be a popular lithic type during Dalton times, and twenty-nine (29) of the Dalton points from Billy Ross fall within the visual range of Sallisaw chert. Similarity is observed, however, between Sallisaw chert and particular varieties of Reeds Spring chert. Following watersheds, Dalton groups at the Billy Ross locality could easily move into the Ozarks without traversing significant landscape barriers.

A total of fifty-eight (58) Dalton points from the Billy Ross locality, 30% of the sample, are made from Ouachita Mountain lithic types. Significantly, nearly half of these (22/58) are made from high-quality quartzites that occur throughout the Ouachita Mountains. The nearest source of Ouachita Mountain lithics is Fourche Maline Creek, especially below the mouth of Bengal Creek, located on the south side of the Sans Bois Mountains. Unlike Ozark chert sources, the Ouachitas are not easily accessed from the Billy Ross locality. The straight-line distance to Ouachita Mountain lithic sources is approximately 35 km, but this route crosses the rugged Sans Bois Mountains. If Dalton groups exploited the path of least resistance, Brazil Creek or upper Sans Bois Creek, the distance to Ouachita lithic sources is approximately 50 km. In any event, Ouachita lithic sources are slightly further and certainly more difficult to reach than Ozark cherts from the Billy Ross locality. The only exotic lithic type observed in the Billy Ross collection is an exhausted projectile point/knife made from probable Florence chert that occurs in the Flint Hills of north-central Oklahoma and south-central Kansas (Table 2).

McKellips

Like the Billy Ross locality, the McKellips locality is nearly equal distance between Ozark and Ouachita mountain lithic sources. The frequency of Ozark and Ouachita lithic types is also very similar to that observed at the Billy Ross locality (Fig. 19). Ozark lithic types dominate the McKellips sample (60/91). The most common type of Ozark chert in the McKellips collection (33/60) is described as Reeds Spring. The McKellips site is a straight-line distance of 45 km from Ozark lithic sources that occur near the mouth of the Illinois River, and this trek is not encumbered by difficult terrain. The Canadian River as well as Dirty Creek provide potential avenues of approach to the Ozarks.

Thirty-one (31) Dalton points from the McKellips site are made from Ouachita Mountain lithic types. Unlike the Billy Ross sample, less than one-third of these are made from quartzite (7/31). More often, the McKellips occupants selected high-quality cherts from the Johns Valley Formation (Banks 1990), especially that variety which develops a distinctive brown patina. A single Dalton point base is made from novaculite from the Ouachita Mountains of eastern Oklahoma and western Arkansas. The straight-line distance to the nearest Ouachita lithic source, near Blue Mountain, is approximately 50 km. Passage into the Ouachita Mountains could be accomplished via Longtown Creek or Gaines Creek without significant difficulty. In terms of exotic raw materials, a single Dalton point in the McKellips collection is described as Niobrara Jasper in Ballenger (1998). This point is more likely made from a patinated variety of Ozark chert.

Table 2. Raw Material Frequencies for Dalton Materials from Arkoma Basin Localities.

Raw Material	Billy Ross Locality	McKellips Locality	Dirty Creek Locality
Ozark stone total	136	60	46
Reed Springs	70	33	18
Sallisaw	29	9	1
Keokuk/Boone	29	11	18
Ozark (gold patina)	3	2	10
Moorefield	3	3	0
Cotter Dolomite	0	2	0
Webbers Falls siltstone	2	0	0
Ouachita stone total	58	31	6
Quartzite	22	7	1
Johns Valley (brown Patina)	4	8	2
Johns Valley (other)	9	8	2
Zipper	11	4	0
Woodford	10	3	1
Chickochoc	2	0	0
Novaculite	0	1	0
Exotic stone total	1	1	0
Florence	1	0	0

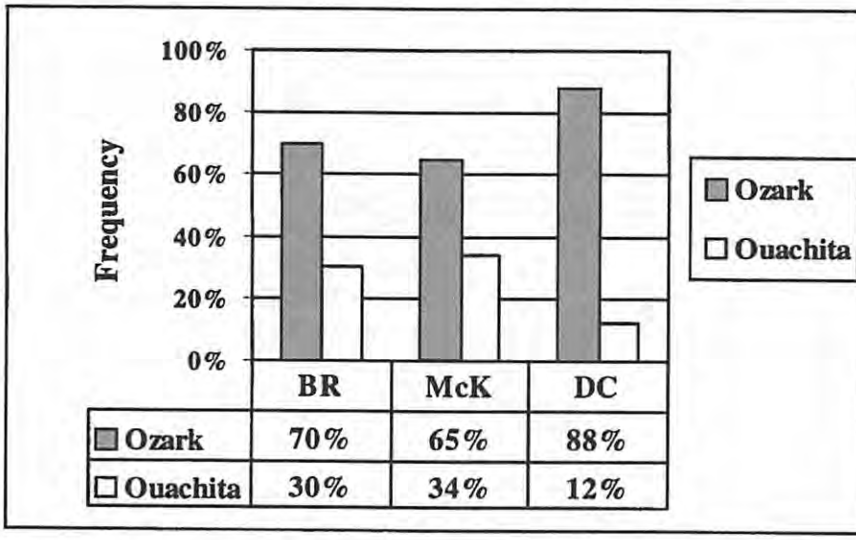


Figure 19. Frequencies of Ozark and Ouachita knappable stone represented by Dalton implements from the Billy Ross, McKellips, and Dirty Creek localities.

Dirty Creek

Unlike the Billy Ross and McKellips localities, the Dirty Creek locality is significantly closer to the Ozarks than it is to the Ouachita Mountains. Forty-six (88%; Fig. 19) of the Dalton points from Dirty Creek are made from Ozark cherts. The majority of these are described as Reeds Spring (18/46) or varieties of Keokuk/Boone (18/46), lithic types that are equally common at Billy Ross and McKellips. Its deep gold patina distinguishes a Ozark Mountain raw material rather unique to the Dirty Creek collection. A few of these specimens exhibit faint bluish banding similar to some varieties of Cotter Dolomite. A large section of the Ozark Uplift, from Bayou Manard to the Illinois River, is within 20-30 km from the upper Dirty Creek locality. This area could be reached by following Dirty Creek downstream to the Arkansas River, or by traversing the lowlands within the Arkansas River Valley.

Only six (6) Dalton points from Dirty Creek are made from Ouachita Mountain lithic types, and only one of these is quartzite. This frequency is strikingly different from that observed at the McKellips site, which is located only 20 km away from the Dirty Creek locality on the south side of the Arkansas-Canadian river divide and which demonstrates significant use of Ouachita lithics. Upper Dirty Creek is approximately 70 km from the nearest source of Ouachita Mountain lithic sources, and a relatively direct route would pass near the McKellips site and follow Longtown Creek.

Functional Diversity of Points

The Dalton points from Billy Ross, McKellips, and Dirty Creek are grouped into 7 classes (Table 3). Tool completeness varies between the collections. Complete points are more common at Billy Ross (34%) and Dirty Creek (23%), whereas only 18% of the points at McKellips are complete. The broken implements are grouped into two fracture types: snap fractures and impact fractures (see Dockall 1997; Odell and Cowan 1986). The Billy Ross locality yielded the fewest impact-fractured projectile points (9%). The Dirty Creek locality sample has the highest percentage of impact fractures (17%). An intermediate frequency of impact fractures is observed in the McKellips collection (11%). Snap fractures outnumber impact fractures in each collection. The Billy Ross and Dirty Creek collections exhibit nearly equal frequencies of snap-fractured points (38-44%), whereas 55% of the Dalton specimens in the McKellips collection are snap fractured. A few fracture types are described as burin breaks. These implements are usually snap-fractured points that exhibit subsequent impact-like fractures (with visible rounding) along one or both lateral edges. Of those points that experienced impact or snap fractures, the majority are represented by basal fragments. A small percentage of broken implements, however, are blades or midsections. At the Billy Ross and Dirty Creek localities, blades or midsections represent between 13% and 14% of the broken points, respectively. Only 6% of the fractured points at the McKellips locality are blades or midsections.

