Journal of Archaeological Science: Reports 36 (2021) 102888

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep

The geophysics of community, place, and identity in the Mississippian Illinois River Valley

Christina M. Friberg [a,*], Gregory D. Wilson [b], Dana N. Bardolph [c], Jeremy J. Wilson [d], John S. Flood [e], Scott D. Hipskind [d], Matthew D. Pike [g], Duane Esarey [f]

[a] Indiana University, Dept. of Earth and Atmospheric Sciences, 1001 E. 10th St., Bloomington, IN 47405, USA
[b] University of California, Department of Anthropology, Santa Barbara, CA 93106-3210, USA
[c] Northern Illinois University, Department of Anthropology, 1425 W. Lincoln Hwy, DeKalb, IL 60115, USA
[d] Indiana University-Purdue University Indianapolis, Department of Anthropology 425, University Blvd., Indianapolis, IN 46202, USA
[e] Indiana University-East, Department of Sociology, 2325 Chester Blvd., Richmond, IN 47374, USA
[f] Dickson Mounds Museum/Illinois State Museum, 10956 Dickson Mounds Rd., Lewistown, IL 61542, USA
[g] Purdue University, Department of Anthropology, 700 W State St, West Lafayette, IN 47907, USA

ARTICLE INFO

Keywords:
Mississippian
Geophysics
Identity
Social organization
Warfare

ABSTRACT

Recent geophysical surveys at six sites in the Illinois River Valley (IRV), just north of the Greater Cahokia area, provide new insights into the region's volatile era of Mississippian occupation by revealing a series of important changes in community organization that occurred from the eleventh to fifteenth centuries. Geophysical data allow us to evaluate these changes through the lens of site layout, special-purpose architecture and communal space, and the spatial alignment of site features to consider how the construction of Mississippian spaces structured social organization and identities. When considered in conjunction with data from previous excavations in the region, this geophysical work indicates that religion played a key role in forging new relationships and shared identities among early Mississippian IRV and Cahokian groups. Our analysis also reveals that IRV Mississippians reconfigured important aspects of these religious practices and socio-political relationships in the context of warfare-induced population nucleation beginning around 1200 CE, leading to more locally structured identities over time.

1. Introduction

This article draws on recent geophysical research to explore changing patterns of social organization and ethnogenesis in the Mississippian period (1050–1450 CE) Illinois River Valley of west-central Illinois. Recent archaeological research in the region has focused on the details of everyday life to highlight the ways in which different socially circumscribed groups selectively adopted Mississippian lifeways (Bardolph, 2014; Friberg, 2020; Wilson et al., 2017, 2020). This process has been referred to as Mississippianization, which resulted in the generation of new traditions and cosmologies through the cultural entanglements of diverse groups of peoples (Pauketat, 2002). However, it is still unclear what initially unified disparate Indigenous groups and how their identities and traditions changed over time. To answer these questions, it is essential to examine Mississippianization on a macro as well as micro scale. Detailed gradiometric maps of multiple sites now reveal the footprints of houses, pit features, palisade walls, plazas, and monumental architecture, which allow for a diachronic comparative analysis of community-scale organizational patterns. When considered in conjunction with data from previous excavations in the region, this geophysical work indicates that religion played a key role in forging new relationships and shared identities among early Mississippian groups in the Illinois Valley and American Bottom regions. Our analysis also reveals that Mississippian groups reconfigured important aspects of these religious practices and socio-political relationships in the context of warfare-induced population nucleation beginning around 1200 CE.

2. The Mississippian Period Illinois Valley

Characterized by its slow current, expansive, resource-rich floodplain, and western terraces and prominent bluffs, the central and lower portions of the Illinois River valley (IRV) stretch 330 km from Putnam

* Corresponding author.
E-mail address: cfriberg@iu.edu (C.M. Friberg).

https://doi.org/10.1016/j.jasrep.2021.102888
Received 17 June 2020; Received in revised form 1 November 2020; Accepted 17 February 2021

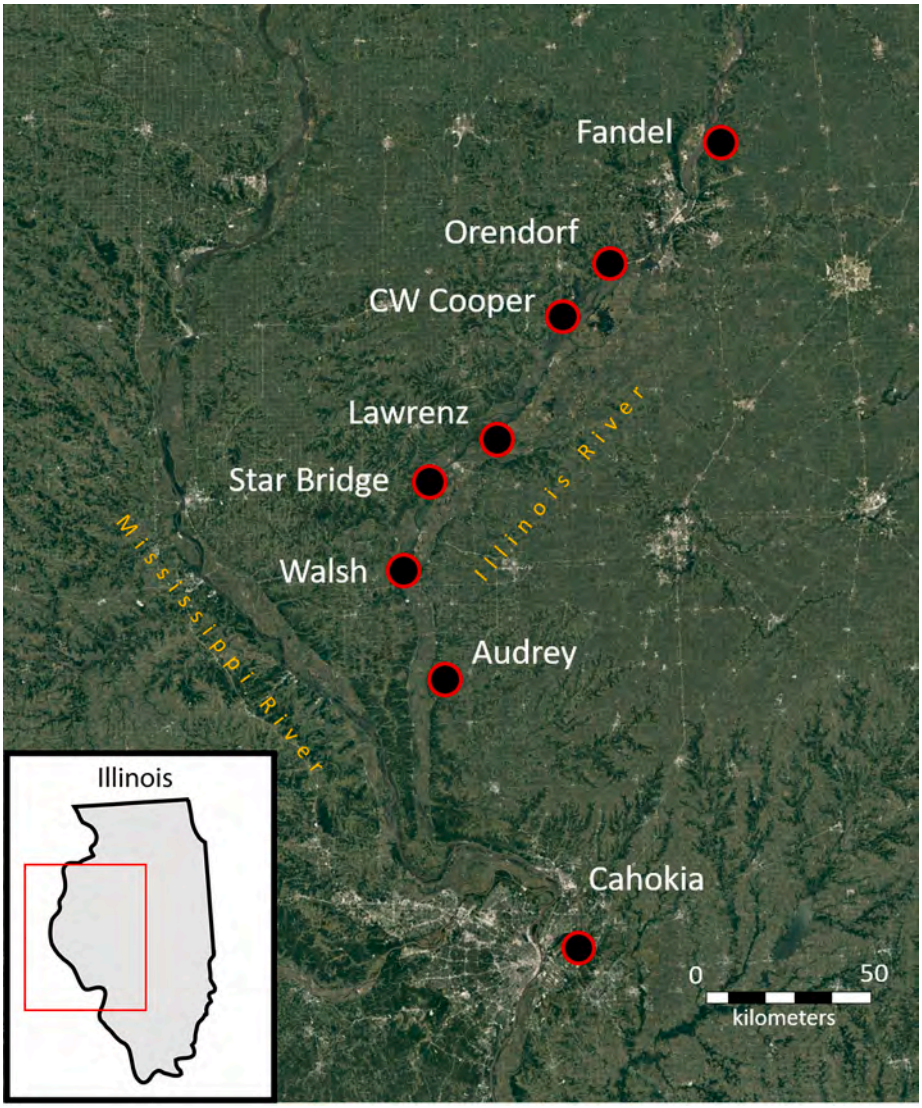

Fig. 1. Map of sites in study area.

County in the north to Jersey County in the south, where it reaches confluence with the Mississippi River (Fig. 1). From the tenth through the fifteenth centuries, periods of violence, coalescence, ethnogenesis, cultural divergence, and warfare exemplify the historical trajectory of the region's Mississippian period occupation (Conrad, 1991). During the preceding Terminal Late Woodland period (approximately the tenth century), the IRV was populated by several different unranked social groups living in riverine villages and small, dispersed upland habitation sites (Esarey, 2000; Green, 1987; Green and Nolan, 2000; Studenmund, 2000). Non-overlapping distributions of ceramic styles along with skeletal evidence of violent trauma suggest these groups followed a strategy of social avoidance that was occasionally punctuated by inter-group hostilities (Emerson, 2007; Green and Nolan, 2000; Perino, 1973; Spencer, 2014; Wilson, 2012). Beginning in the eleventh century, the region witnessed an increase in inter-group interaction in parallel with the formation of the Cahokia polity to the south in the American Bottom region. These events ushered in an era of culture contact and alliance-building on a broad geographic scale. However, this era of relative peace ended by the beginning of the thirteenth century. As Cahokia began to fragment, the southern extent of the lower Illinois River Valley (LIRV) was largely abandoned and the inhabitants of the northern LIRV and central Illinois River valley (CIRV) rapidly relocated to fortified locations atop bluffs or set back from the IRV floodplain (Conner, 1985; Conrad, 1991; Farnsworth et al., 1991; Krus et al., 2019).

To better understand these changes, we conduct a diachronic analysis of the spatial organization of mound centers and other prominent settlements throughout the IRV. Specifically, we evaluate the size and configuration of settlements, the presence and prominence of special-purpose buildings, and the alignment and context of monumental architecture, palisades, and domiciles. To do so, we analyze gradiometric data from six Mississippian sites, including the early Mississippian (CE 1050–1100) components from Fandel Mounds (11Wd4) and Lawrenz Gun Club (11Cs4); the early and middle Mississippian (CE 1100–1200) components from the Audrey-North (11Ge20) and C.W. Cooper (11F5) sites; and the late Mississippian (CE 1200–1400) components from Lawrenz Gun Club, and the Star Bridge (11Br7), and Walsh (11Br11) sites.

