THE MOUND-BUILDERS OF EASTERN NORTH AMERICA
A REGIONAL PERSPECTIVE

ELFDE KROON-VOORDRACHT

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(1868-1945)

Sometimes the deceased king of this province is buried with great solemnity, and his great cup from which he was accustomed to drink is placed on a tumulus with many arrows set around it.

Le Moyne 1564 (In Silverberg 1968)

...so we... struck into the Land againe; where we found a little path to certaine heapes of sand, one whereof was covered with old Matts, and had a woodden thing like a morter whelmed on the top of it, and an earthen pot layd in a little hole at the end thereof; we musing what it might be, digged & found a Bow, and as we thought, Arrowes, but they were rotten ...we deemed them graves...

Mourt's Relation, 1622: 6

Impressive in size and quantity, the earthworks that once lined the major river systems of eastern North America have stimulated debate across the centuries. Shaped by contemporary social and political issues and colored by the Graeco-Roman traditions of European explorers and colonists, interpretations of the mounds and their builders have ranged from dispassionate discussions of empirical evidence to romantic fantasies.

That at least some of the mounds served as mortuaries for recent Indians was suggested by the Le Moyne watercolor (Figure 1) of a 'deceased king', that formed the basis of an engraving published in 1594 by the Flemish house of De Bry (Thomas 1894). Le Moyne's original rendering, now lost, was based upon observations made during 1564–65 and apparently represents the earliest depiction of a burial mound under construction (Silverberg 1968: 20).

The Pilgrims also attributed funerary function to the 'heapes of sand' that they encountered on 16 November 1620, as they sought sorely needed food and debated the location for the 'Plimoth' colony. Their accounts of human remains and grave furniture encountered during excavation with 'Curtlaxes and short Swords' stand as the first descriptions of mound excavation in North America (Mourt's Relation 1622: 6, 10–11).[1]

Non-mortuary earthworks in the Southeast are described in accounts of Soto's ill-fated expedition (1538–1543), with chiefs' houses located upon 'hie mounts, made by hand for strength' (Hakluyt 1966 [1609]: 18). Two hundred and fifty years later (1773–1777), the naturalist Bartram described an impressive variety of ancient monuments during his travels in the Southeast. Speaking of the region occupied by the Cherokee at the time of initial European colonization, he was careful to distinguish 'mounts' of recent Indians from earlier structures built by 'one nation or confederacy, who were ruled by the same system of laws, customs, and language, but so ancient that the Cherokees, Creeks, or the nations they conquered, could render no account for what purposes these monuments were raised.' (Bartram

[1791] in Van Dooren, ed. 1928: 407). After observing the Choctaw ('Chactaw') creation of a 'conical hill or mount' over a pyramid of coffins, Bartram cautioned against assuming – as did 'some ingenious men' – that the mounds were usually sepulchres (Bartram [1791] in Van Dooren, ed. 1928: 404).

Although several United States Presidents have been moved to speculation concerning the 'authors of the Mounds', only Thomas Jefferson actually engaged in mound excavation (Jefferson 1955[1785]). After pondering contemporary wisdom concerning local barrows, he designed a project to determine whether the mounds were: 1) the graves of those fallen in battle who were interred immediately; 2) ossuaries representing the cumulative dead of a community collected and interred at one time; or 3) accretional village cemeteries. Jefferson's approach, problem-oriented and with careful excavation and analysis, is considered an exemplary exercise in archaeological investigation, quite advanced for this period (Willey and Sabloff 1980: 28).

Such dispassionate accounts, however, stand in contrast to speculation that arose during the 18th and the 19th centuries. The observation of massive structures, such as the 100 foot high, 16 acre Monks Mound, near present-day St. Louis, as well as the mapping of tens of thousands of tumuli dominating riverine landscapes in the Midcontinent, led to increased conjecture that it was beyond the ability of contemporary Indians and their immediate ancestors to marshall the labor necessary for mound construction (e.g. Squier and Davis 1848). Speculation held that the mounds were built by Israelites or Tartars or perhaps by Indians who had long since travelled south to found the highly visible civilizations of Mexico and South America (Silverberg 1968).

During the 19th century ballads, dioramas, and even a religion echoed various beliefs and fantasies concerning the Mound-builders. By the closing decades of the century, however, the weight of accumulating evidence favored the less fantastic arguments and placed responsibility for the mounds with the ancestors of con-

temporary Indians. Staff from the Smithsonian Institution's Bureau of Ethnology, such as John Wesley Powell and Cyrus Thomas, forced careful contextual scrutiny of the pipes and tablets that were said to link the mounds variously with Atlantis and with mastodon hunters. As a result of extensive archaeological exploration, Thomas concluded that associations between the Mound-builders and contemporary Indians were many and that support for the mound-builder myths was meagre indeed (Thomas 1887; 1891; 1894). Explorers' accounts, including those of Bartram and Le Moyne, were rediscovered and frequently cited during this period as ethnographic evidence for continuity. Archaeological observations of mounds from Naples, Illinois, were juxtaposed to De Bry's engraving to demonstrate that Le Moyne had witnessed a nascent mound-building episode by recent Indians. Thus, the scientists 'took over from the mythmakers and hacked away the luxurious growth of fantasy' (Silverberg 1968: 6).

Now, a century after Cyrus Thomas sounded the death knell for the mound-builder myths, there remain numerous unanswered questions concerning the mounds and their 'authors'. These range from fundamental issues concerning the development of mound-building traditions to discussions of population structure, diet, and health of the ancient peoples interred within the tumuli. To address such topics, we have developed a regional program in mortuary site archaeology within an area rich in prehistoric burial mounds. The results of this research, gained through twenty years of intensive study, form the basis of the following presentation.

The region chosen for investigation (Figure 2) comprises the lower 100 km of the Illinois River valley and adjacent uplands. Archaeological study in this area is facilitated by a nearly continuous archaeological record spanning 10 millenia, a well-documented and visible prehistoric mound-building tradition, soil conditions that facilitate the preservation of human skeletal re-

mains, and a parallel program in village site archaeology that provides data which usefully complement those from mortuary sites. Although modern agricultural activity is extensive in this region, west-central Illinois has not seen the expansive urbanization that has destroyed many other North American mortuary centers.

There exists an archaeological record throughout the Holocene for the study area (Figure 3). Mortuary remains, however, are most abundant for the Middle Archaic Period, when the mound-building tradition first developed, and for the Middle Woodland, Late Woodland, and Mississippian Periods. Middle Woodland burial mounds in this area are well-known due to the presence of finely crafted, exotic 'Hopewell' grave goods made of imported raw materials. Middle Woodland times also saw the expansion of a horticultural economy based upon indigenous weedy plants such as marsh elder, erect knotweed, little barley, and maygrass. It was, however, during the subsequent Late Woodland period that maize cultivation began, becoming a well-developed subsistence strategy during Mississippian times (Asch and Asch 1985).

Our studies of the mounds and their contents have focused upon a selected series of topics: 1) the origin and development of mound-building traditions; 2) genetic affinities within and between groups; 3) population distribution and structure (paleodemography); 4) diet; and 5) population health (paleopathology). To address these subjects we have combined bioanthropological and archaeological strategies, thus uniting in problem-oriented research two traditionally distinct sub-disciplines of anthropology. The work reported here is also inter-disciplinary involving for example, chemists in the development of dietary models and medical scientists in the assessment of health status.

