A PLATFORM MOUND AT THE NORMAN SITE (34WG2), EASTERN OKLAHOMA

Gregory Vogel, Marvin Kay, and Louis Vogele, Jr.

The Norman Site (34WG2) is a late prehistoric civic ceremonial center in eastern Oklahoma, currently inundated by the Grand Lake Reservoir. The only remaining mound at the site is a platform mound, suffering severe erosion from wave action. Recent investigations of the mound's wave-cut profile recovered no artifacts but revealed a complex internal stratigraphy of cyclical filling, pitting, and capping episodes. Burning, building construction, and loading of highly contrasting matrix are also evident. The mound stratigraphy mirrors at least some aspects of the structure of Caddo ritualism. A method of gridded digital photography allowed for detailed recording of a 200 m^2 profile in under a week, even with a small crew.

Recent investigations of a wave-cut profile through the center of a platform mound at the Norman site (34WG2) offer a view into such a mound in the Arkansas River Valley area which is unprecedented in several decades. Stratigraphic investigations revealed many details of the building techniques and sequence. Construction of the mound was careful and highly structured, and large-scale reworking of much of the mound indicates a far greater investment of time and labor than expressed by the size of the mound itself.

The Norman site was formerly a large mound complex located in eastern Oklahoma along the Grand River. It is situated on the former west side of the Grand (Neosho) River and lies completely within Fort Gibson Lake (Figure 1). (See also Albert 2000 for a summary of previous descriptions of the site.) Fort Gibson Lake is a U.S. Army Corps of Engineers reservoir located in Wagoner, Cherokee, and Mayes Counties, Oklahoma. Initial mapping and excavation of the Norman site was begun in the 1930s by J. Joe Finkelstein (1940) (Figure 2). (*Editor's note:* Finkelstein later changed his name to Bauxar.) Two sets of double mounds were present, designated I and II, together with five additional mounds. Mound I-1 was originally conical in shape, 8.2 m (27 ft) high and 27.4 m (90 ft) in diameter. Mound I-2 was 2.1 m (7 ft) high and 30.5 m (100 ft) in diameter. Mounds I-1 and I-2 were connected by a low broad saddle 3.6 m (12 ft) long, creating a double-mound arrangement. Unit II was also a double-mound arrangement. Mound II-1 was conical, probably 3 m (10 ft) high and 21 m (70 ft) in diameter, while Mound II-2 was circular, 0.76 m (2.5 ft) high and 13.7 m (45 ft) in diameter. Mound III was a low, circular mound 2.1 m (7 ft) high and 30.5 m (100 ft) in diameter. Unit IV was also a low circular mound 0.46 m (1.5 ft) high and 13.7 m (45 ft) in diameter. Finkelstein's excavations focused on Unit II, Mound III, and Unit IV.

The Corps of Engineers started construction of Fort Gibson Lake in 1942 and in 1943 purchased the Norman site (Figure 3). The University of Oklahoma chose this and the nearby Harlan sites for excavation in the late 1940s. According to a typed manuscript prepared by Robert E. Bell and on file at the Sam Noble Oklahoma Museum of Natural History, these excavations at the Norman site were conducted from 1 July to 22 September 1948. The work was accomplished as a cooperative project between the University of Oklahoma, the U.S. Army Corps of Engineers, Tulsa District, and the River Basin Survey of the Smithsonian Institution. Robert E. Bell and Joseph R. Caldwell supervised and directed the excavations.

Throughout July 1948, the University of Oklahoma's Field Session in Archeology under Bell's direction conducted excavations at the site, focusing initially on several structures located south of Mound I-1 (Area A on Figure 2) and later of Mound I-1 itself. From 17 August until 22 September, Joseph Caldwell of the Smithsonian Institution and a crew of locally hired men continued excavations on Mound I-1. Although initially driven by the desire to salvage information from the site in advance of it being inundated, once at the site, an even more immediate concern became apparent. As Caldwell noted regarding his work at the Norman site in 1948:

> *When Robert E. Bell . . . reached the site in July, 1948, he found to his disappointment that nearly all the village area, and all mounds with the exception of the largest double unit [Mound I] had been removed by heavy machinery . . . . Even the largest double unit was damaged: the western periphery had been cut away, and the smaller mound had been cut down several feet [Caldwell 1948:2].*