Morphological tool classes include awls, end scrapers, spoke shaves, preforms, adzes, and "Quince scrapers." The frequency of awls is consistent between the collections and ranges from 9% to 12%. End scrapers are also equally represented at the Billy Ross, McKellips, and Dirty Creek localities, representing between 6% and 7% of each assemblage. Preforms only occur at the McKellips and Billy Ross localities. The number of adzes recovered from each locality varies proportionately with the size of the collection. "Quince scrapers" occur piecemeal as far east as LeFlore County, but have yet to be found at the Billy Ross locality.

Tool Utility

The model of tool utility presented in Part 3 is applied to the points recovered from the Billy Ross, McKellips, and Dirty Creek localities. Potential utility is intended to reflect

Table 3. Functional Diversity of Dalton Points and Other Diagnostic Tools.

Dalton Tools	Billy Ross Locality	McKellips Locality	Dirty Creek Locality
Complete Points	34% (n=67)	18% (16)	23% (12)
Impacted Points	9 (18)	11 (10)	17 (9)
Snapped Points	38 (74)	55 (50)	44 (23)
Burinated Points	5 (9)	5 (5)	2 (1)
Awls	9 (18)	12 (11)	12 (7)
End Scrapers	6 (11)	7 (6)	6 (3)
Spoke Shaves	>1 (1)	0	0
Preforms	Present (1)	Present (2)	Absent
Adzes	Present (7)	Present (3)	Present (3)
Quince Scrapers	Absent	Present (6)	Present (4)

to amount of material planned into the tool's design. Expended utility quantifies the relative amount of material removed from a tool. Residual utility is the absolute amount of material a tool retains.

Potential Utility

Identification of the minimum and maximum base widths observed in the Billy Ross, McKellips, and Dirty Creek samples demonstrates 17 cm of variation (Appendix A). Average base width was calculated for each collection and varies between sites and raw materials (Table 4). Raw material properties are assumed to have not influenced point size since unusually wide and unusually narrow forms are made from both raw material types. Standard deviations are large and demonstrate significant variability within each assemblage.

A pattern is observed in the potential utility averages of the Billy Ross, McKellips, and Dirty Creek samples and suggests that a relationship exists between the central tendency of point width and proximity to raw materials (Fig. 19). Points made from Ozark chert are generally more narrow than points made from Ouachita Mountain materials. Tools made from Ouachita Mountain materials, which occur further from each locality than do Ozark raw materials, are generally more wide. It is also noteworthy that the Dirty Creek locality, approximately 20 km from the nearest source of Ozark chert, but 70 km from Ouachita Mountain raw material sources, yields the highest potential utility averages for both raw materials (Table 4, Fig. 20).

Expended Utility

Expended utility reflects the amount of material removed from a tool's blade width relative to its basal width. Three stages are defined and represent class intervals. The amount of tool maintenance dedicated to each artifact increases from expended utility Stage 1 to expended utility Stage 3 (Table 5). In other words, Stage 1 points are closer to Goodyear's (1974) Initial stage and Stage 3 points are closer to his Final stage. Each class is weighted and averages are calculated. Lower averages reflect less expended tool assemblages and higher averages reflect more expended tool assemblages.

An argument is made that, in a context of intentional discard, broken tools can serve as an approximate index of systemic tool condition. Tool failure may be anticipated, but it is generally not planned or provoked. Tool breakage occurs during tool use and, unless repaired for further use, the broken implement is discarded still bearing evidence of its systemic utility. Broken implements cannot be expected to reflect a snapshot of a tool's condition when it arrived at a site, since a significant amount of maintenance could have occurred during site occupation. Normal tool breakage, however, should cause tools in all stages of reuse to be represented (Nelson 1991:72), and tools arriving in different stages of reuse should be distinguishable. At the very least, broken points represent tools that should have experienced further use had they not failed. Further, assuming that tools in all stages of reuse are subject to loss, just as points in all stages of reuse are subject to breakage, then assemblages resulting from tool loss should be distinguishable from

Table 4. Potential Utility Averages for Dalton Collections from Three Arkoma Basin Localities.

Collection Locality	Ozark Raw Materials (#)	Ouachita Raw Materials (#)	Both Raw Materials (#)
Billy Ross	6.8 (115)	7.3 (49)	7.0 (164)
Standard Deviation	3.0	3.4	3.1
McKellips	6.9 (55)	7.3 (32)	7.0 (87)
Standard Deviation	2.2	3.3	2.6
Dirty Creek	7.9 (42)	9.9 (5)	8.1 (47)
Standard Deviation	3.0	3.8	3.1

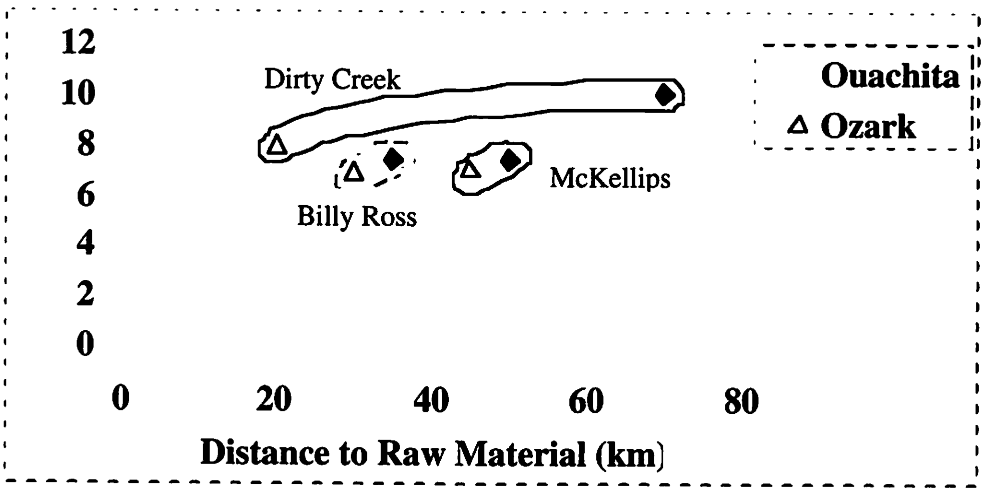


Figure 20. Average potential utility and distance to nearest raw material source for Dalton materials from the Billy Ross, McKellips, and Dirty Creek localities in the Arkoma Basin, eastern Oklahoma.

discarded assemblages. In instances of significant tool loss, the expended utility average of complete points should approximate the expended utility average of broken points. The central tendencies of broken and complete tools may also be similar in situations where "fear-of-failure" dictates tool maintenance and discard or when surplus raw materials and time are available. The intensive maintenance and discard of tools should cause complete points to be generally more reused than broken points (i.e, Bamforth 1986; Kuhn 1989).

The expended utility of broken and complete Dalton points made from Ozark and Ouachita mountain raw materials are presented in relation to the distance from their respective source area (Table 5, Fig. 21). It is noted that broken tools are generally less maintained than complete tools, demonstrating that breakage discourages further reuse and that broken implements better reflect systemic tool utility. An inverse relationship is shown to exist between tool utility and proximity to raw material source (Fig. 21). In other words, Dalton bifaces were not increasingly reused as they were carried farther into chert-poor regions. This pattern contradicts the conventional wisdom of how mobile hunter-gatherer stone tools should change in relation to raw material availability (i.e., Bamforth 1986), where high-quality tool material is gradually depleted and increasingly conserved as populations move into lithic-poor environments. Wyckoff (1999) presents a somewhat similar paradox in his comparison of raw material use by Dalton and Folsom groups in Oklahoma.

Residual Utility

Residual utility measures the absolute amount of material retained on a tool and, in that sense, is similar to the

Table 5. Expended Utility Averages for Ozark and Ouachita Raw Materials at Arkoma Basin Dalton Localities.