THE MOUND-BUILDING TRADITION

In west-central Illinois, the mound-building tradition began approximately 6000 years ago, roughly a millennium after initial

evidence for the development of settled communities. Although burials within habitation sites occur during Early Archaic times (8700–8450 BP), formally structured areas reserved exclusively for disposal of the dead have not been discovered prior to the Middle Archaic Helton Phase (5800–4900 BP).

Middle Archaic bluff crest mounds emerge as one alternative in a locationally dispersed burial program which also includes burials within village middens, for example Horizon VI of the Koster site (Figure 4) and the Modoc Rock Shelter from southern Illinois, and in cemeteries located on sand ridges in the valley floodplain. Located on the most prominent point of bluff crests and capped millenia later by Woodland structures, Middle Archaic mounds appear to have been modest tumuli, consisting of shallow pits covered by 30–50 cm of earth. In most cases there is little evidence of spatial segregation within the burial facility; artifacts appear to be associated with the tomb rather than with a single individual. Diversity within this general pattern is observable, for example, Burial 32 from Mound 1 of the Elizabeth site where 4 young adult males were discovered, each with 2–3 projectile points within the chest cavity (Figure 5). The disarticulated remains of at least 12 persons had been placed within the fill above and beside this tomb (Charles and Buikstra 1983).

In general, the pattern for the bluff crest sites contrasts with that apparent in the Middle Archaic village burials at the Koster and the Modoc sites. No rich artifact display or tomb structure characterizes these habitation site interments, although they do present a specific set of physical characteristics. The remains from the village middens are composed of old adults, young adults with deforming pathology, and adolescents. The elderly within this sample commonly suffered from moderate to severe arthritis, much as the aged within any active human group. Thus, the cemetery is reserved for individuals who either by age or infirmity were unable to perform the full range of adult activities. This pattern differs from the mound interments, such as those from the Gibson site, where a complementary set of young-

middle-aged adults without deforming pathology were recovered (Buikstra 1981).

A third location for Middle Archaic Helton Phase cemeteries is currently being explored at the Bullseye site, situated in the Illinois River floodplain. Although one other similarly located site (Godar site) has been reported (Titterington 1950), the Bullseye site excavations represent the first systematic archaeological investigation of a floodplain Middle Archaic mortuary. The final season of excavation at Bullseye site is just completed and results are preliminary at this time. Certain generalizations can, however, be made that help establish the place of the Middle Archaic mounds within the larger set of interment options.

The Bullseye site is located upon a sand ridge, near the Keach School Terrace, a landform stable throughout the Holocene (Hassan and Farnsworth 1987). The site is characterized by extensive lithic debitage, which extends beyond the current boundaries of the burial area. All phases of lithic reduction, from cobbles and tabular chert to thinning and notching flakes are present. These materials may, however, be associated with two other components present at the site, Early Archaic and Early Woodland. Importantly, there are no identifiable non-mortuary features within the Middle Archaic component and the debris profiles differ from those for the Koster Horizon VI Middle Archaic midden (Brown and Vierra 1983: 185). Although post-depositional processes may have winnowed certain items from the archaeological record at the Bullseye site, it appears that this may be a formally bounded disposal area, as is the case for the contemporary bluff crest mounds[2]. Further research, however, must be directed toward the issue of mortuary exclusivity.

Located upon a raised point bar within the floodplain landscape, Bullseye may have been elevationally analogous to the bluff crest sites. There are, however, certain distinctions between the two types of cemeteries. First, the grave wealth repertoire at Bullseye is different from that discovered in the bluff crest mounds. Chert bifaces and grooved axes are common to both;

however, the Bullseye assemblage includes at least 29 bannerstone atlatl weights made of imported banded slate. This richness apparently also characterized the Godar site, although specific burial associations are not reported (Titterington 1950). In the case of the Bullseye site, all bannerstones were removed during exploration of the center of the cemetery by the landowner prior to systematic archaeological recovery. Thus, the distribution of these artifacts and their function is a matter of conjecture. Grave goods other than bannerstones have been observed *in situ* and can be attributed to specific burials. This direct association of individual skeletons with burial goods contrasts with the bluff crest examples, where caches of artifacts appear to be concentrated in interment facilities, such as Burial 32 from the Elizabeth site (Figure 5), and with juveniles rather than with individual adults (Charles and Buikstra 1983).

Beginning at a time when the lower Illinois Valley was densely occupied, mound-building emerges as one alternative in a spatially diverse series of interment options. Borrowing from theoretical concepts developed through ethnographic observations, we may suggest that these formally bounded cemeteries were created as an expression of solidarity with the ancestors, related to a declaration of ownership or at least preferred access to adjacent resources. Cemeteries and attendant mortuary ritual are known to be one way in which human groups signal stable, multi-generational control of local resources or territories (Goldstein 1980; Saxe 1970). Thus, these most ancient of our cemeteries may be the first indications of stable inter-generational territorial domination within the region. The corporate nature of this territoriality may be most clearly expressed in the bluff crest mounds, where facilities appear to service the accumulating dead of a social group (Charles and Buikstra 1983).

Archaeological evidence for mound-building subsequent to Middle Archaic and prior to Middle Woodland times is sparse indeed. The single large data set, dating to approximately 1000 B.C. and derived from Mound 7 of the Pete Klunk site (Perino

1968), suggests the presence of certain subtle changes that may have social implications. In this case, there appears to be evidence that the mound served as a cemetery for the full community. Unlike the Middle Archaic example, individuals deprived either by age or by infirmity of an active daily round were buried adjacent to their less disadvantaged contemporaries. Males but not females are reported to have associated grave goods. Juvenile remains were frequently curated and held for burial with fully articulated adults. In addition, the mound appears to have developed in a well-defined sequence, perhaps as a calendric cycle of burial.

If mound structural complexity mirrors social complexity, then it appears that Late Archaic groups were more socially differentiated than their earlier counterparts. Importantly, this change occurred long before the increased population density that characterizes the Middle and Late Woodland periods. Late Archaic mortuary sites thus set the stage for the more elaborate structures of the subsequent Middle Woodland period.

Archaeological and bioanthropological perspectives differ somewhat in their interpretations of the relatively elaborate Middle Woodland mortuary structures that characterize the period from approximately 150 B.C. to A.D. 250. These sites, frequently termed Hopewell after a site in Ohio which contained mounds with elaborate, exotic grave goods, often occur in groups that include massive structures over 7 meters high and 35 meters in diameter. Most mounds are located upon bluff crests, although a few floodplain groupings interpreted as regional centers are distributed along the Illinois River (Struever and Houart 1972).

Mound size, elaborate grave wealth, presumed dependence upon corn, and putative Mesoamerican links led early workers to posit elaborate and complex social systems for Hopewell people. More recent analyses, which include ethnographically derived theories, have tended to reverse opinion and argue for relatively simple social structures for mound-building Middle Woodland peoples (Braun 1979, 1981; Brown 1979, 1981; Kerber 1986).

Middle Woodland mounds are typically dominated by log crypts, which serve both as intermediate and final resting places for selected Middle Woodland individuals (Figure 6). The crypts, frequently surrounded by elevated ramps, contrast with less elaborate peripheral graves. There is a tendency for males to receive disproportionate access to the elaborate Hopewell grave goods found within the central tombs. This specialized access of males to grave wealth to some extent parallels the Late Archaic situation. During Middle Woodland times, however, structural elaboration and grave furniture provide a redundant emphasis upon status differentials.

This central tomb/peripheral grave dichotomy is accepted by most workers who have analysed Middle Woodland mortuary practices, though its significance is in dispute. Brown (1979) argues that the absence of symbols of authority and the general demographic structure of Middle Woodland mounds indicate an absence of centralized authority and inherited leadership.