3. Social Organization, Identity, and Space

Geophysical data can provide critical insights into how communities were organized and changed over time, in turn illuminating shifting aspects of social identity and ethnogenesis. By identity we refer to the means by which individuals and social groups distinguish themselves from others (Díaz-Andreu et al., 2005; Insoll, 2007; Meskell, 2002). Ethnogenesis refers to the processes, transformations, causes, and

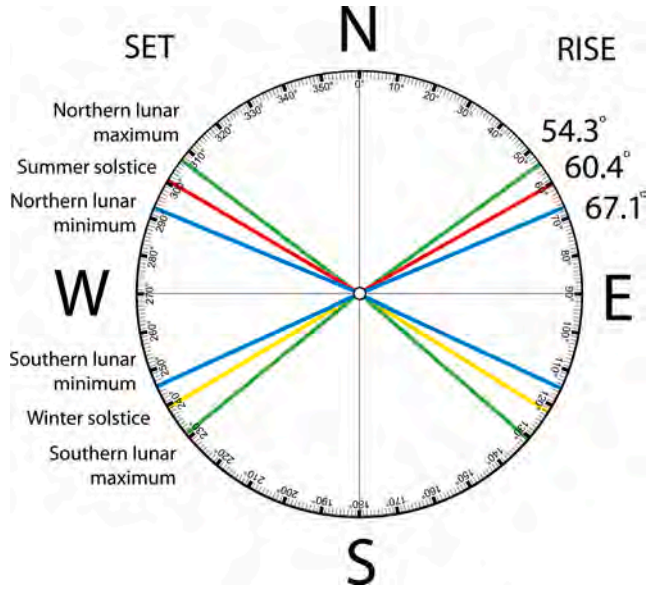

Fig. 2. Azimuths marking specific celestial events.

politics of social identity making (e.g., Hill, 1996; Voss, 2015; Weik, 2015) in which new identities and ethnic groups are formed. While ancient ethnicity is a slippery concept, ethnicities generally operate at scales greater than the individual or household. The identities developed by ethnic groups are historical products of collective social imaginations that are expressed and negotiated materially, spatially, and relationally (Clark, 2001; Jones, 1997; Pauketat, 2001). While overt displays of identity and affiliation from decorated objects to monumental architecture (Knapp, 2009; Wobst, 1977) often manifest during social, economic, and political shifts, social identities also are tied to embedded forms of daily practice, including movement throughout the landscape and built environment (Ashmore and Knapp, 1999; Bowser and Zedeño, 2009; Hutson, 2010). Architecture and other dimensions of the built (and unbuilt) world enable and constrain various forms of movement, providing opportunities for social interaction or restrictions on visibility and community integration, which in turn generate new forms of social relationships and group identities (Bradley, 1998; Delle et al., 2000; Parker-Pearson and Richards, 1994). Architectural arrangements can also generate religious experiences and meanings by bringing groups of people in relation to one another and to objects and entities in the material and spiritual world (Pauketat, 2013).

The prominent architectural components of Mississippian settlements include houses, plazas, courtyards, mounds, palisade walls, and special-purpose buildings of various sizes, shapes, and functions (e.g., Betzenhauser and Pauketat, 2019; Cobb and Butler, 2017; Emerson, 1997; Lewis and Stout, 1998). The arrangement and prominence of these architectural components provide key archaeological insights into the ways Mississippian groups interacted, formed relationships, and negotiated aspects of a shared identity. One important aspect of Mississippian identity includes religious cosmologies, which are intimately tied to landscapes (Baires, 2017; King et al., 2021). Broader archaeological research on Native American religious cosmologies has generated new interest in the placement and orientation of aspects of the built environment and the ways in which landscapes were used as a monumental medium for materializing core beliefs (e.g., Anschuetz and Wilshusen, 2011; Sofaer, 2008; Sugiyama, 1993). Ongoing archaeoastronomy studies in the Eastern Woodlands suggest that certain sites were organized around specific axes to mark particular celestial events, including the summer or winter solstice sunrise and sunset, as well as lunar standstills (Fig. 2, Pauketat, 2013, 2015; Romain, 2018). Throughout the Greater Cahokia area, aligned mounds and architecture mediated celestial and human movements and repositioned people, places, things, and other-worldly forces across vast distances (Pauketat, 2013:88–89; Pauketat and Alt, 2018). Interacting within this relational field harnessed various cosmic forces that emerged at certain times and places on the landscape. People visiting and living at these settlements would have participated in these cosmic interactions through ceremonial gatherings to mark specific calendrical events, granting them membership in a network of regions and settlements with a shared ideology. Moreover, as new identities and relationships emerged from these repeated practices, people may have chosen to materialize them by constructing monumental architecture and/or shared living and work spaces, such as spatially segregated residential groups, plazas, and courtyards (see Wilson, 2010).

Landscape archaeologists also recognize that space is multifaceted, with uses and meanings contingent on the timing, organization, and interaction of their inhabitants (e.g., Ashmore, 2004; Gosden, 1994; Robin and Rothschild, 2002). The convergence or dispersal of social groups can leave distinct spatial signatures tied to patterns of social organization. Some groups may coalesce (Birch, 2012; Kowalewski, 2006) to form more inclusive social groups, resulting in similar patterns of spatial organization and architecture reflective of shared social identity. Others may avoid interaction and demarcate themselves spatially from other ethnic groups (Hally and Chamblee, 2019), including during times of war. Still others may engage in ways that preserve certain aspects of their social autonomy and identities, but reconfigure others (including religious affiliation). Warfare also can shift groups' relationships with the landscape, such that settlement locations, site orientations, the density and distribution of buildings, and architectural features (e.g., palisades) speak more to the necessity of fortification than the signaling of allegiance to a particular social group, resulting in more locally structured identities and alliances. With these considerations in mind, we turn to the summary of our geophysical surveys in the IRV, detailed below.

Table 1
Parameters used with the Bartington Grad 601 dual sensor fluxgate gradiometer for the surveys in this study.

Survey Parameters			
Pace	1.1 m/s	Range	100 nT
Gridsize	30 × 30	Audio	ON
Start	North	Volume	Variable
Pattern	ZigZag	Threshold	1 nT
Lines/m	2	Sensors	2
Samples/m	8	Reject	50 Hz (or default)

4. Magnetic Gradiometry in the Illinois River Valley

Between 2011 and 2019, the authors conducted a series of geophysical investigations at six sites in the IRV, including Fandel Mounds, Lawrenz Gun Club, Audrey-North, C.W. Cooper, Walsh, and Star Bridge through a combined effort on the part of the University of California, Santa Barbara (UCSB), Indiana University-Purdue University Indianapolis (IUPUI), and the Illinois State Archaeological Survey (ISAS). Each site was surveyed with one or more Bartington Grad 601 magnetic gradiometers (Table 1), and data were processed using various software, including TerraSurveyor and the free, open-source program Archaeofusion. Magnetic gradiometry is a geophysical method that detects and maps magnetic signatures (in nanoteslas [nT]) up to 2 m below the ground, including burning events, accumulations of burned or fired artifacts, variations in the magnetic susceptibility of soil and rocks, the displacement or accumulation of soil horizons, and ferrous metal objects (Kvamme, 2003:441; see Skousen and Friberg, 2021 this VSI for a discussion of archaeo-geophysical surveys). While the sandier soils in the eastern portion of the valley deliver variable results, the loess-derived soils beneath the clay loam on the western blufftops are particularly well suited to the generation of detailed magnetic maps of houses, pit features, palisade walls, plazas, and monumental architecture. It should

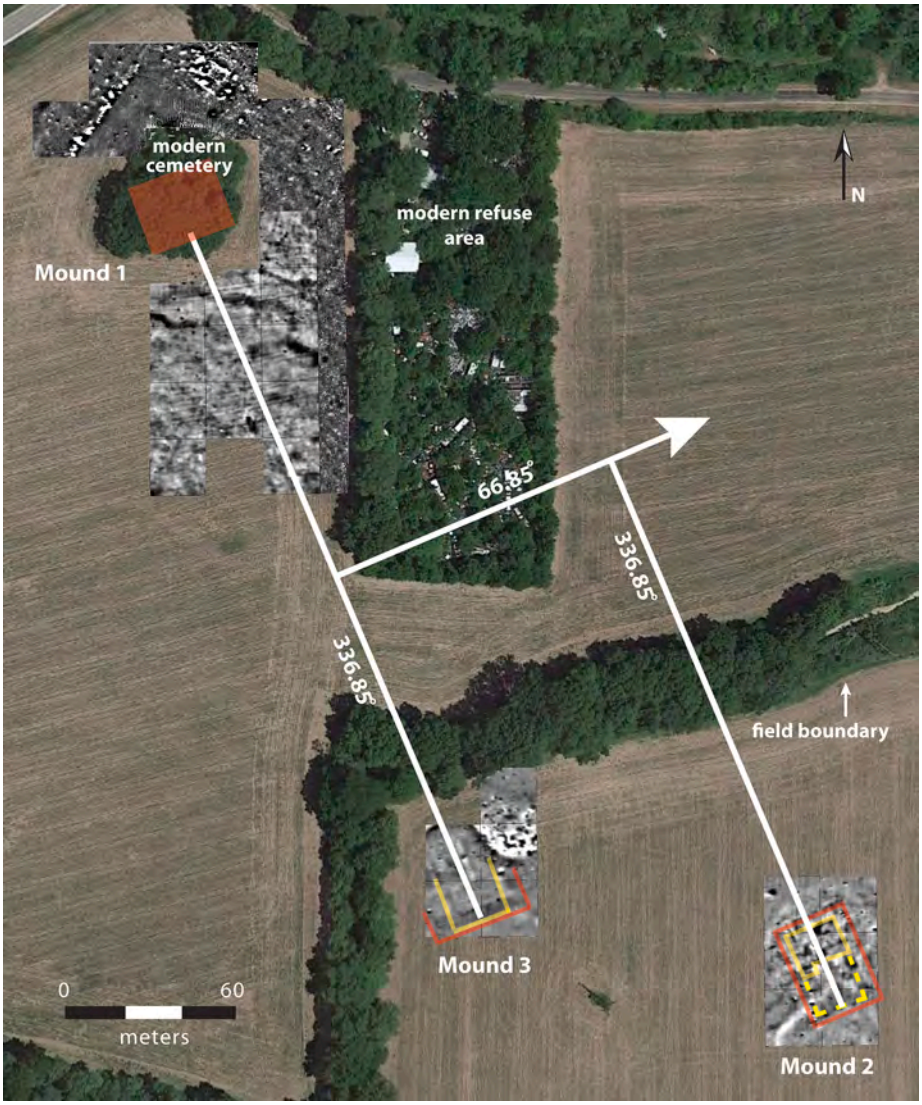

Fig. 3. Gradiometer map of Fandel Mounds showing site azimuth.

be noted that even under these ideal regional conditions, magnetic gradiometry surveys do have limitations in that (1) some features still do not show up or can be misinterpreted; (2) they show a diachronic view of the site (i.e., features are not necessarily contemporaneous); and (3) magnetic anomalies do not always correlate precisely with the size and shape of the features they depict. Despite these limitations, site-wide magnetic maps (and ground-truthing efforts where possible) facilitate the examination of macro-scale aspects of community organization, including the size and configuration of sites, the presence and placement of special-purpose architecture, the use of public space, and site azimuth[1], providing a valuable glimpse into the development of Mississippian culture in the region.