Collection	EU Stage	Ozark Cherts Complete	Ozark Cherts Broken	Ouachita Cherts and Quartizes Complete	Ouachita Cherts and Quartizes Broken
Billy Ross	1	7	8	2	1
	2	26	19	13	8
	3	21	12	6	5
	X	2.26	2.10	2.19	2.29
McKellips	1	1	3	2	3
	2	10	9	3	10
	3	4	1	3	2
	X	2.20	1.85	2.13	1.93
Dirty Creek	1	0	3	0	1
	2	11	12	2	2
	3	4	4	0	0
	X	2.27	2.05	2.00	1.67

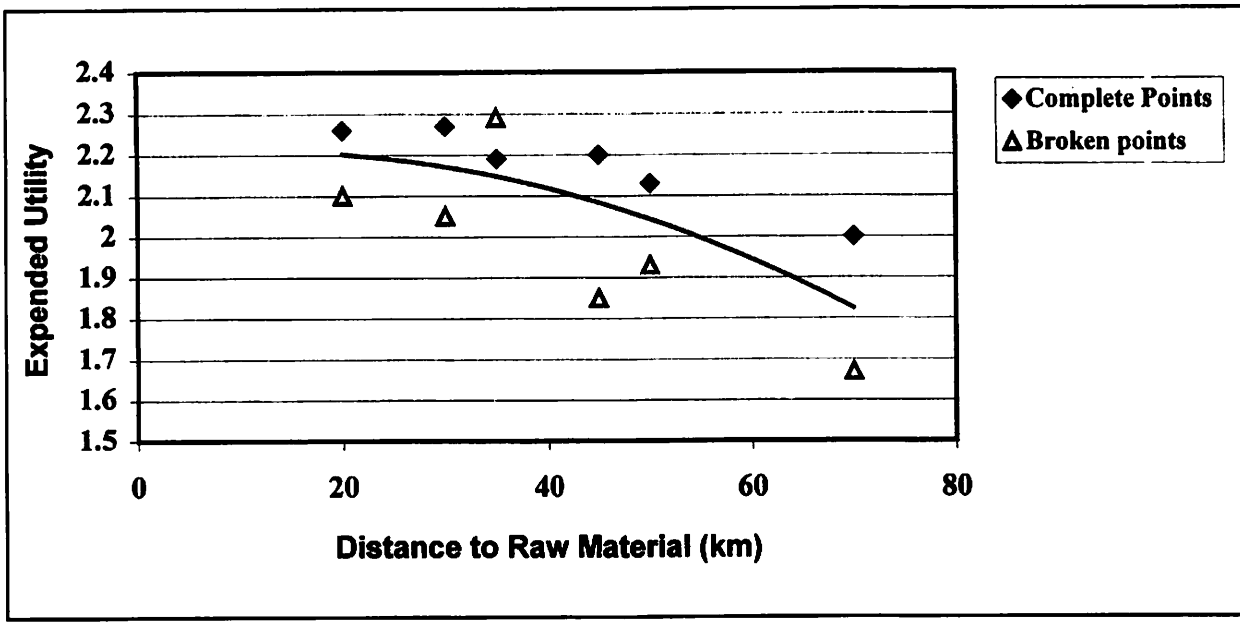


Figure 21. Expended utility of broken and complete Dalton points and their distances to raw material sources near the Arkoma Basin.

Table 6. Average Residual Utility of Complete Dalton Points from Arkoma Basin Localities.

Locality	Ozark Materials (#)	Ouachita Materials (#)
Billy Ross	607 (61)	649 (21)
McKellips	599 (17)	758 (10)
Dirty Creek	544 (15)	762 (2)

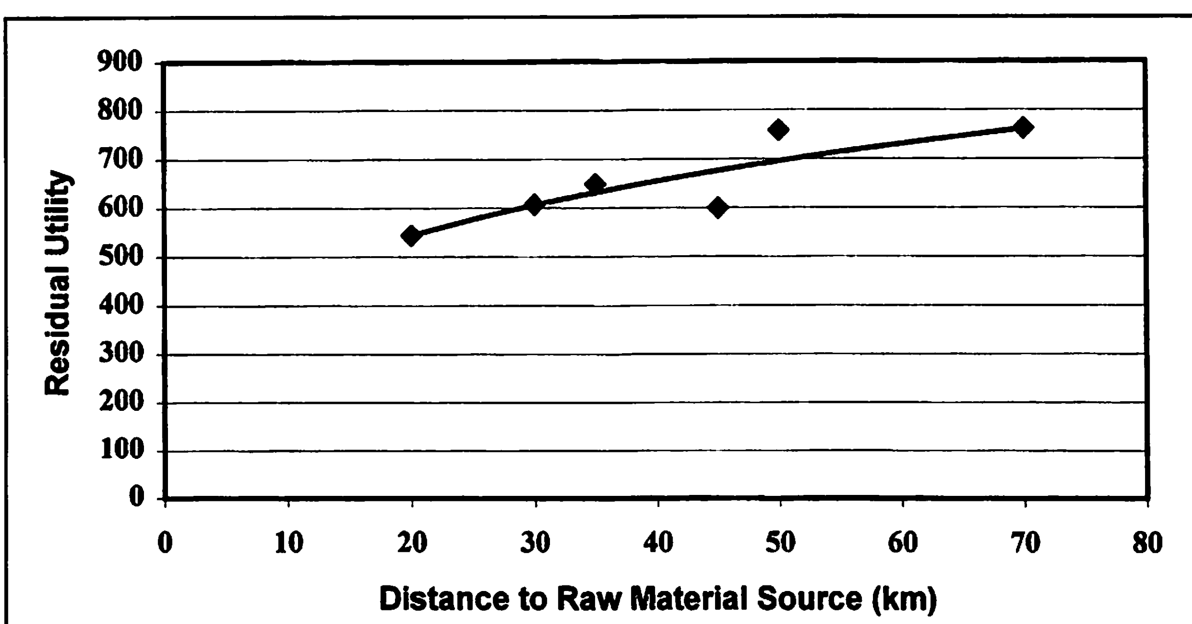


Figure 22. Residual utility of Arkoma Basin Dalton points and their distances to raw material sources.

method used by Morse (1971a) and Goodyear (1974) to identify stages of Dalton point reuse. Because both blade width and length are used in this analysis to determine residual utility, only complete points are measured. Unlike broken tools, which are deemed to reflect tool discard, complete artifacts can result from tool discard or tool loss. At each locality, Ouachita-made points were discarded or lost bearing more residual utility than Ozark-made points (Table 6). Again, the residual utility of complete points is shown to increase in relation to the distance from the raw material source (Fig. 22).

Summary

I have presented information on three Dalton localities in the Arkoma Basin of eastern Oklahoma. A total of 324 Dalton points are examined in terms of raw material identification, functional variability, and tool utility. Relationships are observed between tool condition, tool utility, and proximity to raw material. In summary, the Billy Ross and McKellips localities reflect intensively occupied and spatially restricted occupations, whereas the Dirty Creek collection reflects several small camps distributed over a large area. Ozark and Ouachita mountain raw materials are well represented at Billy Ross and McKellips. The Dirty Creek collection is dominated by Ozark cherts with only a few points made from Ouachita Mountains cherts or quartzites. Functional diversity between the collections indicates that the Dirty Creek locality witnessed more hunting activity, based on the frequency of impact fractures. Dalton points retooled as end scrapers, awls, and burins are represented at each locality. Large adzes also occur at each locality, but "Quince scrapers" are notably absent from the Billy Ross locality.

The potential, expended, and residual utilities of Dalton points at each locality demonstrate an interrelationship. At each locality, points made from Ozark chert generally began their lives with less potential utility than points made from Ouachita cherts and quartzites. Points made from Ozark chert were more extensively reused than points made from Ouachita cherts and quartzites. Because Ozark-made points began their lives with less potential utility and experienced more reuse than Ouachita-made points, their residual utility is generally lower (Table 7). This logical relationship is complicated by the expended utility averages of broken points from Billy Ross and McKellips, where broken points made from Ozark chert were less reused than broken points made from Ouachita cherts and quartzites. This anomalous relationship perhaps reflects functional differences between these localities and activities along Dirty Creek.