Kerber (1986), in an elaborate discussion which includes chronologic comparisons with the more recent Late Woodland mortuaries, places emphasis upon isolating indicators of inter-generational transmission of power and authority. Appropriately stepping beyond material culture to considerations of burial treatment and grave structure, he segments interment forms into components that represent: 1) the status of the deceased, and 2) the power and authority of those conducting the mortuary event. Kerber argues that the numerous children in Hopewell tombs symbolize the authority of the living relatives of the deceased, who as powerful adults were able to marshall the energy and wealth necessary to establish elaborate ritual display. The relative paucity of adults in such contexts suggests that however powerful in life individuals may have been, there was insufficient inter-generational stability in the transfer of prestige to guarantee that elaborate burial ritual would attend the death of a powerful person.

Kerber contrasts the Middle Woodland situation with Late

Woodland examples, where tomb construction is no longer central but rather simply an initializing event in a predictable sequence of mound building. Grave wealth is not isomorphic with feature definition, and the greatest social distinctions are made not with artifact accompaniments but by variations in length of the burial ritual. Kerber associates the increased number of curated burials during terminal Late Woodland times with increased efficiency in the transfer of status and authority across generations. Implying substantial effort in grave preparation, feature maintenance, and handling of the remains, curated burials increase significantly during Late Woodland. Kerber further argues that the increased variability in burial programs during terminal Late Woodland is associated with the emergence of significant local control over resources, including those critical for conducting mortuary events, for example, mound construction.

Thus Kerber describes a region of broadly similar Middle Woodland mounds bound by tradition. During the Late Woodland period, as regional population density increased along with competition for resources, the mounds cease to be efficient territorial markers in the face of overt territorial competition. Territorial defense is indicated by evidence of violent death of males during Late Woodland, although a distinction between raiding and warfare is not clear. As competition increases local political units emerge and become strong. One expression of this strength is the ability for a lineage or other corporate group to maintain a stable control of resources as the living become the ancestors.

While Kerber and others may be essentially correct in describing increasingly complex local authority structures during the Woodland period, biological evidence can be used to argue for a measure of stable inter-generational transmission of privilege during Middle Woodland times. The best evidence for this is derived from two of the three complexes of Middle Woodland mounds located near the present-day village of Kampsville, Illinois. The Middle Woodland components of the Pete Klunk and

Gibson mound groups (Figure 4) have been extensively studied, with intra-site comparisons focusing upon contrasts between those individuals who had either been curated in or finally interred within central log tombs and those in peripheral graves.

As noted above, among adults, males have privileged access to central crypt burial; Hopewell items are associated only with males. Comparisons across the male portion of the population indicate that individuals interred in central tombs are significantly taller than the remainder of the male subset of burials (Buikstra 1976). Explanations for this patterning could invoke images of: 1) special statuses more easily achieved by tall individuals; 2) the sampling of different gene pools, either through selective marriage/residence patterns or immigration; or 3) ascribed statuses whereby the youth of high status families had preferential access to resources that facilitated growth.

The last-mentioned 'dietary' hypothesis is favored here, based primarily upon a study by Cook (1981) of dental microdefects which provide a record of an individual's health status during the growth period. This study indicates that individuals who were interred in Middle Woodland log crypts had fewer episodes of ill health during childhood. Since the pattern holds for all age groups, it must be concluded that **both** juveniles and adults who received special burial treatment had privileged access to resources that contributed to advantaged health status during the period of youthful growth (Cook 1981). As Cook notes (1981: 144), this is a clear argument for ascribed rather than achieved status. The dietary hypothesis is also supported by the fact that trace element frequencies vary across status groups (Lambert et al. 1979).

Other skeletal data, developed through comparisons of arthritis patterning on the articular surfaces of limb long bones, also underscores the significance of the crypt/non-crypt dichotomony. Arthritis patterns for the elbow differ significantly between males from the two burial loci and thus suggest that the day-to-day activities leading to degenerative joint disease varied

between these status groups (Tainter 1980). Thus, at least for the community burying in the Gibson-Klunk Mounds, there is clear skeletal support for stable inter-generational transfer of resource control. The degree to which this pattern also characterizes other Middle Woodland communities remains a subject for further investigation.

BIOLOGICAL DISTANCE

Inherited skeletal and dental features have been studied in order to investigate genetic ('biological distance') relationships between contemporaneous Woodland communities and between temporally sequential Woodland and Mississippian populations (Buikstra 1976; Conner 1984; Droessler 1981). Although cranial dimensions and tooth diameters have been used in biological distance analyses, we have focused primarily upon the minor or non-metric variants of the skull, including the ossicles that occur in cranial sutures and counts of facial foramina which reflect inherited variation in soft tissues. These non-metric traits have the advantage of being scorable in fragmented, poorly preserved, and deformed materials. Thus, a more complete genetic signal can be gained from a Late Woodland cemetery that includes both cremations and inhumations than would be the case if observations were limited to unfragmented materials.

A number of biological distance studies have examined models of culture change that link modifications in artifact style and subsistence strategies with population replacement. Such explanations assume that the distinctly different material cultures which characterize Middle Woodland, Late Woodland, and Mississippian sites imply either immigration or at least extensive intra-regional population movement. Such notions are testable through studies of inherited skeletal attributes.

Inherited features of the cranial and post-cranial skeleton have been used to argue for the presence of stable, temporally sequential groups throughout the Middle and Late Woodland periods.

Studies of non-metric features (Buikstra 1975, 1980) indicate that the region was inhabited by genetically related populations that underwent the social and cultural transformations archaeologists use to distinguish Middle Woodland from Late Woodland. No strong argument can be made for population replacement or significant intra-regional restructuring in association with observed differences in material culture, subsistence, or population distribution.

The pattern changes, however, when the Late Woodland to Mississippian transition is addressed. Analysis of cranial measurements and non-metric traits from the Schild Late Woodland Mounds and adjacent Mississippian cemetery identifies a significant difference between the two culturally distinct groups (Buikstra 1975; Droessler 1981). Before invoking a migration model, however, it is important to partition the Schild Mississippian data set by sex and by time, considering the two temporally sequential Mississippian cemetery areas or 'knolls' separately. From this analysis, it is clear that the apparent Late Woodland – Mississippian difference is actually due to the distinctive inherited features of males from the more recent Mississippian knoll. This suggests that the development of Mississippian led to a change in residence pattern which subsequently affected frequencies of inherited skeletal attributes (Buikstra 1975). Cultural change thus apparently led to altered social relationships and biological features.

A recent study by Konigsberg (1987) has also focused upon the issue of residence pattern through the analysis of intra-site sex differences in non-metric trait frequencies. Konigsberg assumes that, within a given cemetery, the more locationally stable sex will show less variation in inherited features when compared to individuals relocating from other communities. Thus, in a matrilocal society males will show significantly more variability than females. The expected pattern reverses in the case of patrilocal (or avunculocal) residence rules. Given a documented shift in subsistence strategy to maize agriculture during the later Late

Woodland period, which intensified during Mississippian, a change in sexual division of labor with ramifications to other aspects of the social system, such as residence, is not unexpected.

Throughout both the Middle and the Late Woodland periods males show consistently less genetic intra-site variability and more inter-site variability than females. This indicates greater female mobility in the mating network and would be consistent with virilocal or avunculocal residence. The opposite pattern is found in the Mississippian Schild series, suggesting the development of matrilocal residence rules (Konigsberg 1987: 147).