4.1. Fandel Mounds

The Fandel site is the earliest known Mississippian mound center in the northern CIRV; as such it is well suited to investigate the origins of Mississippian culture in the region. Recent excavations at this site revealed that during the early eleventh century it served as an initial point of engagement between local terminal late Woodland and Mississippian groups from the greater Cahokia area (Wilson et al., 2020). Gradiometer surveys conducted by ISAS in 2018 and UCSB/Cornell University in 2019 confirmed the presence of three rectangular platform mounds with monumental architecture (Fig. 3). An azimuth of 336.85 degrees with a 66.85 degree orthogonal was determined based on the orientation of all three mounds, aligning the site to the northern lunar minimum moonrise; a line can be drawn connecting Mounds 1 and 3 at this exact azimuth, strengthening the significance of this alignment within the site. While fluvial and colluvial activity on the landscape generated a strong magnetic signature that obscured most of the subsurface features elsewhere at the site, excavations in 2018 and 2019 in the northern portion of the site uncovered several earth ovens and multiple superimposed wall-trench buildings adjacent to Mound 1. The last building in this construction sequence has been identified as religious in nature due to its large size, substantial internal support posts, and wall trenches lined with crushed limonite and hematite (Wilson et al., 2020). The resulting yellow and red colors have religious significance as they are associated with shrines and temples in the American Bottom, notably the yellow-plastered floors, hearths, and pits of the Emerald Acropolis shrine houses (Pauketat et al., 2017).

[1] Survey grids were oriented to magnetic north. We calculated true north declinations via the National Oceanic and Atmospheric Administration's Magnetic Field Calculator. We then calculated the angle of mounds and structures and adjusted the measures according to the local declinations.

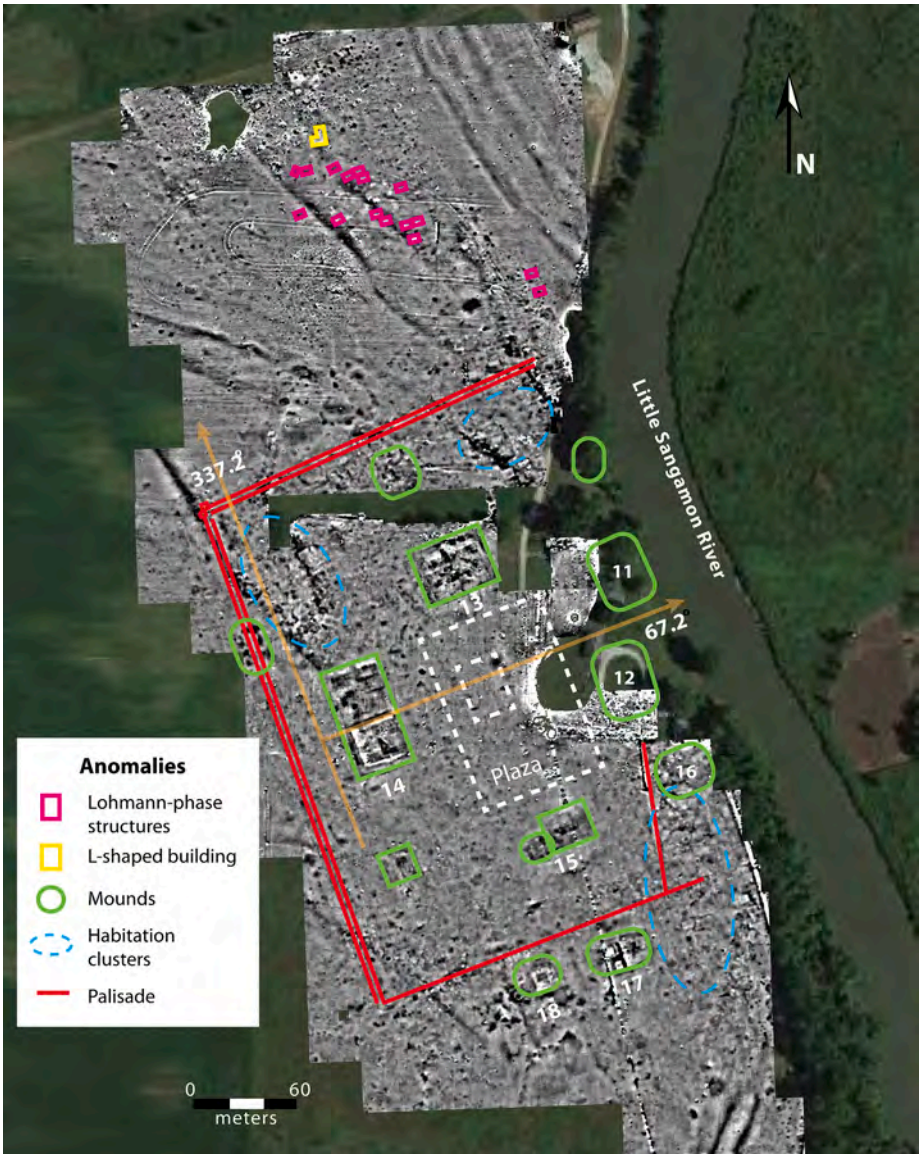

Fig. 4. Gradiometer map of the Lawrenz Gun Club site showing site azimuth.

4.2. Lawrenz Gun Club

Ongoing archaeological research at the Lawrenz Gun Club site, located along the Little Sangamon River in the southern CIRV has revealed a Mississippian mound center that was founded shortly after the abandonment of Fandel. Unlike Fandel, however, Lawrenz had a lengthy period of occupation spanning nearly 200 years (Krus et al., 2019). An expansive 10.26 ha gradiometric survey of the site conducted by IUPUI between 2011 and 2015 produced a detailed magnetic map that has guided subsequent excavations. These research efforts indicate that by the end of the twelfth century Lawrenz had developed into a fortified town with a sizable central plaza surrounded by a minimum of eleven mounds, four of which can be clearly identified as rectangular platforms (Fig. 4). The plaza area is relatively free of anomalies, with the exception of a large anomaly consisting of rectangularly arranged monopolar anomalies that may represent the edges of a smaller, perhaps later plaza. Perhaps the most striking finding from the gradiometer survey was a massive palisade wall surrounding the main portion of the settlement. Excavation and Bayesian analysis of dates from the palisade indicate that it was constructed around the turn of the thirteenth century and later reconstructed on two occasions (Krus et al., 2019).

It is currently unclear how much of this mound and plaza complex was in place when the site was founded. However, a combination of gradiometry, solid-earth cores of the earthworks, excavation, and radiocarbon dating indicates that Lawrenz's earliest configuration was minimally comprised of the site's largest mound (Mound 14) and a ca. 2.5 ha complex of nearly two dozen small, rectangular structures centered on an L-shaped anomaly that may represent a special-purpose building. Excavation of one of the small rectangular anomalies uncovered a late eleventh or early twelfth century Mississippian wall-trench building with a basin fill yielding a mixture of local terminal Late Woodland and Cahokia-style pottery (Krus et al., 2019; Wilson et al., 2020). The buildings in this complex are roughly aligned to a 337/67 degree azimuth, which, like Fandel, aligns with the northern lunar minimum moonrise. This celestial alignment also was built into later versions of the Lawrenz mound and plaza complex. Indeed, this azimuth can be traced from the center of Mound 14 (at the intersection of the lower and upper platforms) toward the river and directly between Mounds 11 and 12.

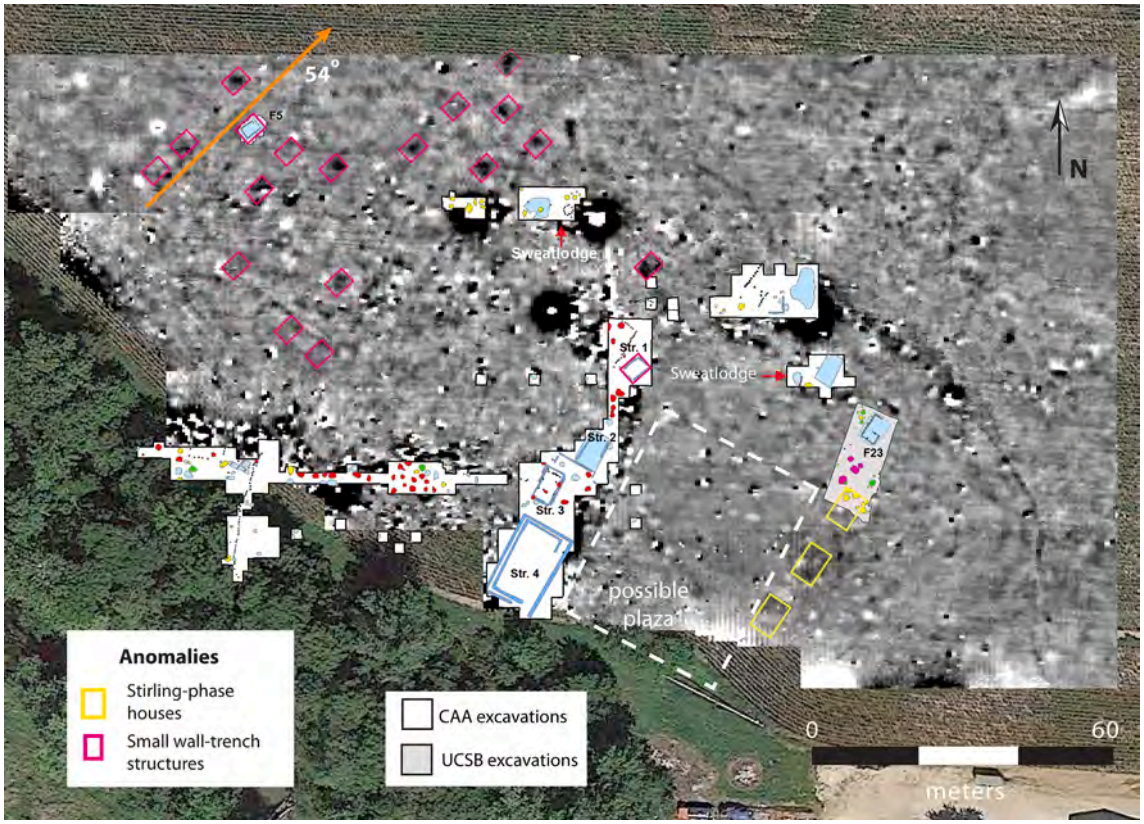

Fig. 5. Gradiometer map of the Audrey-North site showing azimuth of small wall-trench structures. Excavations maps from the 1980s and 2016 are overlaid.