Contrary to my expectations of how stone tools should change with time and across space (Fig. 23, top), a second pattern observed in the data indicates that Dalton points were not becoming more reused as they were carried farther from raw material sources. Rather, points located closer to their quarry source are generally more reused than points located farther from their material source. This pattern is reflected in both the expended and residual utility values (Fig. 20, bottom). The practice of retooling in remote locations is a likely explanation for this pattern. In addition to finished points, bifaces and preforms could be carried away from quarry sources and made into points when needed. Further, partially depleted points would not necessarily be discarded in the process of replentishing raw material supplies, but would be among the first tools to be used and discarded while leaving the quarry source (Bement 1999). This behavior would contribute to the observed trend for heavily resharpened points being found near quarry sources, whereas newer points occur farther away.

Table 7. Relationships Between Potential, Expended, and Residual Utilities of Dalton Points from Arkoma Basin Localities.

Utility Category	Billy Ross		McKellips		Dirty Creek		Notes
	Ozarks	Ouachitas	Ozarks	Ouachitas	Ozarks	Ouachitas	
Potential Utility	-	+	-	+	-	+	Ozark specimens begin with less potential utility than items of Ouachita material.
Expended Utility	+(-)	-(+)	+(-)	-(+)	+(+)	-(-)	Unbroken points of Ozark material experience more extensive reuse than unbroken specimens of Ouachita materials. Billy Ross and McKellips broken points ( ) of Ozark material are less extensively used than those of Ouachita materials.
Residual Utility	-	+	-	+	-	+	Unbroken points of Ozark stone are lost or discarded with less residual utility than those of Ouachita materials.

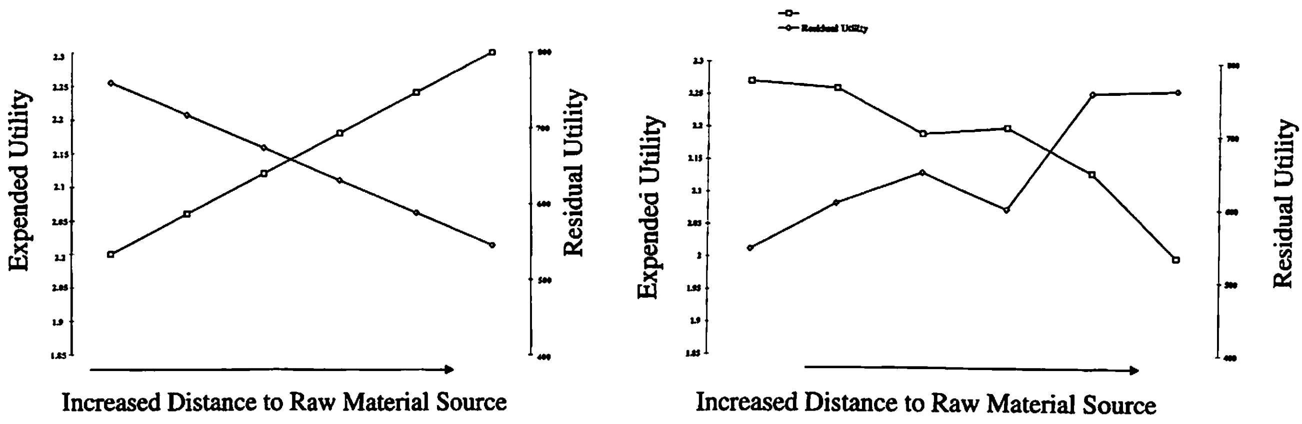


Figure 23. Left: expected relationships between tool utility values and distance to raw material sources for Dalton collections in the Arkoma Basin. Right: observed relationships between tool utility values and distances to raw material sources for Dalton collections in the Arkoma Basin

Part 5
INTERPRETATION AND SUMMARY

Here the information presented in Part 4 is used to explore Dalton settlement mobility in the Arkoma Basin of eastern Oklahoma. The examination of site location, raw material use, functional diversity, and tool utility indicates that important differences as well as similarities occur between the Billy Ross, McKellips, and Dirty Creek collections. The Dalton evidence from these localities is compared to the test implications, and a preliminary model of Dalton settlement is offered for eastern Oklahoma.

Data Interpretation

Because each of the collections analyzed in this thesis occur in the Arkoma Basin and not in the uplands of the Ozark or Ouachita mountains, only a portion of the entire settlement system is represented and all of the implications cannot be tested. Several expectations are recognized for sites located within the Arkoma Basin, however, and these provide an opportunity to evaluate each of the settlement models.

The Dalton settlement hypothesis constructed by Morse (1971b) is not supported by the data. Raw materials from both physiographic regions occur at each locality. This pattern would not occur if Dalton microbands were restricted to single watersheds (Fig. 10). However, an extended territory, including the entire Arkansas River Valley, could result in assemblages that contain both Ozark and Ouachita mountain raw materials. Logistical task groups could move into both uplands to procure chert and other resources, then return those goods to residential base camps located along the Arkansas River or its major tributaries. Residential base camps would be centrally located along the Arkansas River Valley and would not occur in peripheral areas. The McKellips locality, situated 45 km from raw material and other upland resources and demonstrating a wide range of tool-using activities, is more diverse than a simple hunting/butchering station and does not support the notion of a drainage-based Dalton territory along the Arkansas River Valley. Because the North Canadian River is separated from Ozark raw materials by the Arkansas River, a North Canadian River-based Dalton group is equally unlikely.

At face value, the Billy Ross, McKellips, and Dirty Creek localities indicate that Dalton groups practiced residential mobility between the Ozark and Ouachita mountains (Ballenger 1998). Based on disproportionate frequencies of Ozark and Ouachita mountain raw materials at each locality (Fig. 19), a linear pattern of back-and-forth movements is unlikely (Fig. 11). Disproportionate levels of Ozark and Ouachita mountains raw materials could occur, however, if Dalton groups moved between uplands using a circular route. A counterclockwise pattern would place Dalton groups in the Dirty Creek area with abundant supplies of Ozark chert. Because these tools would have to endure a long trek until Ouachita Mountain raw material sources were available, their potential utility should be relatively high. Further, because Dirty Creek is relatively close to Ozark chert sources, the expended utility of Dalton points arriving at the Dirty Creek locality should be relatively low. As groups continued south towards the Canadian River and the McKellips locality, the expended utility of tools made from Ozark chert should increase. At the McKellips site, logistical trips to procure raw materials should exploit the nearest source, or the Ozark Mountains. After a seasonal occupation in the Ouachita Mountains, groups occupying the Billy Ross locality should have large supplies of Ouachita Mountain cherts and quartzites. Logistical parties would exploit Ozark chert sources, if necessary. This relationship would be reversed using a clockwise route.

The Dirty Creek and McKellips assemblages do not indicate unidirectional or circular movement from the Ozarks to the Ouachita Mountains. Small amounts of Ouachita Mountain raw materials are observed in the Dirty Creek collection and are well represented at the McKellips locality (Fig. 19). Further, points made from Ozark chert are less reused at the McKellips site than they are at Dirty Creek (Table 5). The Billy Ross locality also precludes the likelihood of unidirectional movement from the Ouachita Mountains to the Ozarks, because most points are made from Ozark chert. A clockwise route is equally unfeasible, since such a trek would influence the nearly exclusive use of Ozark chert at the Billy Ross locality (Fig. 11).

In more general terms, the expended and residual utility averages calculated for each locality indicate that Dalton points did not become increasingly reused as they were moved farther from perspective raw material sources (Figures 21 and 22). This observation alone discounts the likelihood that residential mobility was practiced between the Ozark and Ouachita mountains, which would encourage tools to become more exhausted as they were carried farther away from the raw material source. A second possible explanation for the relationship observed between utility values and distance to material source (Fig. 23) is the use of portable bifaces and preforms to replentish tool supplies while away from preferred material sources, and also the discard of extensively reused points soon after leaving those sources.