Thus, inherited features are used to argue for regional stability through much of the Woodland and Mississippian periods. Evidence for changes in residence patterns, possibily related to a changing division of labor associated with agricultural intensification, emerges only after the development of Mississippian.

DEMOGRAPHIC PATTERNING

Demographic study within the region has taken two forms. The first of these is the estimation of regional population density through transect surveys and the development of a time-sensitive mound typology. The second, more traditional form of paleodemographic study is the use of age-at-death statistics to estimate vital rates, such as mortality and fertility schedules.

Mound surveys were initiated for three transects located in the north, south, and central portions of the study area. Subsequent expeditions have included two secondary valleys and the remainder of the bluff crests adjacent to the Illinois river, where most of the mounds are located.

Both excavation and comprehensive survey data indicate that site locations and mound structure vary predictably through time. By constructing a typology of mounds based upon shape and location, integrating information from excavated sites, we have generated diachronic estimates of regional population densities. The first regional approximation, thus derived, defined a

pattern of population growth throughout the Middle and Late Woodland periods (DeRousseau 1973). A similar, general increase has been noted by Styles (1981) for habitation site density.

Following additional survey, the original DeRousseau model has been refined and expanded to define shifting settlement patterns within the study area. Charles (1985), focusing upon survey data from two transects, isolated six mound types with temporal correlates. Four chronologically sequential types describe mounds from the Middle Woodland period; the remainders are associated with early and terminal Late Woodland sites. Coeval burial mounds, identified through this technique, are thought to reflect the distribution of catchments used by territorially based communities (Charles and Buikstra 1983; Charles 1985). Thus defined is initial colonization of the northern portion of the study area, in the vicinity of Blue Creek, where thirteen Type 1 mounds are located (Figure 7). Type 2 mounds also cluster to the north, with catchments including and adjacent to the earlier territories. More recent Middle Woodland mounds are found to the east of the river and in the southern transect, with corresponding depopulation of the northwestern portion of the valley. Subsequent saturation of the region during Late Woodland times is easily identifiable from the mound plots.

Thus, systematic mortuary site survey has facilitated projection of both regional patterns of population increase and intraregional community distribution. These diachronic projections now need to be tested through development of radiometric sequences and seriation of time-sensitive material culture markers.

A factor contributing to the projected regional population increase emerges from the second form of paleodemographic study, the estimation of vital rates for temporally sequential Middle and Late Woodland populations. These analyses have been directed toward two goals: 1) the use of the age-specific mortality patterns as indicators of health status for groups becoming increasingly dependent upon maize; and 2) the estimation of fertility.

Cook (1979, 1981, 1984) has conducted seminal research upon the issue of mortality patterns and health in the study area. Focusing upon comparisons of groups before and after the advent of maize agriculture, her projections separate juvenile death statistics from those reflective of adult mortality schedules. Using a device borrowed from contemporary demography, she evaluates childhood health by using a ratio of infant death rates during the weaning period to total childhood deaths. The elevated weaning age death rate observed in Late Woodland juveniles, coupled with a lower adult mean age at death, suggests that the health status of Late Woodland Mound-builders was somewhat disadvantaged when compared to that of earlier groups.

A second series of paleodemographic studies has concentrated upon the estimation of fertility rates. Using a statistical technique based upon the observed relationship between death rates and fertility patterning in ethnographically documented human groups, we have suggested that a major shift in fertility occurred between the Middle and Late Woodland periods. Given that one of the most efficient means of increasing fertility in human groups is to decrease birth spacing, we have proposed a model that links shortened birth intervals with early weaning in Late Woodland juveniles (Buikstra, Konigsberg, and Bullington 1986). A correlated and perhaps causative factor is the change in ceramic manufacturing technology reported by Braun (1983). During the fifth century A.D. thin-walled vessels with improved conductivity and resistance to thermal stress were developed, designed perhaps to increase the efficiency of boiling starchy seeds such as chenopodium. The ready availability of a soft, palatable and digestible weaning food would have facilitated early weaning. Decreased birth intervals and increased fertility could have easily ensued.

There are two forms of independent evidence for a change in weaning diet following Middle Woodland times. One is the early onset of caries in Late Woodland deciduous dentitions, indicating an increased carbohydrate content in the early childhood diet

of agriculturalists when compared to Middle Woodland groups (Cook and Buikstra 1979). The second develops from a study conducted by Bullington (1988), who used electron microscopy to investigate microwear on the deciduous dentitions of Middle Woodland and Mississippian juveniles from west-central Illinois. The age-related microwear features investigated by Bullington suggest that the diet of Mississippian juveniles was softer and less variable than the foods consumed by Middle Woodland children. Although Late Woodland dentitions were not investigated in the Bullington study, the composite picture is one of an increasing use of starchy gruels as weaning food during the Late Woodland and Mississippian periods.

Thus, paleodemographic study has enhanced our knowledge of mound-builder population structure and quality of life. A gradual but notable population increase associated with the development of maize agriculture is described throughout the Middle and Late Woodland periods. A change in birth-spacing, perhaps due to advances in ceramic technology and the ready availability of a cereal-based weaning food, is implicated in explaining the inferred change in population numbers. Finally, it appears that the quality of life for terminal Late Woodland peoples was somewhat compromised when compared to that of earlier groups.

DIET

Although paleobotanic and paleofaunal residues are the most accurate indicators of the prehistoric menu, estimates of diet are best derived from the actual physical remains of the consumers. As noted above, dental health can assist in dietary determinations. Caries in Late Woodland juvenile dentitions argue for significant carbohydrate content in the diet, just as do the elevated frequencies we see in the Late Woodland and Mississippian adult consumers of maize (Cook 1984).

More sensitive to dietary differences, however, are the chemical constituents of the skeleton. The composition of both the

mineral and the organic phases of bone are to some degree influenced by diet. Trace elements, such as stable strontium and barium, are carried from the soil to the herbivore's bones through plant consumption. Since both elements tend to then concentrate in osseous rather than soft tissue, primary and secondary carnivores receive relatively little dietary strontium. Thus, within a region, the relative herbivory of an omnivorous species such as *H. sapiens* can be estimated. Complimentarily, zinc tends to concentrate in flesh and thus be a dietary marker for animal protein consumption. Environmental pollutants such as cadmium and lead can also be studied.

Zinc and strontium have been used to investigate dietary differences within and between Middle and Late Woodland groups within the study area. Although other elements such as vanadium do co-vary with diet and would thus be desirable dietary markers, most are subject to post-depositional enrichment or depletion (diagenesis) and are thus contextual signatures rather than dietary signals.

Focused upon intra-site variation, our initial studies examined patterning across status groups in Middle Woodland mounds and sought gender-related differences within Middle and Late Woodland samples. As noted in the previous discussion of social dimensions in mortuary behavior, the non-random distribution of trace elements across burial groups in Hopewell mounds suggest the presence of status-related dietary habits within Middle Woodland communities. Although no gender differences were observable in Middle Woodland data, bones from Late Woodland males contained significantly more zinc and less strontium than females. This may either reflect a true gender-based dietary difference or the increased metabolic demands Late Woodland females faced due to closer birth spacing (Buikstra et al. 1987).

Diachronic study of Middle and Late Woodland samples indicate that although zinc values do not vary chronologically, strontium does decrease during Late Woodland times. This de-

crease in strontium may seem enigmatic, given the development of maize agriculture during this period. Maize is, however, relatively element poor and thus the observed pattern is expected. The values for zinc suggest that the proportion of animal protein in the diet did not vary significantly across Woodland groups.