4.3. Audrey-North

Audrey-North is an early twelfth-century nucleated settlement located adjacent to Apple Creek in the LIRV. Excavations in the 1980s through the Center for American Archaeology (CAA) uncovered several rectangular wall-trench structures, including a larger elite structure with associated screens, two circular sweat lodges, and a number of pit features (Cook, 1983). Ceramic analysis and radiocarbon dating confirm both a Late Woodland, White Hall phase (AD 400–750) occupation (primarily in the southern portion of the site) and a more prominent, non-overlapping early Stirling-phase Mississippian occupation (Delaney-Rivera, 2004; Friberg, 2020). In 2014, a UCSB gradiometer survey covering 2 ha revealed the site to have a much larger settlement than previously estimated, with additional buildings, a possible plaza area just east of the site's known special-purpose buildings, and a series of equally spaced anomalies in the western portion of the site (Fig. 5). Excavations of one of these anomalies by UCSB in 2016 uncovered a small (2 × 3 m) Mississippian wall-trench structure with an internal smudge pit and a floor lightly lined with yellow clay. The combination of the structure's small size and floor preparation is reminiscent of the Emerald shrine houses (Friberg, 2020; Pauketat et al., 2017). A comparable structure excavated by CAA also sits in the northwestern portion of the site, suggesting the group of similar magnetic anomalies may also be small wall-trench structures. These multiple gradiometeric patterns support the possibility of a special-purpose complex of some kind at Audrey-North. While the main area of the site appears to be oriented to an azimuth of 33.25 degrees, the two smaller structures (potential shrines) have a more eastward orientation of 54 degrees, aligning to the northern lunar maximum moonrise. The survey and excavations demonstrate that Audrey-North represents the earliest sizeable nucleated Mississippian settlement in the region (perhaps preceded by the structure compound at Lawrenz Gun Club), with many organizational characteristics echoed in the planning of later towns in the CIRV.

4.4. C.W. Cooper

C.W. Cooper is a bluff-edge site near the Spoon River in the CIRV, with both a Mississippian town dating to the beginning of the thirteenth century and a later Oneota town dating to the early fourteenth century (see Conrad, 1991; Wilson et al., 2017). A UCSB/IUPUI gradiometer survey in 2013 covered 1.67 ha of the site, revealing numerous rectangular anomalies that excavation demonstrated to be Mississippian wall-trench structures. The magnetic data also revealed the presence of loose row-like distributions of rectangular anomalies (more square in shape) that excavation demonstrated to be burned Oneota buildings (see Esarey and Conrad, 1998). The density of magnetic anomalies throughout the entire survey area highlights the crowding of structures and pits from both occupations.

The rectangular, Mississippian buildings identified in the survey were arranged around a large, rectangular area, mostly devoid of magnetic anomalies that likely served as a central plaza (Fig. 6). A large, rectangular wall-trench structure was located on the western edge of this plaza. Excavation revealed that this structure was a wall-trench Mississippian building with a prepared, circular hearth that was ritually sealed with powdered limonite. Elsewhere on the structure floor were numerous informal hearths and a refuse deposit that included a flint clay figurine fragment. This probable elite building was connected via a screen wall to a large, circular, single-post rotunda with interior benches. Excavation revealed evidence of burning in many of the post-molds associated with this rotunda. This architectural arrangement may represent another example of the adjoined special-purpose structures excavated at Orendorf Settlement D (discussed further below) and tentatively identified in our gradiometry map for Lawrenz Gun Club. The elaborate architectural complex and associated rectangular plaza are oriented to an azimuth of 45 degrees east of north; the relative scattering of the Oneota houses at varying angles, however, reveals no single site-wide azimuth for this later occupation. Overall, the current

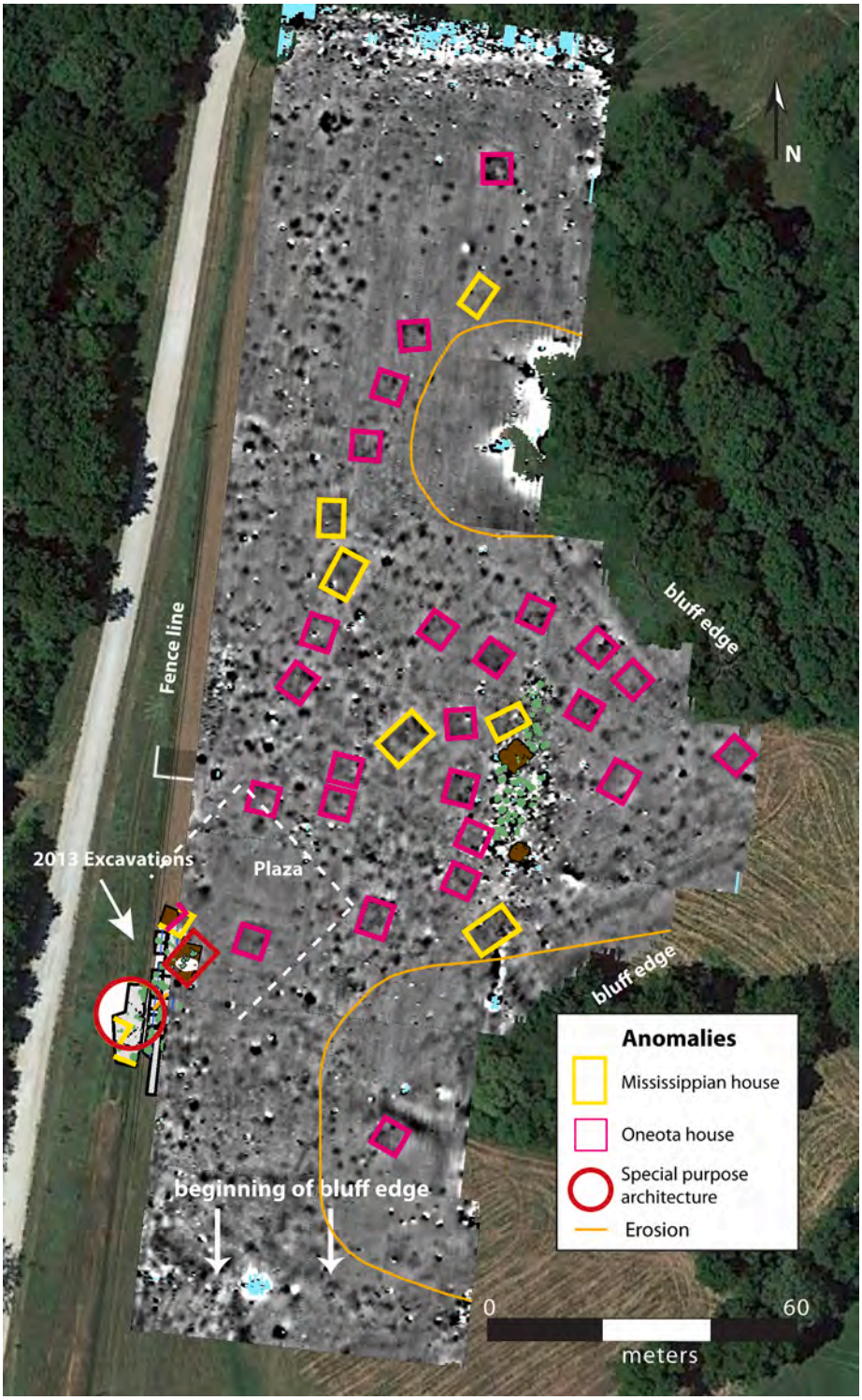

Fig. 6. Gradiometer map of the C.W. Cooper site with 1970s excavations in the center and UCSB's 2013 excavations to the west.

analysis and prior investigations at C.W. Cooper provides the earliest evidence of a nucleated town in the CIRV, only preceded by Audrey-North in the LIRV. While the site's orientation deviates from the celestially significant azimuths of the earlier IRV sites, its layout, including a plaza flanked on one side by special purpose buildings, is similar to the Audrey-North village and foreshadows organizational elements observed in later settlements in the region.