The assumption that Dalton groups moved seasonally between the Ozark and Ouachita Mountains (Ballenger 1998) seems unlikely in light of the evidence discussed here. Still more, in environments that provide ecologically similar uplands such as the Ozark and Ouachita mountains, what motive would Dalton groups have to trek 60 km or more across the Arkoma Basin to exploit both regions? An alternative explanation is offered that does not include upland-to-upland travel, but accounts for the use of both Ozark and Ouachita mountain raw materials in the Arkoma Basin. Specifically, the Dalton evidence collected from the Billy Ross, McKellips, and Dirty Creek localities can be explained if two Dalton macrobands, one staging from the Ozarks and the other from the Ouachita Mountains, occupied eastern Oklahoma (Wyckoff and Bartlett 1995). The Arkoma Basin represents a buffer between these physiographic regions and would have supported aggregation sites as Ozark-based and Ouachita-based groups came together to fulfill physical and social needs.

In terms of the expended and residual utility values, it is argued that Dalton groups from each territory visited sites in the Arkoma Basin during seasonal residential camps and aggregations. Using portable bifaces and preforms, new points were made at these encampments. The Billy Ross and McKellips localities, each located an approximately equal distance between the Ozark and Ouachita mountains, are considered to represent fall aggregation sites. These are two of the largest Dalton collections reported from the Arkoma Basin and reflect significant use of both Ozark and Ouachita mountain raw materials (Table 2). Dalton groups could anticipate the duration of these aggregations and prepare their tools accordingly. In the case of the McKellips locality, points made from Ozark chert and Ouachita cherts and quartzites arrived with different amounts of potential utility (Table 4). Based on expended and residual utility averages (Tables 5 and 6), Ozark tools experienced more intensive reuse and additional raw material supplies may have been required. Because Ozark chert sources are closer and more topographically accessible than Ouachita raw material sources, logistical parties should have reinforced raw material supplies with Ozark cherts. This may account for Ozark cherts being more frequent at the McKellips site than Ouachita cherts and quartzites. A similar situation may have occurred at the Billy Ross locality, where points made from Ozark chert arrived at the site with less potential utility than points made from Ouachita resources and may have required replenishment, therefore introducing greater supplies of Ozark chert to the assemblage. An alternative explanation for the greater frequencies of points made from Ozark chert may be larger populations representing an Ozark-based macroband, or more frequent visits by Ozark-based groups.

The Dirty Creek locality is a more elevated setting that reflects ephemeral Dalton use. Based on an increase in impact fractures (Table 3), Dirty Creek may have functioned as a hunting locality that supplemented local aggregation sites such as McKellips. Whether Dalton populations in eastern Oklahoma were exploiting bison is unknown and, without uncontestable evidence otherwise, it is assumed that the populations who hunted along Dirty Creek were targeting deer and other small game. Cooperative hunts along Dirty Creek would account for the occasional points made from Ouachita Mountain raw materials. Although the number of points made from Ouachita Mountain raw materials is small at the Dirty Creek locality, their average potential utility is high (Table 4). In fact, complete points made from Ouachita Mountain raw materials are generally wider, less extensively reused, and discarded or lost with more residual utility than points made from Ozark chert. Because cobble size is not considered a significant factor, this pattern suggests that Ouachita-based groups practiced a less conservative strategy of point reuse and discard than Ozark-based groups. This level of consumption would not be supported by larger supplies of Ouachita Mountain raw materials, since Ouachita cherts and quartzites are less common and less accessible than Ozark cherts at each locality. This observation further supports the contention that two Dalton macrobands, with slightly different tool-using practices, existed in eastern Oklahoma.

Large Dalton points are argued to reflect social alliances such as, for example, male hunting cults (Walthall and Koldehoff 1998). The display and trade of these items are expected at seasonal aggregations. The Billy Ross, McKellips, and Dirty Creek collections each contain a few unusually large Dalton points that would qualify as Dalton "long blades," but none that do not indicate use as knives. Whether or not equally large points occur in upland winter sites is not documented, but their occurrence at non-aggregation sites would help resolve the question of whether large, utilitarian Dalton points were designed for strictly economic or socio-economic purposes.

The presence of Quince "scrapers" at the McKellips and Dirty Creek localities indicates that a special task was performed in these settings that was not important at the Billy Ross locality. Without a better understanding of these tools' function, little can be interpreted by their presence or absence at particular sites. Similarity is observed with the Dalton adz, and Quince scrapers are certainly more portable than the typical adz, but no evidence exists that they functioned as "miniature adzes" on the prairie or during seasons of increased mobility.

To conclude, large, diverse Dalton collections in the Arkoma Basin can be best explained using the Ozark-Ouachita macroband interpretation. These aggregations reinforced social alliances shared by hunter-gatherer groups whose territories were defined by sheltered, chert-rich physiographic regions. Fall aggregations would also allow groups to physically prepare themselves for winter dispersal into the Ozark and Ouachita uplands during the lean season. Cooperative hunts, characterized by small sites or isolated finds, were also performed in the Arkoma Basin. This scenario is in general agreement with a number of studies that emphasize the role of lithic sources, territoriality, and social interaction in early Archaic settlement strategies.

Summary

I have examined 324 Dalton points collected from three localities in the Arkoma Basin of eastern Oklahoma. Dalton occupations are documented but poorly understood along this prairie-woodland border. Chronological issues cannot be examined using surface-collected materials. Until a series of dates are produced from buried assemblages, there is no reason to suspect that Dalton occupations in Oklahoma occurred outside Goodyear's (1982) time frame of 10,500 to 9900 years ago. The alluvial history of the Arkoma Basin is not well documented, but early Holocene occupations are elusive and thus retard our understanding of Dalton population structure in eastern Oklahoma. Questions of Dalton subsistence must remain unanswered until deposits with plant and animal remains are discovered. Based on pollen records from Ferndale Bog in southeast Oklahoma and Muscotah Marsh in northeastern Kansas, eastern Oklahoma was a prairie during Dalton times with wooded environments confined to the valleys (Ferring 1994; Grüger 1973). This scenario introduces the potential for an adaptive shift to prairie-plains resources. Still, Dalton adaptations in eastern Oklahoma seem to parallel those observed in the Eastern Woodlands.

This study has examined Dalton technology and settlement in the Arkoma Basin. Raw material identification demonstrates a relatively strict use of Ozark and Ouachita mountain raw materials. The functional diversity of Dalton points is defined and provides a mechanism to explore interassemblage variability using diagnostic tools. Further, a model is presented that quantifies the potential, expended, and residual utility of Dalton points (i.e., Kuhn 1989, 1994). This information is used to address Dalton settlement in eastern Oklahoma. Three models of Dalton settlement are presented, including the Dalton settlement hypotheses advanced by Morse (1971a, 1975, 1977, 1997) and Schiffer (1975a,b), as well as the Ozark-Ouachita macroband construct suggested by Wyckoff and Bartlett (1995). Based on site location, raw material use, tool breakage, and tool utility, preference is given to the Ozark-Ouachita macroband model. A generalized routine of Dalton settlement is argued to have involved overwintering camps in the Ozark and Ouachita mountains; spring and summer camps along major valleys such as the Arkansas River, the Illinois River in the Ozarks, and the Kiamichi River in the Ouachitas; and fall aggregations in the Arkoma Basin. Testing this hypothetical settlement pattern will require similar studies along the Arkansas River Valley of western and central Arkansas and in the Ozark and Ouachita mountains.

Footnotes

1. Page 13: Morse et al. (1996) and Anderson et al. (1996) place the early side-notched projectile assemblage at Dust Cave at 10, 200 years ago.