As anticipated, lead is age-accumulative in our prehistoric series. Surprising, however, is the significant association with male remains (Buikstra et al. 1987). Gender-specific exposure to lead could have resulted from ceremonial use of galena, although a number of other explanations could be posited.

A second form of chemical study has focused upon the collagen fraction of bone. Studies based upon stable carbon isotope ratios derived from bone collagen allow predication of the presence of maize in diets with a precision far beyond estimates based on the paleobotanic record or upon dental health. Maize, a tropical grass, fixes carbon through the Hatch-Slack or C_4 pathway. This contrasts with the usual pattern for temperate climate vegetation where the common pathway is C_3 or Calvin. As $\delta C13$ values – the standard transformation used in such studies – become more positive, the presence of maize in the diet is more likely. Values derived from human collagen more positive than –20 or –21 are considered evidence of C_4 plant consumption.[3]

The association of maize agriculture with Mississippian cultures is well known. Debate has centered, however, on the degree to which the timing of maize intensification is directly associated with the development of Mississippian lifeways and the relative importance of maize to Mississippian peoples. The carbon isotope technique has provided a means for resolving these and related issues concerning agricultural intensification in the eastern United States. This significant methodological advance, developed only within the past 10 years, has facilitated the resolution of century-old arguments about the role of corn in American prehistory.

As indicated in Figure 8, a representation of $\delta C13$ values for diachronic series from the Illinois River valley, maize consump-

tion pre-dates the Mississippian period. These values suggest a rather gradual increase during the terminal phases of Late Woodland, including a highly variable period of experimentation. Values stabilize during Mississippian times, indicating that corn formed a significant component of the diet for the late prehistoric peoples. Of special interest is the fact that corn consumption was apparently higher in the 'farmstead' communities of the lower and central Illinois River valley than it was at the major ceremonial center of Cahokia during the early, expansive phase of the Mississippian period (Buikstra and Milner 1988). Also significant is the fact that the δC_{13} values from Illinois never reach the extremely positive figures (−7.8 to −8.0‰) that characterize the Mississippian peoples of the Ohio Valley and the Nashville Basin of Tennessee. These very positive values are currently a source of debate, with suggested causal factors ranging from true dietary contrasts to varietal differences in corn (Buikstra et al. 1988).

PALEOPATHOLOGY

Osteoarthritis

Daily activities produce stresses that promote, over time, degeneration of joint surfaces in the human skeleton. Thus the wear-and-tear of ancient lifestyles can be read through analysis of the porosity, eburnation, and lipping that characterize arthritic joints.

One study of degenerative joint disease in Middle Woodland males has already been cited above (Tainter 1980). A more recent study (Pickering 1984) has extended this earlier synchronic investigation to an analysis of diachronic changes associated with the development of maize agriculture. Also embedded within this work is the attempt to isolate patterns in the male upper limb that were associated with the documented shift in hunting technology between the spear, characteristic of Middle Woodland groups, and the bow-and-arrow, used by Late Woodland and Mississippian populations.

Although an altered hunting technology is indeed documented within the study area for the period in question, no significant difference in symmetry, timing of onset, patterning, or degree of arthritic expression in the upper limb was discovered in the male subsample. The arthritic costs of agricultural intensification are, however, clearly written in severity scores, age-corrected, for the female upper back. The demands of repetitive food production activities, associated both with maize agriculture and larger family size, are implicated in explaining this difference in degenerative joint disease.

Non-specific Indicators of Stress

Archaic peoples from west-central Illinois show skeletal markers of growth arrest and recovery in a pattern suggestive of a regular cycle of stress, perhaps associated with an annual late winter 'hunger time'. Radiopaque lines of growth arrest, or 'Harris Lines', provide evidence of this seasonality, which is also characteristic of other Midwestern Archaic populations. A similar phenomenon has been documented among hunting and gathering populations from California and among the historic Caribou Eskimo of the Canadian Arctic. Line periodicity is not characteristic of Woodland or Mississippian populations from the study area, suggesting that agricultural intensification buffered against the seasonal late winter stresses of west-central Illinois.

Given the probability that line counts, though not necessarily the ability to judge periodicity, may be affected by extensive resorption under conditions of high carbohydrate diets, Harris Lines are not ideal markers of stress in agricultural populations. Other indicators, such as dental hypoplasias and microscopically visible enamel defects that do not remodel after formation are, therefore, more reliable. In this light it is interesting that Cook (1984) finds no recognizable trends in dental microdefects when Middle Woodland and Mississippian samples of young adults are compared. It thus appears that for the two ends of the in-

tensification continua, as judged by these markers, juvenile health status for adults surviving childhood were equivalent.

Other skeletal markers, however, provide indications that, at least for the juveniles, there were significant biological costs attendant upon the agricultural transition. Terminal Late Woodland juveniles younger than six years of dental age show evidence of depressed stature attainment when compared to Middle Woodland and Mississippian groups. Cortical thinning is also present in 2–3 year olds from one of these Late Woodland sites, although this may be associated with maize-related hyperparathyroidism rather than protein-calorie malnutrition. Grossly observed indicators of adult bone maintenance do not change through time, although there is some evidence from microstructural studies for increased remodelling in ribs and femoral cortices during the terminal Late Woodland period (Stout 1978; Hanson 1988).

Specific Diseases

Bone inflammations ('periostitis' and 'osteitis'), usually appearing as symmetrical expressions on the surfaces of the limb long bones, are common in Woodland and Mississippian skeletal series from west-central Illinois (Figure 9). Cook (1984: 259) notes that a similar manifestation, though of lower prevalence, occurs in the Pete Klunk Late Archaic sample. Although observations have been limited by the poor preservation in Middle Archaic series, it appears that periosteal reaction is much less extensive during this earliest mound-building period.

The cause of the disease, which is characteristic of many cemetery samples from throughout eastern North America and occasionally includes extensive remodelling of the cranial vault along with long bone changes, has been a matter of debate for over a century. In 1876 Joseph Jones argued that the 'erosions' he observed in burials from stone box graves and mounds in Tennessee and Kentucky were syphilitic, a conclusion that was cautiously supported by William Whitney, Curator of the War-

ren Anatomical Museum of the Harvard Medical School a decade later. Such notables as the anatomist Virchow have disputed this conclusion, thus joining an argument that continues today (Jarcho 1966).

The nature of the debate has changed, however. Today few would disagree with the notion that the skeletal lesions presented by these prehistoric remains resemble most closely the constellation of related diseases collectively known as the treponematoses. Included within this group are venereal syphilis, yaws, endemic syphilis, and pinta. In her rigorous consideration of clinical and epidemiologic patterning from recent medical histories, Cook (1976) argues compellingly that either non-venereal syphilis or yaws are the best modern models for the observed prehistoric pathology. Therefore, the burden of proof at this time is upon those favoring venereal transmission of the disease. Contemporary wisdom thus frees New World native peoples from responsibility for the epidemics that ravaged Europe during the Era of Discovery.

Even though there is little evidence for venereal syphilis in pre-Columbian North America, it is important to underscore the presence on this continent for several millenia of a chronic disease that affected significant numbers of individuals. Beginning in childhood and progressing throughout life, these inflammations doubtless reflect a considerable health burden for prehistoric peoples.