4.5. Walsh

Walsh is a late Mississippian site with six mounds located on a meandering blufftop overlooking the Illinois River in the southern CIRV. The 2016 gradiometer survey by IUPUI covered multiple modern land parcels and agricultural fields for a total of 7.74 ha (Fig. 7). The geophysical data indicate that the core of the site consists of a nucleated arrangement of buildings distributed around a rectangular central plaza. Mound 4 appears to include a multi-room structure or series of

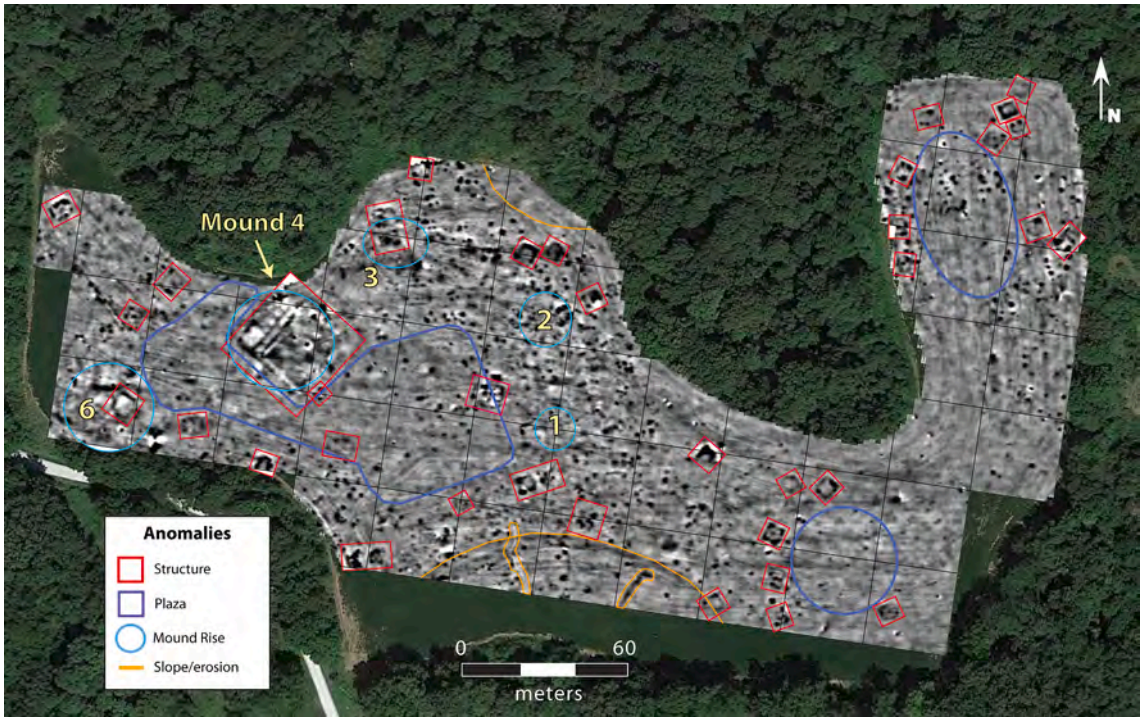

Fig. 7. Gradiometer map of the Walsh site main mound center area.

superimposed structures, either beneath or within the mound fill. A radiocarbon date obtained by IUPUI from Mound 4 yielded a calibrated age of 1270–1299 CE (95.4% probability), suggesting that this portion of the site dated primarily to the late thirteenth to early fourteenth century. Two larger rectangular anomalies south of the main plaza may represent special-purpose buildings or merely closely-placed domestic structures.

To the east of the mound and plaza complex lie two loosely organized clusters of buildings distributed around areas devoid of rectangular magnetic anomalies that may have been plazas. A similar distribution of magnetic anomalies indicative of wall-trench structures was observed in the eastern and northeastern portions of this same field, as well as ridge-top fields south of the mound center (Fig. 8). At present it is unclear how these three areas relate, but it is apparent that the Mississippian occupation of the landform extends beyond the agricultural fields and onto the smaller fingers of the bluff, where the density of structures is lower.

The site's mounds have varying orientations and it is currently unclear whether they reference any specific celestial events. However, the sprawling distribution of buildings at Walsh suggests the irregular topography of the blufftop played a prominent role in the organization of this settlement. It would appear that Walsh lacks the rigid spatial structure exhibited by many of the other fortified settlements in the region. Meanwhile, the site's mound and plaza complex, and the presence of possible special-purpose buildings on the edge of the plaza and within or beneath mounds are all features shared with contemporaneous towns and mound centers in the region.

4.6. Star Bridge

Star Bridge is another late Mississippian nucleated settlement located on the south side of the LaMoine River, shortly before its confluence with the Illinois River (Flood, 2020). Aerial photos following a deep plowing event in the late 1970s revealed over 200 structures distributed in partial rows and clusters with indications for one or more residential plazas (Fig. 9; Conrad, 1991). In addition, the rectangular layout of the visible house basins and abrupt delineation of these deposits suggests the presence of a palisade, thereby protecting community members from rival polities in the fourteenth century. Some have speculated that a conflagration initiated by combatants may have incinerated the whole community at Star Bridge (Conrad, 1991), though this possibility has not been ground truthed. Seriation of surface-collected jar rims and two radiocarbon dates from the site indicate it was occupied during the fourteenth century (Flood, 2020; Upton, 2019:74).

In 2018, IUPUI and ISAS conducted a 3.24 ha magnetic gradiometer survey, leading to several key observations. The geophysical data corroborate that Star Bridge was a densely occupied fourteenth century Mississippian settlement; in fact, some of the site's houses are less than 2 m apart. Although it is possible that not all of these anomalies were contemporaneous, it appears that by the thirteenth and fourteenth centuries defensive concerns had intensified, requiring a greater nucleation of the regional populace. Beyond the rectangular structures of varying size observed in the aerial photos, two large circular anomalies suggest the presence of possible public/civic or ceremonial buildings (Fig. 10). Meanwhile, the northern circular structure and the largest of the rectangular anomalies occur near a magnetically quiet area interpreted as the site's plaza; the pairing of circular and rectangular structures on plaza edges is a pattern seen at other Mississippian sites in the region after 1200 CE, including the C.W. Cooper site (Conrad, 1991; Wilson and Geiger, 2020). It bears noting that the southernmost circular building overlays a rectangular Mississippian house anomaly, suggesting that this special-purpose building was not part of the site's initial configuration or it was replaced by a rectangular structure later in time. While the survey was unable to identify a palisade wall, the clear site boundaries seen in the 1970s aerial photo (see Fig. 9) and the westernmost row of house anomalies from the gradiometer survey suggest an alignment of 17 degrees east of north was used in the original planning of the site; neither this azimuth nor its orthogonals correspond to a known celestial event. Ultimately, Star Bridge represents another example of a nucleated Mississippian town plan with additional evidence for site reconfiguration during its relatively brief occupation.

5. Changing Alignments and Spatial Orders

Analysis of the geophysical data presented here reveals a series of important changes in community organization took place during the

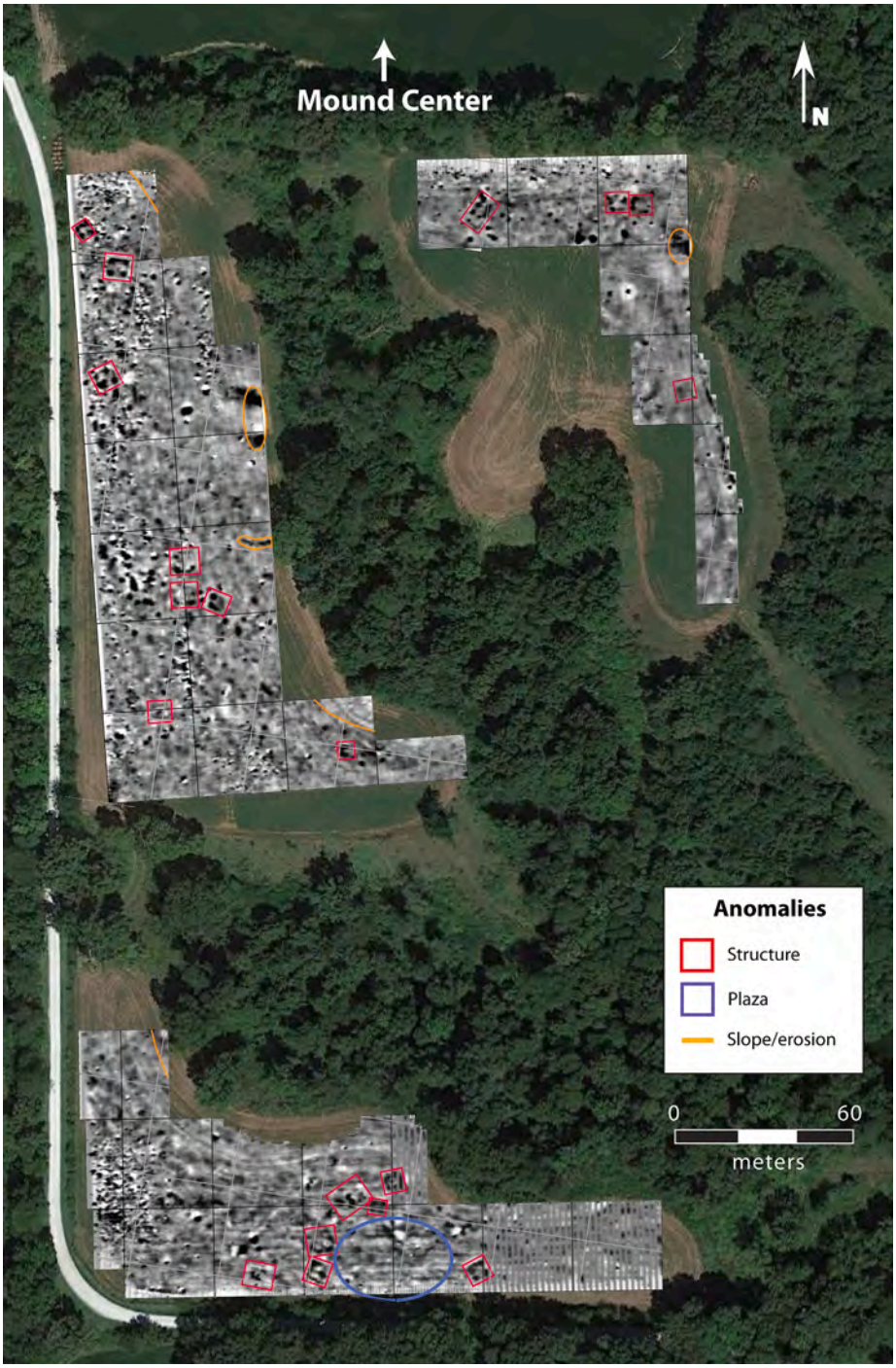

Fig. 8. Gradiometer maps of the Walsh site from fields south of the mound center area.