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Appendix A

Characteristics of the Studied Dalton Points

Key:
I = Impact fracture
S = Snap fracture
B = Burin-like fracture
Oz = Ozark chert
Ou = Ouachita Mtns. chert or quartzite
KC = Florence chert (Kay County, Oklahoma)

Attributes and Variables of Dalton Points from Billy Ross Locality

Spec #	Length	Base Width	Blade Width	Blade Length	Thickness	Breakage	Raw Mat.	Notes
1	91.7	17.6	21.3	76.1	6.6	I	OZ	Ear missing
2	61.1	28.5	30.8	--	7.3	S	OZ	Preform, tip and ear missing
3	98	24.0	25.5	70.0	8.8	--	OZ	
4	61.4	24.0	24.0	46.0	8.4	--	OU	
5	70.5	22.8	23.1	54.0	7.2	--	OZ	
6	53.3	20.1	20.3	35.0	6.5	I	OZ	Ear missing
7	45.8	29.8	29.8	--	8.8	S	OZ	Tip missing
8	66.9	18.5	18.5	--	7.8	S	OZ	Refit
9	69.7	19.4	19.1	54.0	7.5	--	OZ	
10	68.5	19.7	19.0	58.0	7.5	--	OU	
11	43.6	24.8	24.0	--	5.9	S	OZ	Tip missing
12	54.2	23.0	21.7	39.0	7.5	--	OZ	
13	43.1	24.3	22.7	--	7.5	I	OU	Tip missing
14	60.6	19.4	18.1	47.0	6.6	--	OZ	
15	57.8	15.9	14.7	--	5.8	S	OZ	Ear missing
16	101.5	25.8	24.1	86.0	6.5	--	OZ	
17	78.9	25.7	23.8	63.0	7.8	--	OZ	
18	51.0	23.0	21.2	--	7.0	I	OZ	Tip missing
19	59.8	24.4	21.6	--	7.0	I	OZ	Tip missing
20	50.5	27.7	24.7	--	6.8	S	OZ	Tip missing
21	44.6	21.2	19.0	--	7.3	I	OZ	Tip missing
22	110.6	21.0	18.6	87.0	8.8	--	OU	
23	51.3	24.0	21.1	--	7.1	S	OU	Tip missing
24	64.4	20.0	17.5	50.0	9.0	--	OZ	
25	99.5	23.8	20.3	--	8.8	S	OZ	Tip missing
26	40.6	26.3	22.4	--	8.8	S	OZ	Tip missing
27	71.6	23.3	19.4	57.0	7.0	--	OZ	
28	67.5	22.9	18.9	55.0	6.8	--	OU	
29	47.0	22.6	18.5	--	6.0	S	OZ	
30	43.2	22.3	18.4	--	7.8	I	OU	Tip missing
31	30.1	20.6	16.9	--	6.9	S	OZ	Tip missing
32	--	20.0	16.4	--	6.3	I	OU	Tip missing
33	59.5	25.0	20.0	48.0	8.6	--	OZ	
34	66.7	21.1	16.7	49.0	8.0	--	OZ	
35	59.8	24.6	19.5	43.0	7.5	--	OU	
36	64.0	26.5	20.6	--	7.1	--	OU	Tip missing
37	--	18.7	14.5	--	6.9	S	OZ	Tip missing
38	47.3	20.5	15.7	35.0	7.8	--	OU	Spokeshave
39	46.1	23.5	17.9	--	7.1	--	OU	
40	58.0	24.0	18.3	40.0	6.8	--	OZ	
41	75.3	23.0	17.4	62.0	6.7	--	OZ	
42	52.5	24.0	17.9	38.0	7.1	--	OZ	
43	66.0	25.2	18.4	51.0	7.0	--	OZ	
44	56.5	23.0	16.8	40.0	7.9	--	OZ	
45	37.3	21.8	15.8	--	6.7	S	OZ	Tip missing

Attributes and Variables of Dalton Points from the Billy Ross Locality (cont.)

46	99.3	25.0	18.0	77.0	8.2	I	OZ	
47	49.0	18.0	12.7	--	7.3	S	OU	Tip missing
48	40.3	23.9	16.6	--	6.4	S	OZ	Tip missing
49	84.1	24.2	16.8	67.0	8.3	--	OZ	
50	73.6	25.0	17.2	55.0	8.1	--	OZ	
51	60.4	27.2	18.7	47.0	6.5	--	OU	
52	44.9	21.1	14.4	31.0	6.5	S	OZ	Tip missing
53	46.0	23.2	15.7	--	7.8	S	OZ	Tip & ear missing
54	45.5	19.1	12.8	30.0	5.5	--	OZ	
55	63.0	19.8	13.2	53.0	6.9	--	OZ	
56	56.0	25.5	17.0	36.0	5.5	--	OU	
57	64.7	23.2	15.2	45.0	8.2	--	OU	
58	63.6	17.8	11.6	49.0	11.6	--	OZ	Awl
59	62.0	27.1	17.7	50.0	7.7	--	OU	
60	44.5	21.5	13.8	--	6.2	I	OZ	Tip missing
61	47.8	20.0	12.7	31.0	6.0	S	OU	Ear missing
62	56.9	25.7	15.8	45.0	6.5	--	OZ	
63	47.4	22.5	13.7	31.0	5.5	--	OZ	
64	45.6	26.8	16.1	27.0	7.6	--	OZ	
65	53.1	23.5	14.0	--	7.9	S/B	OZ	Ear missing
66	45.7	22.5	13.3	30.0	6.0	--	OZ	
67	--	33.2	19.5	--	9.2	S	OZ	Tip missing
68	45.0	21.6	12.5	33.0	6.2	--	OZ	
69	51.1	27.9	16.0	--	6.6	I	OZ	Lateral edge missing
70	46.3	21.0	12.0	29.0	6.0	--	OZ	
71	43.4	22.1	12.4	30.0	6.8	--	OU	
72	30.1	18.5	15.7	--	6.5	S	OU	Tip missing
73	35.9	17.5	9.4	18.0	6.7	S	OZ	Tip missing
74	42.1	19.1	10.1	26.0	5.9	--	OZ	
75	42.8	25.8	13.5	--	8.8	S/B	OU	Tip missing
76	68.0	28.3	14.8	51.0	6.5	--	OU	
77	60.0	21.0	10.8	--	8.4	S	OU	Awl, ears missing
78	44.8	23.9	12.2	30.0	6.5	--	OZ	
79	35.2	20.4	10.4	25.0	6.9	--	OZ	
80	--	23.8	12.0	--	7.1	S	OZ	Awl, tip missing
81	49.0	22.8	11.4	39.0	7.3	--	OZ	
82	58.2	21.3	10.5	47.0	6.6	--	OU	Awl
83	41.6	25.8	12.5	29.0	7.0	--	OZ	
84	51.8	19.7	9.4	40.0	5.5	--	OZ	
85	50.4	21.8	10.2	36.0	6.8	--	OZ	
86	44.7	22.8	10.7	35.0	5.6	--	OZ	
87	50.6	23.7	11.0	38.0	5.2	--	OU	
88	35.7	20.0	9.2	19.0	6.5	I	OZ	Tip repaired
89	64.6	21.7	10.0	--	6.0	S	OZ	Awl, refit
90	41.5	22.6	10.3	24.0	7.7	S	OZ	Tip repaired

Attributes and Variables of Dalton Points from the Billy Ross Locality (cont.)