A different form of pathology was limited to late prehistoric peoples from west-central Illinois. Expressed most commonly as erosive spinal lesions (Figure 10), sometimes also affecting the joint surfaces of the limb long bones, this disease is found only in Mississippian populations post-dating A.D. 1000. Epidemiologic patterning, considered with lesion location, suggests that the most closely analogous modern disease is tuberculosis rather than blastomycosis, a fungal infection. Both blastomycosis and tuberculosis present similar skeletal lesions, but their expected age-specific mortality patterns differ. Young adults are dispro-

portionately represented among those dying with clinically-documented bone tuberculosis, whereas blastomycosis tends to present a profile with more older adults. The age-specific disease pattern observed in west-central Illinois resembles tuberculosis more closely than blastomycosis (Buikstra and Cook 1981).

The tuberculosis diagnosis developed from modern clinical literature does not, however, provide a perfect fit for our prehistoric example. Through simulation analysis, McGrath (1986) has modelled the course of a tuberculosis-like disease in Middle Woodland, Late Woodland, and Mississippian populations from the study area. She concludes that a disease resembling modern tuberculosis would have rendered our prehistoric peoples extinct or would have itself ceased to exist. Thus, either our estimates of group size and interaction frequency are misspecified or the tuberculosis model is not fully transferable to the prehistoric context. The important role of effective population size in disease spread is emphasized in McGrath's conclusions, underscoring the importance of relatively brief periods of contact involving large numbers of individuals. Thus, the role of socially important economic and religious collective activities that encourage population aggregation – however brief – must be considered in explaining patterns of disease spread and maintenance in prehistoric groups.

SUMMARY AND CONCLUSIONS

Now, a century after the archaeologically-induced demise of the mythical Mound-builder, the construction of mortuary monuments in eastern North America is seen as a five-millenium long tradition that cross-cuts a variety of prehistoric lifeways. In west-central Illinois, mound-building began as one alternative within a spatially dispersed Middle Archaic burial program, perhaps as a means for a lineage or a community to symbolize its control over local resources. Initiated by Archaic peoples to express solidarity with the ancestors, mound construction had

been transformed by Middle Woodland times into a symbolic representation of wealth and power of the living. Even though there is skeletal evidence that the status differences represented by different tracks in Middle Woodland burial programs were inherited, it is only with the emergence of extended mortuary ritual during terminal Late Woodland times that there is conclusive evidence for stable inter-generational transfer of power and authority.

Systematic mortuary site surveys within the study area document a pattern of population increase throughout the more recent mound-building periods. Statistical projections of fertility rates suggest that a major change in population structure occurred during the Middle to Late Woodland transition. A key factor explaining this demographic change may have been the development of ceramic vessels capable of sustained cooking of starchy seeds. The ready availability of a weaning food may have encouraged smaller birth intervals, increased fertility, and consequently led to population expansion.

Subsistence strategies during Middle and Late Woodland times move from an initial emphasis upon intensive cultivation of local weedy plants to the development of maize agriculture. Evidence of these changes appear within the chemical constituents of bone, as well as in dental health. Status and gender-related differences in diet have been documented in Woodland peoples, with maize gradually assuming a primary role in the menu of terminal Late Woodland and Mississippian groups.

The development of maize agriculture, as evaluated here, is best viewed as a biological compromise. More people were supported on the landscape, and there is little evidence of the annual, late-winter stresses recorded in the repetitive Harris Lines of Archaic peoples. Even so, life was less long and mortality during the weaning period was relatively high. A new disease, similar to tuberculosis, affected the health of Mississippian peoples, and treponematosis-like bone infection became more common in adults. Osteoarthritis of the back also developed as an occupa-

tional hazard of maize cultivation and food preparation among Mississippian females. Especially pronounced in terminal Late Woodland juvenile remains is evidence for decreased growth and thinned long bone cortices. In Mississippian samples, however, after the shift to maize agriculture, there is less evidence of disadvantaged health status among the young.

The Mississippian period also saw certain significant changes in social structure and residence patterning. Although the initial phases of Middle Woodland, Late Woodland, and Mississippian periods are not associated with significant population replacement, inherited features bear evidence of a change in residence pattern during Mississippian times. The typical Woodland pattern of high variability in inherited traits among females reverses, thus suggesting a shift to matrilocality during late prehistory.

With the development of Mississippian lifeways, the complexion of the moundbuilding tradition changed. In fact, the mounds themselves, long used as symbols of local power, ceased to serve as community cemeteries. Only selected ancestors were buried within mounds, and these mounds were located exclusively at major regional centers such as Cahokia, marking the emergence of the larger Mississippian polity. Thus, a tradition spanning five millenea was transformed in a manner that underscores the symbolic importance of the mounds to prehistoric North American peoples.

To archaeologists today the mounds also stand as symbols, representative of a rich North American prehistory that is closely bound to mortuary monuments. In the study of this unwritten past, our tools and excavation strategies have advanced far beyond the crude weaponry of the Pilgrims, and our theories are no longer laced with the myths and fantasies of the 19th century. Even so, much remains to be learned about these ancestors and their priceless legacy.

[1] No human remains were encountered during the explorations conducted on 16 November. Subsequent excavations later in the same expedition did, however, result in the discovery of a burial.

. . . and as we came into the plaine ground, wee found a place like a grave, but it was much bigger and longer then any we had yet seene. It was also covered with boords, so as we mused what it should be, and resolved to digge it up, where we found, first a Matt, and under that a fayre Bow, and there another Matt, and under that a boord about there quarters long, finely carved and paynted, with three tynes, or broches on the top, like a Crowne; also between the Matts we found Boules, Trayes, Bishes, and such like Trinkets; at length we came to a fiare new Matt, and under that two Bundles, the one bigger, the other lesse, we opened the greater and found in it a great quantitie of fine and perfect red Powder, and in it the bones and skull of a man. . . . the red Powder was a kind of Embaulment, and yeelded a strong, but no offensive smell; It was a fine as any flower. We opened the lesse bundle likewise, and found of the same Powder in it, and the bones and head of a little childe, about the leggs, and other parts of it was bound srings, and bracelets of fine white Beads; there was also by it a little Bow, about three quarters long. . .

Mount's Relation 1622, pp. 11

[2] Even thought the Middle Archaic mounds appear to be formally bounded areas reserved exclusively for disposal of the dead, evidence of non-mortuary activities has been recovered from bluff crests near Middle Archaic Mounds. At the Elizabeth site, for example, tools used for woodworking have been recovered from an Archaic surface preserved beneath a Middle Woodland mound (O'Dell 1988).

[3] Since diets including marine resources can mimic the positive δC_{13} values characteristic of maize eaters, stable isotope ratios of coastal populations are more difficult to interpret.