The Corps of Engineers was not the guilty party in this action. At the same time that the Corps was focused on constructing the lake, a new bridge was being built by an independent contractor just downstream from the Norman site. Nearly the entire site was used as fill for the elevated causeway for the bridge. Quoting again from Caldwell:

> *With the assistance of the [Corps of] Engineers, Bell was able to halt these operations and carefully staked out areas which the*

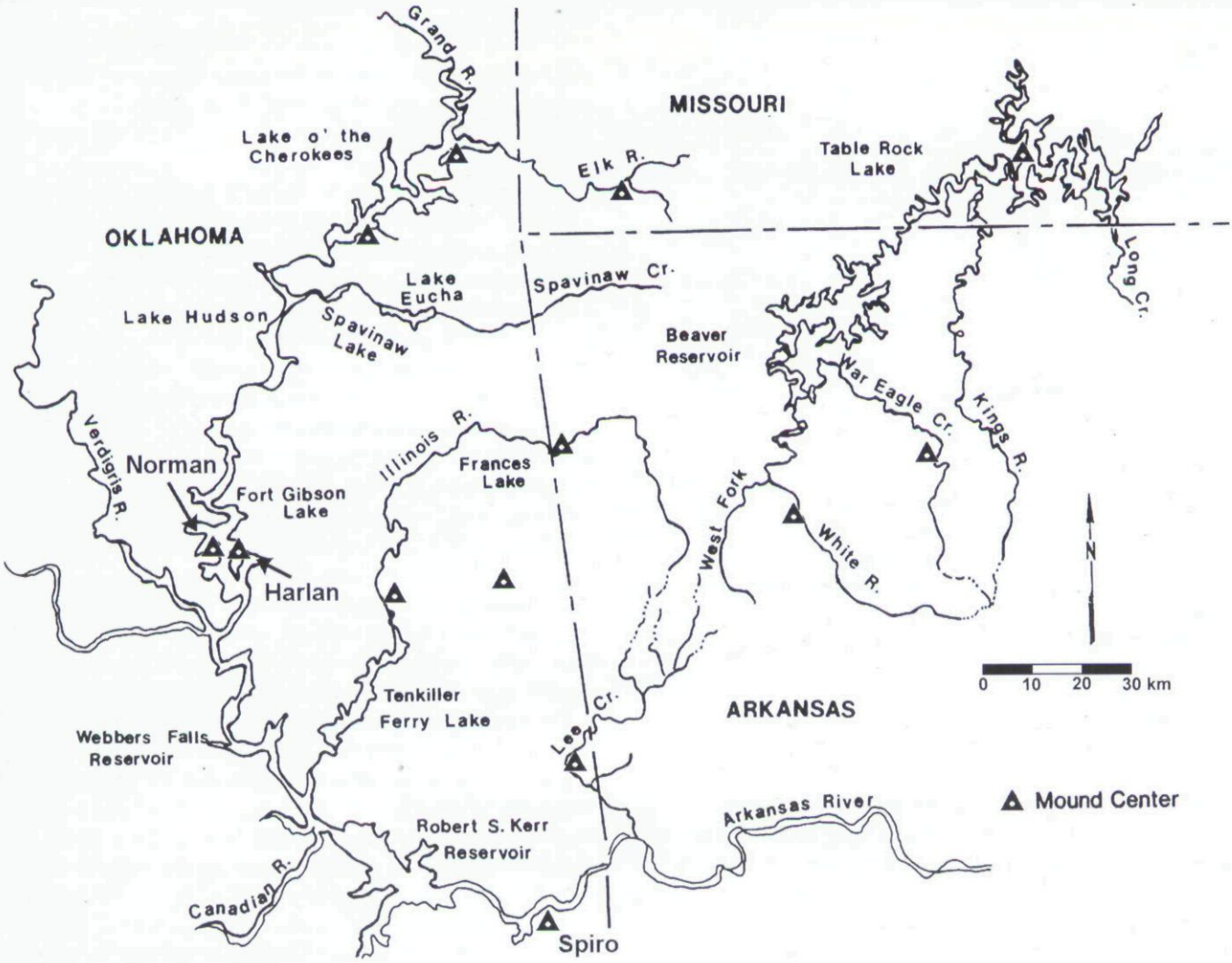

Figure 1. Location of the Norman site and other large mound centers (after Kay, Sabo, and Merletti 1989).

bulldozers were not to pass. Nevertheless during all the time Dr. Bell and the writer [Caldwell] were at the site constant vigilance was required to keep the bulldozers off the small mound and the peripheries of the larger [Caldwell 1948:3].