91	31.0	22.5	10.2	--	7.0	--	OU	Tip & ear missing
92	57.3	23.7	10.7	41.0	6.5	B	OZ	
93	39.5	16.9	7.6	--	5.8	S	OZ	Awl, tip & ear missing
94	33.4	21.3	9.5	--	5.8	S	OZ	Awl, tip missing
95	61.6	18.0	7.8	40.0	7.1	--	OZ	
96	51.0	19.5	8.2	48.0	5.4	--	OZ	Awl
97	37.1	21.0	8.8	--	5.9	S	OZ	Awl
98	58.9	20.9	8.7	45.0	6.3	--	OZ	
99	38.5	23.2	9.6	29.0	7.5	--	OU	
100	61.5	24.9	10.3	50.0	7.5	--	OU	
101	45.0	20.3	8.4	34.0	7.1	--	OZ	Awl
102	40.0	26.2	10.8	25.0	5.0	B	OZ	
103	42.1	27.0	11.0	--	5.5	S	OU	Tip & ear missing
104	54.5	22.3	8.9	37.0	5.8	--	OZ	
105	34.2	22.0	8.8	22.0	7.5	--	OZ	
106	40.2	20.3	8.0	--	6.5	B	OU	Awl
107	46.2	21.8	8.5	30.0	5.6	--	OZ	Awl
108	66.6	24.8	9.5	50.0	7.0	--	OZ	
109	41.5	25.2	9.5	24.0	6.9	B	OU	
110	60.3	25.0	9.2	43.0	6.6	S	OZ	Ear missing
111	72.9	24.4	9.0	56.0	7.4	--	OZ	Awl
112	47.3	24.0	8.7	39.0	6.1	--	OZ	
113	52.3	26.4	9.0	40.0	6.6	--	OZ	Awl
114	35.5	25.1	8.5	22.0	6.8	B	OZ	
115	50.6	17.0	5.7	38.0	6.7	--	OU	
116	40.6	24.1	7.4	28.0	5.7	--	OZ	
117	23.7	23.2	7.0	--	6.1	S	OZ	
118	46.0	23.3	6.7	36.0	6.2	--	OZ	Awl
119	49.6	26.0	6.6	39.0	6.8	--	OU	
120	36.5	21.6	5.4	27.0	5.0	--	OZ	Awl
121	29.0	21.0	--	21.0	5.8	--	OZ	
122	30.5	21.9	3.6	20.0	6.5	--	OZ	
123	41.8	23.4	10.9	--	6.7	S	OU	Awl
124	54.4	16.9	9.3	42.0	7.4	--	OU	Awl
125	32.8	20.0	6.2	--	5.4	S/B	OZ	
126	29.5	26.1	--	20.3	6.0	--	OZ	
127	29.1	33.0	--	--	6.2	--	OU	
128	34.0	23.2	--	20.6	7.0	S/B	OU	Both ears missing
129	24.9	25.7	--	--	6.5	S	OZ	Tip missing
130	28.0	21.8	--	--	5.3	I	OU	Tip missing
131	--	--	--	--	--	--	KC	Severely reworked
132	31.8	21.6	--	--	5.8	I	OU	Tip missing
133	--	30.0	--	--	--	S	OU	Base
134	--	29.4	--	--	--	I	OZ	Base
135	--	23.0	--	--	--	S	OZ	Base
136	--	20.8	--	--	--	S	OZ	Base
137	--	22.0	--	--	--	S	OZ	Base

Attributes and Variables of Dalton Points from the Billy Ross Locality (cont.)

138	--	30.4	--	--	--	S	OZ	Base
139	--	24.0	--	--	--	S	OZ	Base
140	--	20.6	--	--	--	S	OZ	Base
141	--	23.2	--	--	--	S	OZ	Base
142	--	21.0	--	--	--	S	OZ	Base
143	--	26.5	--	--	--	S	OZ	Base
144	--	26.7	--	--	--	S	OZ	Base
145	--	23.5	--	--	--	S	OZ	Base
146	--	21.2	--	--	--	S	OZ	Base
147	--	23.8	--	--	--	S	OZ	Base
148	--	20.0	--	--	--	S	OU	Base
149	--	23.5	--	--	--	S	OU	Base
150	--	30.0	--	--	--	S	OU	Base
151	--	28.0	--	--	--	S	OU	Base
152	--	19.5	--	--	--	S	OU	Base
153	--	20.0	--	--	--	S	OU	Base
154	--	22.0	--	--	--	S	OU	Base
155	--	--	--	--	--	S	OU	Base
156	--	--	--	--	--	S	OU	Base
157	--	--	--	--	--	S	OU	Base
158	--	--	--	--	--	S	OZ	Midsection
159	--	--	--	--	--	S	OZ	Midsection
160	--	--	--	--	--	S	OZ	Midsection
161	--	--	--	--	--	S	OZ	Midsection
162	--	--	--	--	--	S	OU	Midsection
163	--	--	--	--	--	S	OZ	Midsection
164	--	--	--	--	--	I	OU	Midsection
165	--	--	--	--	--	I	OZ	Midsection
166	--	--	--	--	--	S	OZ	Blade
167	--	--	--	--	--	S	OZ	Blade
168	--	--	--	--	--	S	OZ	Blade
169	--	--	--	--	--	S	OZ	Blade
170	--	--	--	--	--	S	OZ	Blade
171	--	--	--	--	--	S	OZ	Blade
172	--	--	--	--	--	S	OZ	Blade
173	--	--	--	--	--	S	OU	Blade
174	39.3	26.4	--	--	6.4	--	OZ	Scraper
175	78.0	22.4	21.5	--	8.7	--	OZ	Scraper
176	44.0	25.6	18.4	--	7.2	--	OU	Scraper
177	44.5	17.5	18.0	--	8.0	--	OZ	Scraper
178	43.0	22.0	--	--	6.9	--	OZ	Scraper
179	32.2	21.0	--	--	6.4	--	OU	Scraper
180	33.0	24.3	--	--	7.6	--	OZ	Scraper
181	38.0	22.6	17.6	--	8.3	--	OZ	Scraper
182	36.2	22.0	17.1	--	6.8	I	OZ	Scraper
183	34.4	19.0	--	--	6.4	--	OZ	Scraper
184	44.6	22.3	13.3	--	7.4	--	OZ	Scraper

* 12 fragments not included in table

Attributes and Variables of Dalton Points from McKellips Locality

Spec #	Length	Base Width	Blade Width	Blade Length	Thickness	Breakage	Raw Mat.	Notes
1	84.0	25.0	30.1	--	9.0	--	OU	Preform
2	63.0	21.5	24.0	--	8.0	S	OZ	Tip missing
3	143.5	26.8	29.2	105.0	7.3	--	OU	
4	52.5	23.8	24.4	--	6.5	I	OU	Tip & ear missing
5	73.3	23.0	23.0	58.0	6.8	--	OZ	Preform
6	37.5	26.0	25.2	--	7.0	S/B	OZ	Tip missing
7	43.0	32.0	31.0	--	7.0	S	OU	Tip missing
8	39.0	21.0	19.5	--	7.0	S	OU	Tip and ear missing
9	36.0	24.0	22.0	--	6.5	I/B	OZ	Tip and ears missing
10	44.0	22.0	19.8	--	8.0	S	OU	Tip and ear missing
11	59.0	27.0	23.7	36.0	7.0	--	OZ	
12	58.0	19.5	17.0	37.0	7.2	--	OZ	
13	61.0	23.0	20.0	36.0	8.5	--	OU	
14	63.0	20.5	17.2	--	7.5	I	OZ	Tip missing
15	68.5	25.0	21.0	--	9.5	I	OU	Tip missing
16	60.5	20.2	16.5	43.0	5.6	--	OZ	
17	64.0	26.0	20.2	47.0	7.0	--	OU	
18	69.0	18.5	14.3	--	7.0	I	OZ	Tip and ear missing
19	65.0	24.0	18.5	--	8.0	S	OZ	Tip missing
20	57.4	22.6	17.3	42.0	7.2	--	OZ	
21	50.5	20.5	15.5	--	7.5	I	OU	Tip missing
22	50.2	23.2	17.3	--	6.6	S	OZ	Tip and ear missing
23	33.0	22.5	16.5	--	7.0	S	OZ	Tip missing
24	48.5	24.8	18.2	--	8.4	S	OU	Tip missing
25	56.7	24.5	18.0	--	6.3	S	OZ	Tip missing
26	41.1	20.8	14.9	24.0	5.9	I	OU	Tip repaired
27	56.0	26.0	19.0	33.0	6.0	I	OZ	Lateral edge missing
28	48.0	22.0	15.2	34.0	6.0	I	OU	Tip missing
29	56.4	23.5	15.9	41.0	8.0	S	OU	Tip missing
30	61.0	24.0	16.6	52.0	5.7	--	OZ	
31	53.0	24.0	16.5	39.0	8.7	--	OZ	
32	37.0	20.0	13.5	--	6.5	S	OU	Tip missing
33	60.0	20.0	13.2	45.0	6.0	--	OU	
34	62.0	24.0	15.4	43.0	7.0	--	OZ	
35	41.0	22.0	14.0	--	6.0	S	OZ	Tip missing
36	41.0	23.0	14.0	25.0	8.0	--	OZ	
37	47.0	20.0	11.6	43.0	7.2	--	OZ	
38	35.0	24.0	13.6	--	7.0	I	OZ	Tip missing
39	51.0	16.0	9.0	36.0	6.0	--	OZ	Awl
40	52.0	20.0	10.5	--	5.8	S	OU	Tip missing
41	58.0	18.0	9.0	--	7.5	S/B	OU	Tip and ear missing
42	61.8	23.3	11.0	49.0	7.0	--	OZ	Awl

Attributes and Variables of Dalton Points from McKellips Locality (cont.)