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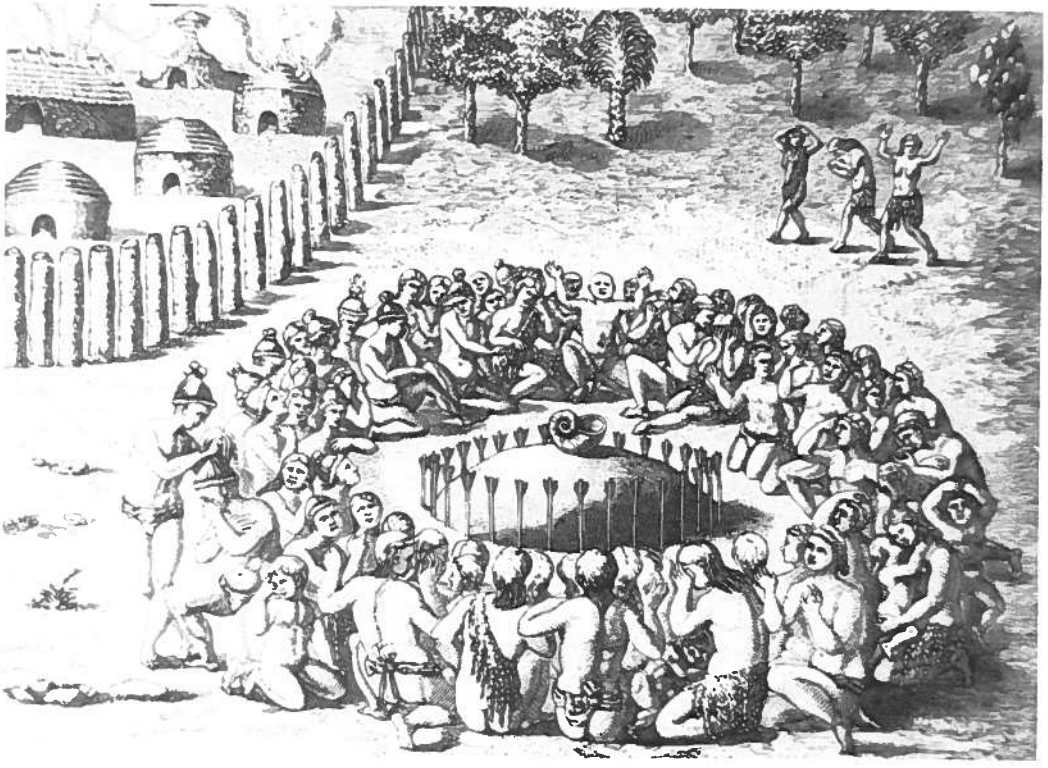
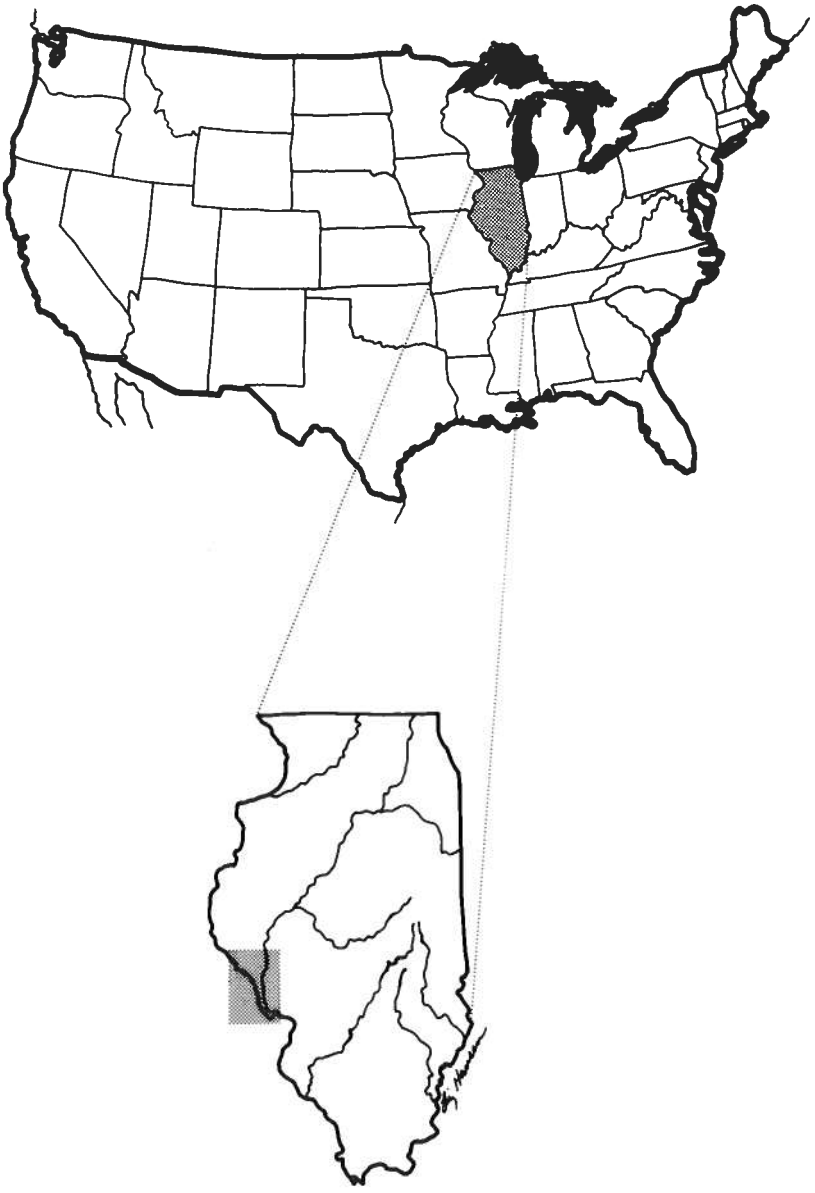
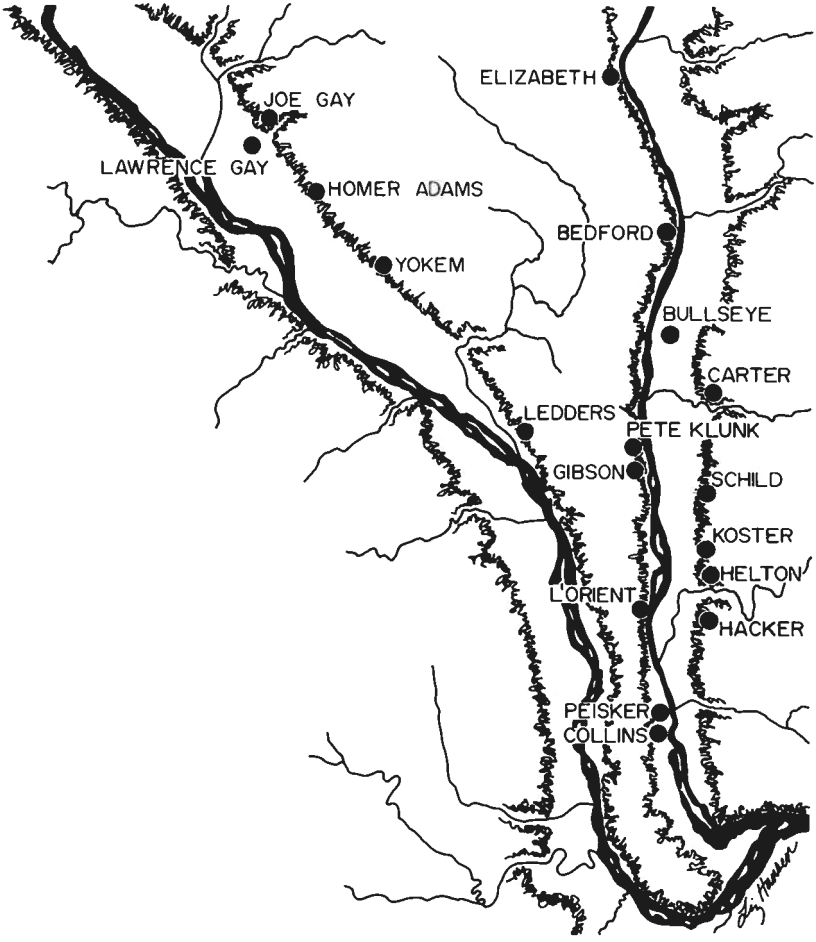