Mississippian period occupation of the IRV. The spatial and architectural patterns associated with these changes provide key insights into the reconfiguration of social relationships and identities in the region. The initiation of platform mound ceremonialism and the construction and use of special-purpose religious buildings was an important means by which the disparate, socially circumscribed groups of the Woodland era began to form new and more inclusive relationships with one another during the early Mississippian period. Pauketat and colleagues have argued that celestial alignments were built into early Mississippian shrine complexes in the greater Cahokia area (Alt and Pauketat, 2017; Pauketat et al., 2017; Pauketat and Alt, 2018). Indeed, our investigation has revealed that the two early Mississippian IRV mound centers were spatially aligned to azimuths shared by a network of Cahokia-centered Mississippian groups engaged in similar aspects of religious expression.

The fact that Fandel and Lawrenz, over 100 km apart in a region dominated by local Woodland peoples, were built to nearly identical azimuths indicates they were part of this network. Azimuths of 67 degrees align to the northern lunar minimum moonrise, an alignment that is shared with the Pfeffer site shrine complex in the greater Cahokia area, the Trempealeau - Fisher Mounds complex in west-central Wisconsin (Pauketat, 2015:11; Romain, 2018), and the Angel Mounds site in southern Indiana (Watts Malouchos, 2020; Watts Malouchos et al., 2021). The minor lunar standstill, occurring only every 18.6 years, is a phenomenon during which the series of the moon's rises and sets create

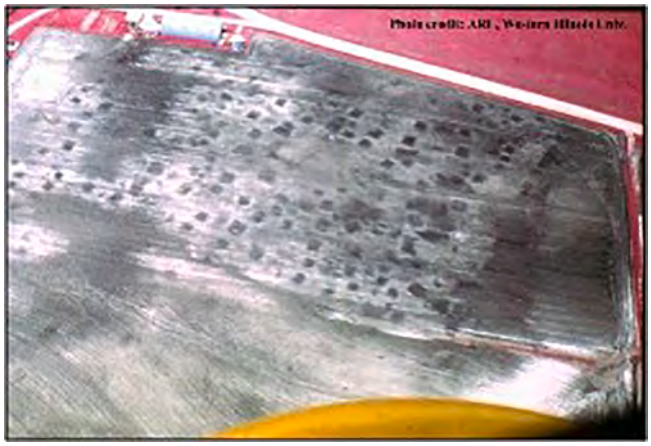

Fig. 9. Aerial photo of the Star Bridge site following a deep plowing episode (image courtesy of Western Illinois University).

its narrowest range on the horizon. Pauketat and Alt have argued that these celestially aligned mounds, shrines, and temples provided the ritual and experiential means by which far-flung groups began to generate and share religious practices, meanings, and identities in the early Mississippian world (Pauketat, 2013, 2015; Pauketat et al., 2017; Pauketat and Alt, 2018). In this scenario, each of these mound centers in this network were locations where older and more locally bounded identities and relationships were reconfigured through peoples' ceremonial engagement with each other and otherworldly cosmic powers (see Pauketat, 2013; Wilson et al., 2020). These newly reconfigured identities were then materialized in various ways, including the production of more stylistically homogeneous artifact assemblages and the widespread adoption of wall-trench architecture.

At the beginning of the twelfth century, the establishment of a well-ordered, nucleated town at Audrey-North in the LIRV represents a precocious example of the organizational changes to come in the greater IRV. Nearly all the elements that characterize middle and late Mississippian towns in the region (rows of buildings, a central plaza, and plaza-edge special-purpose buildings) are present at the site. However, it is important to note that a subset of the buildings at Audrey-North were organized in reference to a celestially important azimuth. The two small special-purpose structures at the site are oriented to 54 degrees, which aligns these structures with the northern lunar maximum rise, the same azimuth as the Emerald Acropolis in the Greater Cahokia area (Pauketat et al., 2017). Thus, Audrey-North represents a transitional stage in the region's Mississippian occupation.

The outbreak of warfare towards the end of the twelfth century entailed dramatic organizational changes throughout the region as palisade walls were erected around existing communities and new towns (some also fortified) were built on defensible blufftop locations (Conner, 1985; Conrad, 1991; Conrad et al., 2020; Farnsworth et al., 1991; Krus et al., 2019). While early Mississippian mound centers in the region, including Fandel and Lawrenz, were structured by a clear spatial segregation of residential and ritual areas (a pattern also evident at the early Mississippian Eveland site, see Wilson et al., 2020), warfare-induced nucleation resulted in a more direct juxtaposition of domestic and ritual contexts. This pattern is observed in the integration of platform mounds within the larger late Mississippian community plans at Lawrenz and Walsh, and the construction of large special-purpose structures in the residential areas at Cooper and possibly Lawrenz and Star Bridge. Increasingly nucleated populations also necessitated the shrinking of plazas, witnessed at Lawrenz and Star Bridge and the closer spacing of buildings, which is particularly notable at Star Bridge. In extreme circumstances, such as Walsh, settlements were constricted in their expansion by blufftop landscapes, resulting in a sprawling pattern of expansion.

These trends likely had implications for the way community members engaged in public ceremonialism in these spaces. Indeed, while many early Mississippian villages and mound centers from Cahokia to Wisconsin and southwest Indiana were aligned to commemorate specific celestial events, this broadly shared religious and cosmological practice appears to have diminished as a unifying principle for the inhabitants of numerous late Mississippian sites. Our data suggest that the variable and shifting orientations of later towns were based more on the spatial challenges of building nucleated settlements on meandering blufftops, and the confinement of living within palisade walls, than on

Fig. 10. Gradiometer map of the Star Bridge site.

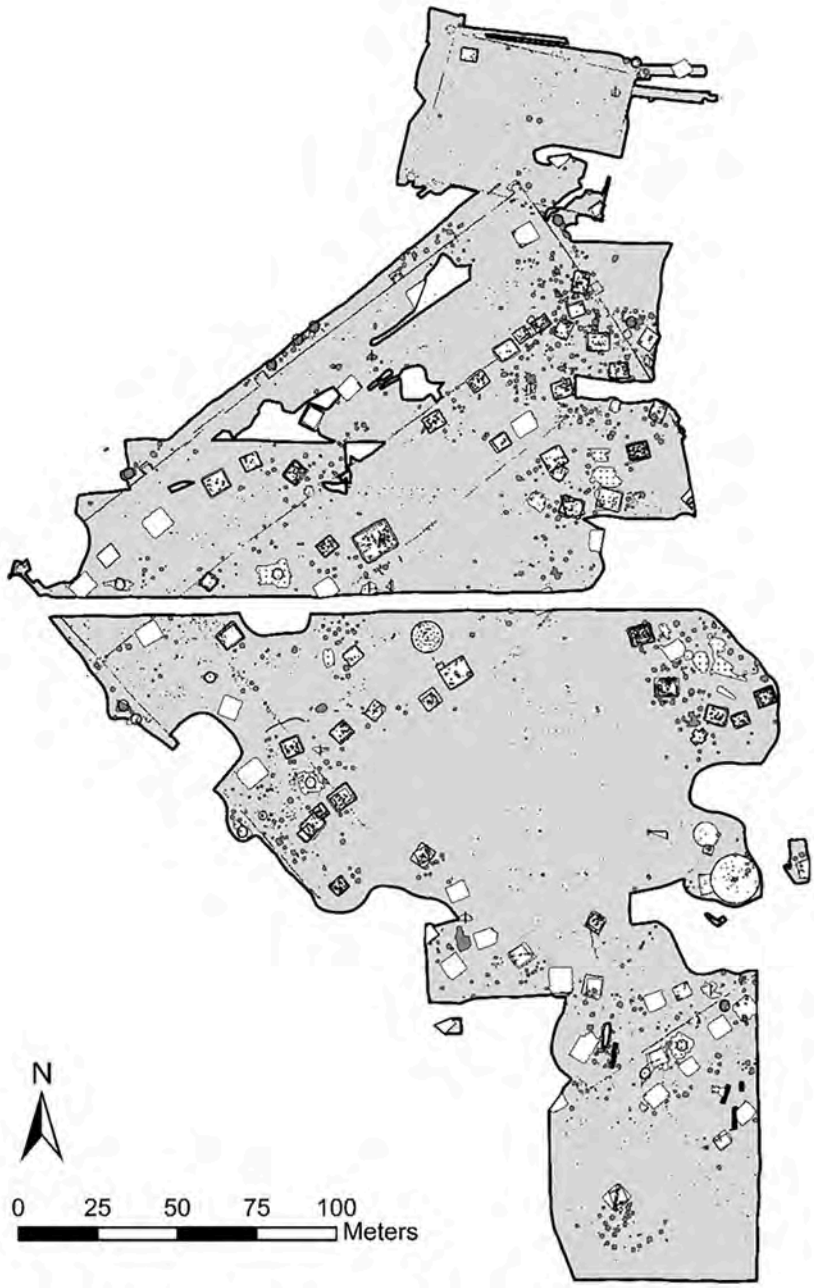

Fig. 11. Excavation map of the Orendorf Settlement D site.

interregional shared religious practices and identities.

The best evidence we have for the impacts of warfare on population density and community organization comes from the extensively excavated Orendorf Settlement D in the CIRV. In less than fifty years (1200–1250 CE), this fortified Mississippian settlement underwent three rebuilding episodes involving the expansion and reorganization of space to integrate newcomers within a community dealing with chronic warfare (Fig. 11; Conrad et al., 2020; Steadman, 2008; Wilson and Geiger, 2020). In the site's first iteration, its orderly plan consisted of a circular council house (rotunda) and adjacent L-shaped structure positioned prominently on the edge of the central plaza, suggesting an architectural reinforcement of power structures. During its initial expansion, the site's original paired rotunda and L-shaped building were razed and rebuilt on opposite sides of the plaza. The rotunda was also rebuilt much larger, presumably to ritually incorporate incoming groups in the expanding community order (Wilson and Geiger, 2020). Ultimately, the entire site was catastrophically burned and abandoned around 1250 CE (Conrad et al., 2020).