43	40.0	19.0	8.7	33.0	6.5	--	OU	Awl, lateral edge missing
44	52.0	24.5	11.2	--	5.7	S	OU	Awl, tip missing
45	40.5	23.5	10.0	25.0	7.5	--	OZ	Ear missing
46	55.0	23.0	9.4	55.0	5.8	--	OZ	Awl
47	51.0	23.0	9.2	42.0	6.0	--	OZ	Awl, lateral edge missing
48	47.0	20.0	6.5	37.0	6.0	--	OU	Awl
49	38.0	28.0	8.8	30.0	5.5	B	OZ	Lateral edges missing
50	42.0	18.0	5.5	35.0	5.7	--	OU	Awl
51	28.0	21.0	--	14.0	6.5	--	OZ	
52	--	29.0	--	--	--	S	OZ	Base
53	--	27.0	--	--	--	S	OU	Base
54	--	22.0	--	--	--	S	OZ	Base
55	--	23.1	--	--	--	S	OZ	Base
56	--	22.3	--	--	--	S/B	OU	Base
57	--	28.6	--	--	--	S	OU	Base
58	--	23.7	--	--	--	S	OZ	Base, awl
59	--	23.4	--	--	--	S	OZ	Base
60	--	23.5	--	--	--	S	OZ	Base
61	--	21.4	--	--	--	S	OZ	Base, awl
62	--	23.6	--	--	--	S	OZ	Base
63	--	20.3	--	--	--	S	OZ	Base, awl
64	--	21.5	--	--	--	S	OZ	Base
65	--	21.6	--	--	--	S	OZ	Base
66	--	22.9	--	--	--	S	OZ	Base
67	--	24.5	--	--	--	S	OZ	Base
68	--	21.2	--	--	--	S	OZ	Base
69	--	22.5	--	--	--	S	OZ	Base
70	--	22.8	--	--	--	S	OZ	Base
71	--	24.5	--	--	--	S	OZ	Base
72	--	21.2	--	--	--	S	OZ	Base
73	--	22.2	--	--	--	S	OZ	Base
74	--	25.0	--	--	--	S	OZ	Base
75	--	22.0	--	--	--	S	OZ	Base
76	--	25.4	--	--	--	S	OU	Base
77	--	21.3	--	--	--	S	OU	Base
78	--	28.5	--	--	--	S	OU	Base
79	--	26.6	--	--	--	S	OU	Base
80	--	23.0	--	--	--	S	OU	Base
81	--	23.7	--	--	--	S	OU	Base
82	--	--	--	--	--	S	OZ	Midsection
83	--	--	--	--	--	S	OZ	Midsection
84	70.0	--	--	--	6.5	S	OZ	Midsection
85	53.5	--	--	--	7.5	S	OZ	Midsection
86	45.5	22.0	--	--	6.5	--	OZ	Scraper
87	28.3	22.4	--	--	6.0	--	OZ	Scraper
88	34.0	22.0	--	--	6.5	--	OZ	Scraper
89	30.4	24.6	--	--	6.9	--	OZ	Scraper
90	32.0	22.5	--	--	6.0	--	OZ	Scraper
91	35.0	23.0	--	--	9.5	--	OZ	Scraper

Attributes and Variables of Dalton Points from Dirty Creek Locality

Spec #	Length	Base Width	Blade Width	Blade Length	Thickness	Breakage	Raw Mat.	Notes
1	44.6	--	22.2	--	6.5	I	OZ	Tip and ears missing, no maintenance
2	38.1	25.5	24.0	--	6.9	I	OU	Tip missing
3	35.2	22.7	21.0	--	--	S	OZ	Tip missing
4	43.4	26.8	23.5	--	--	S	OZ	Tip and ear missing
5	48.7	23.5	20.0	--	8.7	S	OZ	Tip missing
6	37.4	26.5	22.2	--	6.4	I	OZ	Tip missing
7	59.1	21.5	17.7	42.2	6.1	--	OZ	
8	59.2	22.8	18.2	--	7.6	I	OZ	Tip missing
9	52.6	24.0	18.8	--	9.0	I	OU	Tip and ear missing
10	32.9	24.0	18.3	--	8.0	S	OZ	Tip missing
11	56.1	25.0	18.8	--	7.7	I	OU	Tip and ear missing
12	40.0	22.5	18.0	--	7.6	S	OZ	Tip missing
13	28.9	23.4	17.0	--	--	S	OZ	Tip missing
14	59.9	20.6	15.0	54.0	6.8	--	OZ	
15	86.7	32.4	17.5	67.0	7.7	--	OU	
16	47.6	30.0	19.0	--	5.4	S	OZ	Tip missing
17	52.5	22.9	14.5	37.0	6.0	--	OZ	
18	58.3	19.3	12.0	44.0	5.9	--	OZ	
19	64.0	24.0	14.6	--	7.2	I	OZ	Tip missing
20	34.3	28.3	17.0	--	10.0	S	OZ	Tip missing
21	64.0	26.1	15.7	48.0	7.7	--	OZ	
22	46.8	24.0	13.8	29.0	6.0	--	OZ	
23	42.7	22.7	13.0	27.0	6.6	--	OU	
24	65.0	22.1	12.5	48.0	6.8	--	OZ	
25	61.4	24.8	13.4	45.0	7.7	--	OZ	
26	49.5	21.9	11.8	38.0	8.5	--	OZ	
27	47.9	23.2	12.0	31.0	5.4	--	OZ	
28	44.0	22.1	22.1	--	--	S	OZ	Tip missing
29	43.6	19.9	15.0	--	--	S	OZ	Tip missing
30	30.9	19.8	10.0	--	5.0	I	OZ	Tip missing
31	70.5	22.9	11.0	55.0	8.8	--	OZ	Awl
32	33.9	23.6	11.2	--	7.7	S	OZ	Awl
33	73.8	22.2	10.5	60.0	7.6	--	OZ	Awl
34	36.0	19.9	9.0	19.0	7.3	--	OZ	
35	75.4	25.1	11.0	50.0	8.1	--	OZ	Awl
36	37.5	24.1	10.0	--	5.5	S	OZ	Awl
37	53.1	30.0	10.0	41.0	4.5	--	OZ	
38	30.6	26.3	7.0	--	6.6	S	OZ	Awl
39	25.5	21.1	--	--	6.8	S/B	OZ	Awl
40	--	22.1	--	--	6.9	I	OZ	Base
41	--	21.8	--	--	5.8	S	OZ	Base
42	--	25.0	--	--	6.1	S	OZ	Base
43	--	22.2	--	--	6.3	S	OZ	Base
44	--	33.1	--	--	7.8	S	OZ	Base
45	--	30.0	--	--	5.0	S	OZ	Base

Attributes and Variables of Dalton Points from Dirty Creek Locality (cont.)

46	55.5	--	24.2	--	8.1	S	OZ	Blade
47	55.6	--	19.6	--	7.6	S	OZ	Blade
48	63.6	--	20.9	--	7.3	S	OZ	Blade
49	77.0	--	22.7	--	6.5	S	OU	Blade
50	33.2	23.3	--	--	6.0	--	OZ	Scraper
51	26.0	23.4	--	--	7.5	--	OZ	Scraper
52	33.5	24.0	--	--	7.4	--	OZ	Scraper

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