1. Reproduction of the De Bry engraving (1591) that illustrates the construction of a burial mound.



2. Map indicating the location of the west-central Illinois study area.

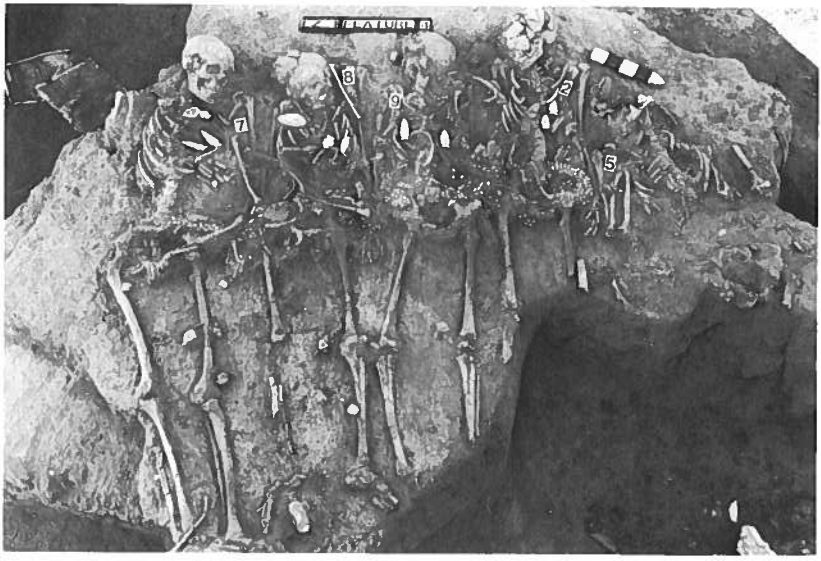


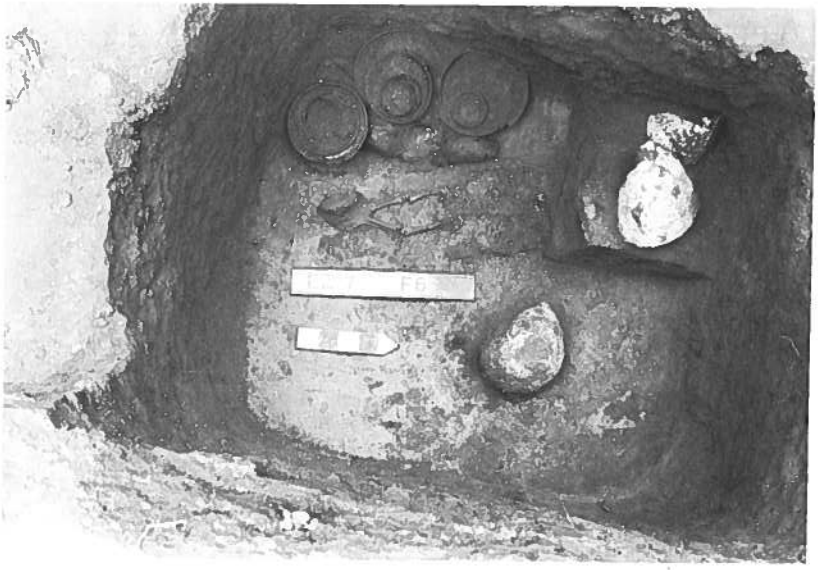
4. Location of sites that serve as the basis for this lecture.

CHRONOLOGY OF PREHISTORIC OCCUPATION IN THE LOWER ILLINOIS VALLEY

MISSISSIPPIAN:		A.D. 1000–1300
WOODLAND:		
	LATE –	A.D. 250–1000
	MIDDLE –	150 B.C.–A.D. 250
	EARLY –	600–150 B.C.
ARCHAIC:		
	TERMINAL –	500–600 B.C.
	LATE –	2500–500 B.C.
	MIDDLE –	6000–2500 B.C.
	EARLY –	8000–6000 B.C.
PALEO-INDIAN:		10,000–8000 B.C.

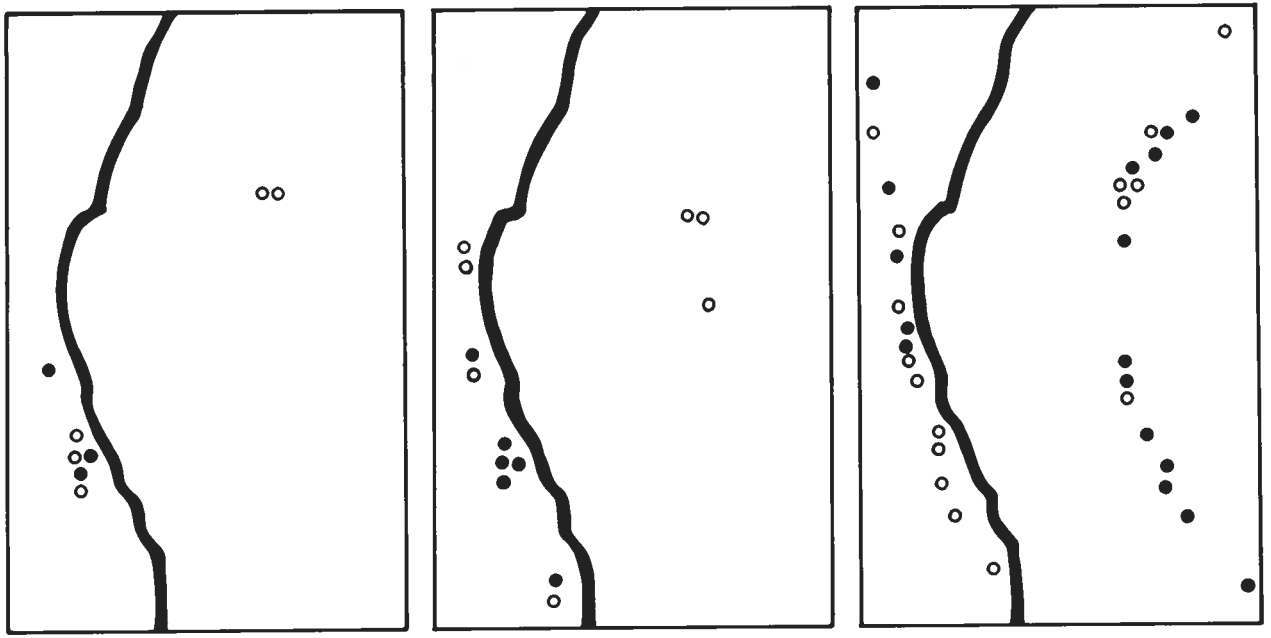
3. Chronology of prehistoric occupations for the lower Illinois Valley.





5. Burial 32 from the Elizabeth site.

6. Central tomb from the Elizabeth site, Mound 7.



7. Schematic representation of mound locations for the northern transect of the study area.

MEAN δC13 VALUES FOR ILLINOIS VALLEY SITES

SITE	PERIOD	δC13
Schild Knoll B	Mississippian	–12.3
Helton Md. 47	Emergent Mississipian	–17.5
Ledders	Later Late Woodland	–17.4
Koster	Early Late Woodland	–20.9
Gibson	Middle Woodland	–20.9
Koster	Middle Archaic	–21.7

8. Mean δC13 values for Illinois valley sites.

9. Remains from the Carter site (Mound 1, Burial 7) presented as an example of the treponematosis-like pathology common in Woodland and Mississippian skeletons.

10. Deforming pathology of the lower back characteristic of the tuberculosis-like disease found in Mississippian skeletons from the Schild Cemetery. These are remains of a 19–22 year old female, Schild Knoll B Burial 201.

KROONVOORDRACHTEN

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