In addition to the damages wrought by the bridge construction, the excavations conducted by Bell and Caldwell at the site were in themselves of considerable magnitude. Continuing to quote from Caldwell:

The writer [Caldwell] arrived at the site August 19 and men were hired until the excavation crew numbered 15. It was decided that the $2,000 allotted for the project would be insufficient for excavation of the mound by the method of cutting forward with a continuous vertical face. Accordingly, a long north-south trench was cut through the center of the mound . . . . This trench was 10 feet wide . . . and eventually reached a length of 90 feet and a maximum depth of 29 feet. We were able to borrow a bulldozer from time to time, and when occupation levels appeared in the upper portion of the central profile, the bulldozer was employed to remove the overburden, exposing the summit as it had appeared at the period of each level. This was only possible for the two uppermost substages, for subsequently diminishing funds necessitated limiting excavations to the main trench [Caldwell 1948:3–4].

Figure 4 is a profile of the internal stratigraphy of Mound I-1 prepared after completion of the 1948 excavations at the site. From the remaining notes and manuscripts prepared by Caldwell and Bell, we know that the upper two substages of the mound were completely excavated. We also know that a 3 m (10 ft) wide north-south trench was excavated through the entire mound to a depth of 8.8 m (29 ft), and that a large vertical cut was made on the north end of the mound that was at least 3.6–4.6 m (12–15 ft) in depth. It is also likely that the filling activities associated with the construction of the nearby bridge causeway continued to whittle away at the mound once the archeologists had left the site.

What happened at the Norman site after the lake filled is unclear. Beginning in 1997, however, former Tulsa District archeologist Frank Winchell initiated a program to document and protect what remained of the Norman

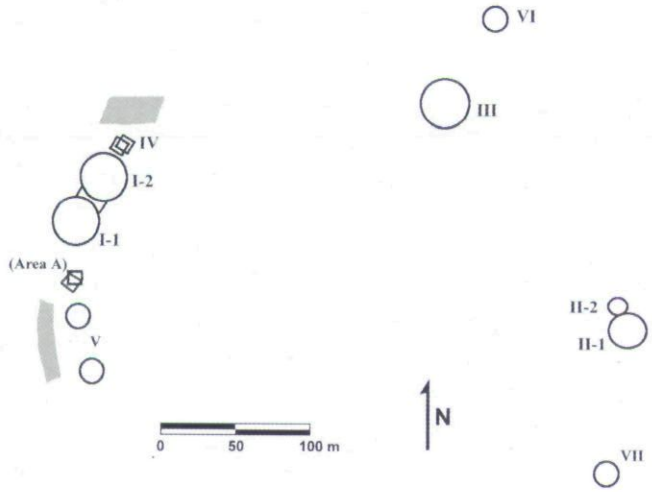

Figure 2. Map of the Norman site, combining elements from Finklestein (1940) and Caldwell (1948). Finklestein's map includes only one Mound V, whereas Caldwell's has two, and only Finklestein's map includes Mound VII. The shaded areas are "midden" on Caldwell's map. Area A and Unit IV are superimposed structures. The only remaining feature of the site is a portion of conjoined Mounds I-1 and I-2.

site, and in 1998 he was successful in getting a 1 ft contour map made of Mounds I-1 and I-2 (Figure 5). Winchell left the Tulsa District shortly after the contour map of the mounds was completed and was replaced by Louis Vogele, Jr. in 1999. No absolute datum point was used in previous mapping efforts, and it is therefore impossible to exactly match current maps with previous ones. No excavations of the western portion of the mound were undertaken, and it is possible that the mound appears wider today because of erosion from fluctuating lake levels.