The reconfiguring of Mississippian settlements in the CIRV corresponds with the tumultuous trajectory of Cahokia's decentralization to the south. By the end of the twelfth century, Mississippian groups had begun to abandon the American Bottom region (Emerson, 1991; Pauketat and Lopinot, 1997), and the expansive network that had united groups across disparate regions and river valleys of the midcontinent was segmenting. Chronic warfare came to circumscribe and limit interaction between IRV groups and the American Bottom in the wake of Cahokia's collapse. It is in this bellicose context that we see the first clear evidence for the development of a unified cultural tradition in the IRV. Beginning with the Audrey site, every settlement in our study consists of rows of rectangular structures surrounding a central plaza with special-

purpose architecture (and occasionally mounds) placed prominently on its edges. Furthermore, our analysis reveals that a specific pattern of paired circular and rectangular buildings on plaza edges appeared around 1200 CE, a unique architectural arrangement notably absent from the Cahokia area (see Collins, 1990; Emerson, 1997; Fowler, 1978; Mehrer, 1995). In addition to Orendorf Settlement D's excavated circular and L-shaped pairing, our gradiometry survey shows C.W. Cooper's partially excavated adjoining circular and rectangular structures also sit on the edge of the site's central plaza; it is also possible the paired round and rectangular portions of Mound 15 at Lawrenz Gun Club were preceded by corresponding paired special-purpose buildings whose wall trenches are represented by magnetic anomalies seen in Fig. 4, although this possibility has not yet been ground truthed. This coupling of rectangular and L-shaped special-purpose buildings with circular council houses effectively fused aspects of early Mississippian religious ceremonialism with a mechanism to ritually integrate the members of nucleated communities. One of the outcomes appears to have been a more regionally interconnected network of potters than in previous eras that generated a stylistically homogeneous ceramic tradition throughout the central and lower Illinois valley areas (see Upton, 2019).

6. Conclusion

As other papers in this issue (and beyond) can attest, the uses of geophysical data have moved far beyond methods of archaeological prospection, as these data are increasingly employed to address broader theoretical issues (King et al., 2021; Skousen and Friberg, 2021; Watts Malouchos et al., 2021). In this study, the evaluation of spatial organization, architectural features, public spaces, and site azimuths provides important insights into how Mississippian Illinois River Valley (IRV) communities were organized and changed over time, in turn illuminating shifting aspects of social identity and ethnogenesis. As indicated by both gradiometric and excavation data, shared identities and the broader social relations in which they were embedded were heavily reconfigured over the course of several centuries. Specific spatial patterns and architectural elements at IRV sites, supported by excavation data, indicate that early Mississippian identities were structured by shared organizational patterns, including collective engagement in religious practices. The participation in certain types of religious ceremonialism, including mound and temple construction that also involved lunar phenomena, produced and reproduced aspects of a shared Mississippian identity that unified previously disparate Indigenous groups in the region.

The onset of warfare towards the end of the twelfth century entailed some fundamental reorganizations of those groups, as later Mississippian communities were reconfigured to cope with increasing threats of violence. This reconfiguration resulted in the appearance of new types of politico-religious special purpose buildings on the later Mississippian landscape, along with a particular composition of palisaded towns with central mounds and plazas. With regional networks scaled down, a new unified cultural tradition emerged in the IRV, one accompanied by the disappearance of celestial alignments (a trend that paralleled similar disappearance rates in the American Bottom and at the Trempealeau-Fisher Mounds complex).

While the details of our case study are specific to the Illinois Valley, our approach is broadly relevant to any archaeologists investigating the complicated and uncertain intersections of landscape, monumentality, religion, memory, and identity on a diachronic scale. The macro-scale comparative analysis that geophysical data can provide allows us to trace how social relationships and ethnic identities were formed, unraveled, and reconstituted over the longue durée. Geophysical survey has allowed us to, quite literally, look at the bigger picture of the construction and transformation of Mississippian culture in the Illinois River Valley.

Acknowledgments

We acknowledge and honor the Peoria, Kickapoo, and Potawatomi people on whose ancestral homelands this research was conducted. Many thanks for the permission and support for geophysical surveys and excavations provided by the Hardwick, Robertson, and Kuhlman families (Lawrenz Gun Club); Charlie Snyder (Star Bridge); Gary Clevenger (Walsh); Denny and Sherry Vetter (Audrey-North); Barney Wolff (C.W. Cooper); and Carol Heinz and Pete Fandel (Fandel Mounds). We also thank Kaitlyn Brown, Kerwin Brown, Lynn Carl, Colleen Delaney, Bee Geiger, Tim Horsley, Jenna Santy, Bob McCullough and the Illinois State Archaeological Survey for their help with these investigations. This research was funded by the Cornell Hirsch Fund, National Science Foundation, and UCSB Academic Senate and Institute for Behavioral and Economic Research.

References

Alt, S.M., Pauketat, T.R., 2017. Cahokia and the Mississippian World: Shrines Near Cahokia. Illinois Archaeology 29, 1–26.
Anschuetz, K.F., Wilshusen, R.H., 2011. Ensouled Places: Ethnogenesis and the Making of the Dinétah and Tewa Basin Landscapes. In: Nelson, M.C., Strawhacker, C.A. (Eds.), Movement, Connectivity, and Landscape Change in the American Southwest. University Press of Colorado, Boulder, pp. 321–344.
Ashmore, W., 2004. Social Archaeologies of Landscape. In: Meskell, L., Preucel, R.W. (Eds.), A Companion to Social Archaeology. Blackwell Publishing, Malden, MA, pp. 255–271.
Ashmore, W., Knapp, A.B. (Eds.), 1999. Archaeologies of Landscape: Contemporary Perspectives. Blackwell, Oxford.
Baires, S.E., 2017. Land of Water, City of the Dead: Religion and Cahokia's Emergence. The University of Alabama Press, Tuscaloosa.
Bardolph, D.N., 2014. Evaluating Cahokian Contact and Mississippian Identity politics in the late prehistoric central Illinois River Valley. American Antiquity 79 (1), 69–89.
Betzenhauser, A., Pauketat, T.R., 2019. Elements of Cahokian Neighborhoods. Archaeological Papers of the American Anthropological Association 30, 133–147.
Birch, J., 2012. Coalescent Communities: Settlement Aggregation and Social Integration in Iroquoian Ontario. American Antiquity 77 (4), 646–670.
Bowser, B.J., Zedeño, M.N. (Eds.), 2009. The Archaeology of Meaningful Places. University of Utah Press, Salt Lake City.
Bradley, R., 1998. The Significance of Monuments: On the Shaping of Human Experience in Neolithic and Bronze Age Europe. Routledge, London.
Clark, J.J., 2001 Tracking Prehistoric Migrations: Pueblo Settlers among the Tonto Basin Hohokam. Anthropological Papers of The University of Arizona, No. 65. The University of Arizona Press, Tucson.
Cobb, C.R., Butler, B.M., 2017. Mississippian Plazas, Performances, and Portable Histories. J. Archaeol. Method Theory 24 (3), 676–702.
Collins, J.M., 1990 The Archaeology of the Cahokia Mounds ICT-II: Site Structure (no. 10). Illinois Historic Preservation Agency.
Conner, M.D. (Ed.), 1985. The Hill Creek Homestead and the Late Mississippian Settlement in the Lower Illinois Valley. Kampsville Archaeological Center Research Series 1. Center for American Archeology, Kampsville, IL.
Conrad, L.A., Emerson, K.E., Emerson, T.E., Esarey, D.E. (Eds.), 2020. Orendorf Settlement D: A Burned Fortified Mississippian Town in the Central Illinois River Valley. Illinois State Archaeological Survey Research Report No. 50. Prairie Research Institute, University of Illinois at Urbana-Champaign.
Conrad, L.A., 1991. The Middle Mississippian Cultures of the Central Illinois Valley. In: Emerson, T.E. (Ed.), Cahokia and the Hinterlands: Middle Mississippian Cultures of the Midwest. University of Illinois Press, Urbana, pp. 119–156.
Cook, T.G., 1983. The Audrey Site: A Summary of Research through 1982. The Center for American Archaeology, Kampsville, Illinois.
Delaney-Rivera, C., 2004. From Edge to Frontier: Early Mississippian Occupation of the Lower Illinois River Valley. Southeastern Archaeology 23 (1), 41–56.
Delle, J.A., Mrozowski, S.A., Paynter, R., 2000. Lines that Divide: Historical Archaeologies of Race, Class, and Gender. University of Tennessee Press, Knoxville.
Díaz-Andreu, M., Lucy, S., Babic, S., Edwards, D.N., 2005. The Archaeology of Identity: Approaches to Gender, Age, Status, Ethnicity and Religion. Taylor & Francis, New York.
Emerson, T.E., 1991. Some Perspectives on Cahokia and the Northern Mississippian Expansion. In: Emerson, T.E., Lewis, R.B. (Eds.), Cahokia and the Hinterlands: Middle Mississippian Cultures of the Midwest. University of Illinois Press, Urbana, pp. 221–236.
Emerson, T.E., 1997. Reflections on Cahokian Hegemony. In: Pauketat, T.R., Emerson, T. E. (Eds.), Cahokia: Domination and Ideology in the Mississippian World. University Press of Nebraska, Lincoln, pp. 167–189.
Emerson, T.E., 2007. Cahokia and the Evidence for Late Pre-Columbian War in the North American Mid-continent. In: Chacon, R.J., Mendoza, R.G. (Eds.), North American Indigenous Warfare and Ritual Violence. University of Arizona Press, Tucson, pp. 129–148.
Esarey, D., 2000. Late Woodland Maples Mills and Mossville Phase Sequence in the Central Illinois River Valley. In: Emerson, T.E., McElrath, D.L., Fortier, A.C. (Eds.),