Fort Gibson Lake is as a multipurpose reservoir. Flood control, hydropower, recreation, and water regulation for navigation on the Arkansas River are all important roles the lake serves. All of these purposes contribute to and remain management concerns that affect the Norman site and other archeological sites at Fort Gibson Lake. In order to serve its role in flood prevention in the region, Fort Gibson Lake has a significant capacity range. Normal conservation pool for the lake is 168.8 m (554 ft) amsl, while the maximum flood control level is 177.4 m (582 ft) amsl. The reservoir was designed to increase as much as 8.5 m (28 ft) in elevation as a result of high rainfall and flooding and varies in surface area from 8053.1 hectares (19,900 acres) at conservation pool to 20638.6 hectares (51,000 acres) at the top of flood pool.

By the end of August 1999, the lake level at Fort Gibson had dropped enough to allow inspection of portions of Mounds I-1 and I-2, the last remnants of the Norman site. At normal conservation pool level, Mounds I-1 and I-2 form a small island located approximately 100 m off shore from a popular swimming beach (see Figure 3). Based on topographic information gathered at the site in 1998, it appears that somewhere between one-third and one-quarter of these mounds remains. In 1998, Mound I-1 was approximately 35 m long, 20 m wide, and had a maximum height of around 6 m. Mound I-2 was much smaller, with dimensions of around 17 m long, 8 m wide, and 1.5 m high.

The western portion of Mound I-1 appears to be relatively undisturbed, with no visible potholes or erosion present, although according to Caldwell's notes, the western periphery of this mound had been disturbed by bulldozers. More than half of this mound has eroded from the east, forming a nearly vertical cutbank that faces out into the reservoir. This remaining remnant is west of the central trench excavated in 1948, and the location of the (backfilled) east-west trench is visible at the northern edge of Mound I-1 as an area of darker fill. Although the remaining *in situ* mound deposits are relatively stable, the site is slowly eroding away, especially along the unprotected eastern cutbank.

Continuing the efforts started by Frank Winchell, in 2000 the Tulsa District was able to secure funds to undertake some limited, yet very successful, stratigraphic recording of the deposits exposed in the eroded cutbank on the east side of Mounds I-1 and I-2. The result of this work is reported here. The 2000 fieldwork confirmed the suspicions of those who have visited the site: a very detailed and complex stratigraphic record of mound construction and use remains in the Mound I-1 and I-2 deposits, in spite of severe damage over the past 65 years.

Civic Ceremonial Centers in the Arkansas River Valley

Late prehistoric mound-building cultures in the central Arkansas River Valley and upper White River Valley (Figure 1) are conventionally referred to as "Caddoan" (Bell 1984; Brown, Bell, and Wyckoff 1978; Wyckoff 1980), although their cultural and genetic relationship to the historically documented and current Caddo Indians is unknown. Also unknown is their cultural and genetic relationship to late prehistoric groups in the Red River Valley of southeastern Oklahoma and southwestern Arkansas, considered the "core" Caddoan area (Perttula 1996). Regardless of genetic affiliation, populations in this area participated in a broad, southeastern Mississippian way of life and exchange system. This lifestyle included a subsistence system based at least partly on agriculture, manufacture, and trade of Southeastern Ceremonial Complex and related items and the large-scale building of earthworks for burial and other purposes.

The Norman site was a large mound complex, interpreted as a civic ceremonial center. While no extensive archaeological reconnaissance has been conducted in the areas surrounding many of these sites in the Arkansas