Late Woodland Tradition and Transformation across the Midcontinent. Lincoln, University of Nebraska Press, pp. 387–410.
Esarey, D., Conrad, L.A., 1998. The Bold Counselor Phase of the Central Illinois River Valley: Oneota's Middle Mississippian Margin. Wisconsin Archeologist 79 (2), 38–61.
Farnsworth, K.B., Emerson, T.E., Glenn, R.M., 1991. Patterns of Late Woodland/ Mississippian Interaction in the Lower Illinois Valley Drainage: A View from Starr Village. In: Emerson, TE., Lewis, R.B. (Eds.), Cahokia and the Hinterlands: Middle Mississippian Cultures of the Midwest. University of Illinois Press, Urbana, pp. 83–118.
Flood, J.S., 2020. Star Bridge: A Late Mississippian Village in the Central Illinois River Valley. M.A. Indiana University Department of Anthropology, Indianapolis.
Fowler, M.J., 1978. *The Cahokia Atlas, Revised: A Historical Atlas of Cahokia Archaeology*. Illinois Transportation Archaeological Research Program, Studies in Archaeology 2. University of Illinois, Urbana.
Friberg, C.M., 2020. The Making of Mississippian Tradition. University Press of Florida, Gainesville.
Green, W., 1987. Between Hopewell and Mississippian: Late Woodland in the Prairie Peninsula as Viewed from the Western Illinois Uplands.. PhD Dissertation, Department of Anthropology, University of Wisconsin, Madison.
Gosden, C., 1994. Social Being and Time. Blackwell, Oxford.
Green, W., Nolan, D., 2000. Late Woodland Peoples in West-Central Illinois. In: Emerson, T.E., McElrath, D.L., Fortier, A.C. (Eds.), Late Woodland Societies: Tradition and Transformation across the Midcontinent. University of Nebraska Press, Lincoln, pp. 345–386.
Hally, D.J., Chamblee, J.F., 2019. The Temporal Distribution and Duration of Mississippian Polities in Alabama, Georgia, Mississippi, and Tennessee. American Antiquity 84 (3), 420–437.
Hill, J.D. (Ed.), 1996. History, Power, and Identity: Ethnogenesis in the Americas, 1492–1992. University of Iowa Press, Iowa City.
Hutson, S.R., 2010. Dwelling, Identity, and the Maya: Relational Archaeology at Chunchucmil. Altamira Press, Landham, MD.
Insoll, T. (Ed.), 2007. The Archaeology of Identity: A Reader. Routledge, New York.
Jones, S., 1997. The Archaeology of Ethnicity: Constructing Identities in the Past and Present. Routledge, London.
King, A., Walker, C.P., Reilly, F.K., 2021. The Etowah Archaeo-Geophysical Survey: Creating Place and Identity through the Built Environment. J. Archaeol. Sci.: Reports, this VSI.
Knapp, B.A., 2009. Monumental Architecture, Identity and Memory. Proceedings of the Symposium: Bronze Age Architectural Traditions in the East Mediterranean: Diffusion and Diversity, pp. 47–59.
Krus, A.M., Herrmann, E.W., Pike, M.D., Monaghan, G.W., Wilson, J.J., 2019. Chronology of a Fortified Mississippian Village in the Central Illinois River Valley. Radiocarbon 61 (3), 713–731.
Kvamme, K.L., 2003. Geophysical Surveys as Landscape Archaeology. American Antiquity 68 (3), 435–457.
Kowalewski, S.A., 2006. Coalescent Societies. In: Pluckhahn, T.J., Ethridge, R. (Eds.), Light on the Path: The Anthropology and History of the Southeastern Indians. University of Alabama Press, Tuscaloosa, pp. 94–122.
Lewis, R.B., Stout, C. (Eds.), 1998. Mississippian Towns and Sacred Spaces: Searching for an Architectural Grammar. The University of Alabama Press, Tuscaloosa.
Mehrer, M., 1995. Cahokia's Countryside: Household Archaeology, Settlement Patterns, and Social Power. Northern Illinois University Press, DeKalb.
Meskell, L., 2002. The intersections of identity and politics in archaeology. Ann. Rev. Anthropol. 31, 279–301.
Parker-Pearson, M., Richards, C., 1994. Architecture and Order: Approaches to Social Space. Routledge, London.
Pauketat, T.R., 2001. Practice and History in Archaeology: an Emerging Paradigm. Anthropol. Theory 1 (1), 73–98.
Pauketat, T.R., 2002. A Fourth-Generation Synthesis of Cahokia and Mississippianization. Midcontinental J. Archaeol. 27 (2), 149–170.
Pauketat, T.R., 2013. An Archaeology of the Cosmos: Rethinking Agency and Religion in Ancient America. Routledge, London.
Pauketat, T.R., 2015. Illuminating Triangulations: Moonlight and the Mississippian World. In: Papadopolous, C., Moyes, H. (Eds.), The Oxford Handbook of Light in Archaeology. Oxford University Press, pp. 1–21.
Pauketat, T.R., Alt, S.M., 2018. Water and Shells in Bodies and Pots. In: Harrison-Buck, E., Hendon, J.A. (Eds.), Relational Identities and Other-than-human Agency in Archaeology. University Press of Colorado, Louisville, pp. 72–99.
Pauketat, T.R., Alt, S.M., Kruchten, J.D., 2017. The Emerald Acropolis: Elevating the Moon and Water in the Rise of Cahokia. Antiquity 91 (355), 207–222.
Pauketat, T.R., Lopinot, N.H., 1997. Cahokia Population Dynamics. In: Pauketat, T.R., Emerson, T.E. (Eds.), Cahokia: Domination and Ideology in the Mississippian World. University of Nebraska Press, Lincoln, pp. 103–123.
Perino, G., 1973. The Koster Mounds, Greene County, Illinois. Illinois Archaeological Survey Bulletin 9 (1), 141–210.
Robin, C., Rothschild, N.A., 2002. Archaeological Ethnographies: Social Dynamics of Outdoor Space. Journal of Social Archaeology 2 (2), 159–172.
Romain, W.F., 2018. Ancient Skywatchers of the Eastern Woodlands. In: Koldehoff, B.H., Pauketat, T.R. (Eds.), Archaeology and Ancient Religion in the American Midcontinent. University of Alabama Press, Tuscaloosa, pp. 304–342.
Skousen, B.J., Friberg, C.M., 2021. Investigating Mississippian Landscapes, Places, and Identities through Geophysics. J. Archaeol. Sci.: Rep., this VSI.
Sofaer, A., 2008. Chaco Astronomy: An Ancient American Cosmology. Ocean Tree Books, Santa Fe.
Spencer, S.D., 2014. Violence in the Lower Illinois River Valley (ca. AD 700–1250): An Examination of Injuries at Schild Utilizing Taphonomy, Paleopathology and Forensic Science.. PhD Dissertation, Department of Anthropology, Indiana University.
Steadman, D.W., 2008. Warfare Related Trauma at Orendorf, a Middle Mississippian Site in West-Central Illinois. Am. J. Phys. Anthropol. 136 (1), 51–64.
Studenmund, S., 2000. Late Woodland Occupations in the Lower Illinois Valley: Research Questions and Datasets. In: Emerson, T.E., McElrath, D.L., Fortier, A.C. (Eds.), Late Woodland Societies: Tradition and Transformation across the Midcontinent. Lincoln, University of Nebraska Press, pp. 301–344.
Sugiyama, S., 1993. Worldview Materialized in Teotihuacan. Mexico. Latin American Antiquity 4 (2), 103–129.
Upton, A.J., 2019. Multilayer Network Relationships and Culture Contact in Mississippian West-Central Illinois, AD 1200-1450. PhD Dissertation, Department of Anthropology, Michigan State University.
Voss, B., 2015. What's New? Rethinking Ethnogenesis in the Archaeology of Colonialism. American Antiquity 80 (4), 655–670.
Watts Malouchos, E., 2020. Angel Ethnogenesis and the Cahokian Diaspora. J. Archaeol. Method Theory 27, 128–156.
Watts Malouchos, E., Schurr, M.R., Herrmann, E.W., 2021. From the Mound to the Moon: Geophysical Insights into Angel Phase Landscapes. J. Archaeol. Sci.: Rep. this VSI.
Weik, T., 2015. The Archaeology of Ethnogenesis. Ann. Rev. Anthropol. 43, 291–305.
Wilson, G.D., 2010. Community, Identity, and Social Memory at Moundville. American Antiquity 75 (1), 3–18.
Wilson, G.D., 2012. Living with War: The Impact of Chronic Violence in the Mississippian-Period Central Illinois River Valley. In: Pauketat, T.R. (Ed.), The Oxford Handbook of North American Archaeology. Oxford University Press, Oxford, pp. 522–533.
Wilson, G.D., Bardolph, D.N., Esarey, D., Wilson, J.J., 2020. Transregional Social Fields of the Early Mississippian Midcontinent. Journal of Archaeological Method and Theory 27 (1), 90–110.
Wilson, G.D., Delaney, C.M., Millhouse, P.G., 2017. The Mississippian of the Illinois and Apple River Valleys. In: Wilson, G.D. (Ed.), Mississippian Beginnings. University of Florida Press, Gainesville, pp. 97–129.
Wilson, G.D., Geiger, B., 2020. Community Layout and Occupational History. In: Conrad, L.A., Emerson, K.E., Emerson, T.E., Esarey, D.E. (Eds.), Orendorf Settlement D: A Burned Fortified Mississippian Town in the Central Illinois River Valley. Illinois State Archaeological Survey Research Report No. 50, Prairie Research Institute, University of Illinois at Urbana-Champaign, pp. 87–114.
Wobst, M.H., 1977. Stylistic Behavior and Information Exchange. In: Cleland, C.E. (Ed.), For the Director: Research Essays in Honor of James B. Griffin. University of Michigan Museum of Anthropology, Ann Arbor, pp. 317–342.