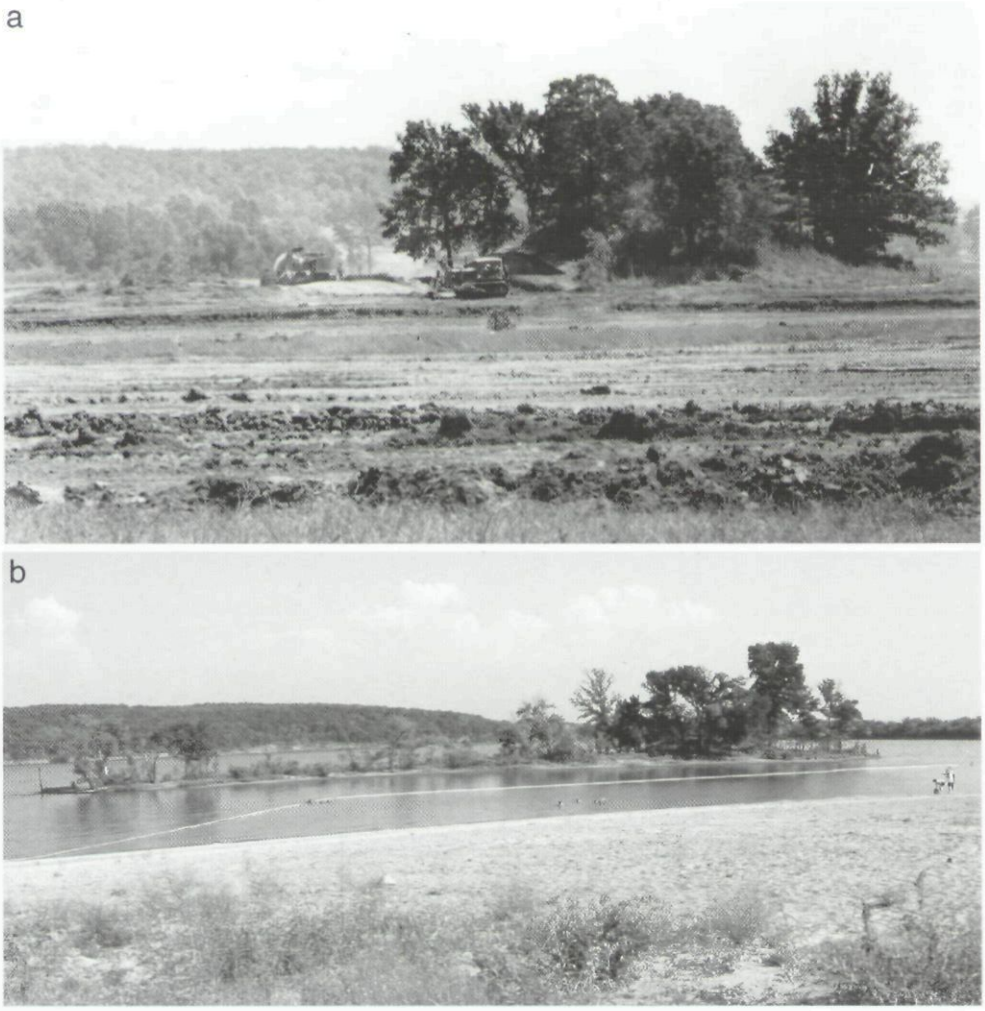

Figure 3. Views of Norman Mound I in 1948 (a) and 2000 (b). Both views are from the northwest. Bulldozers are removing soil from the area around Mound I-2 in the 1948 image. The 2000 image shows the mound at low water. Most of the area to the north (left) of Mound I-1 is usually submerged. The row of trees on the horizon at the right of the 2000 image is on the embankment constructed in the 1940s, largely from other mounds at the site.

River basin, they do not appear, in general, to have served as loci for permanent habitations. Caldwell (1948) mentioned a "village area" at the Norman site and mapped two areas of "midden" (see Figure 2), but these areas were unexcavated and no other evidence suggests that an associated village was present. Rather, each mound center appears to have served as a central gathering place for surrounding villages (Bell 1984). Several distinct mound types are recognized, primarily consisting of structural, accretional burial, and platform type mounds.

Structural mounds are low, conical features erected over a previously existing structure. The structures buried at the base of the mounds appear to have been used for specialized, ceremonial purposes. Many are hypothesized to have served as charnel houses or temporary burial locations (Rogers 1982). These mounds were usually constructed in a single episode and contain few or no burials or artifacts. Mound VI at the Norman site likely represents such a structural mound. Structures found within Mounds I-1 and I-2 and Structure IV likely represent charnel houses as well.

Accretional burial mounds are elongated, multilobed, or round features that are the result of multiple episodes of mound building. Each building episode generally contains multiple burials, many of them secondary burials that were probably processed in the structures underlying structural mounds. Grave goods and elaborate burial features are common features in this type of mound. Accretional burial mounds and structural mounds likely represent a basic "pair" of earthworks—structural mounds built over short-term processing structures and accretional burial mounds built as permanent burial platforms for the remains. Each accretional burial mound stage may correspond to a single burial processing structure, although this has not been determined conclusively. Mound III and conjoined Mounds II-1 and II-2 at the Norman site are accretional burial mounds.

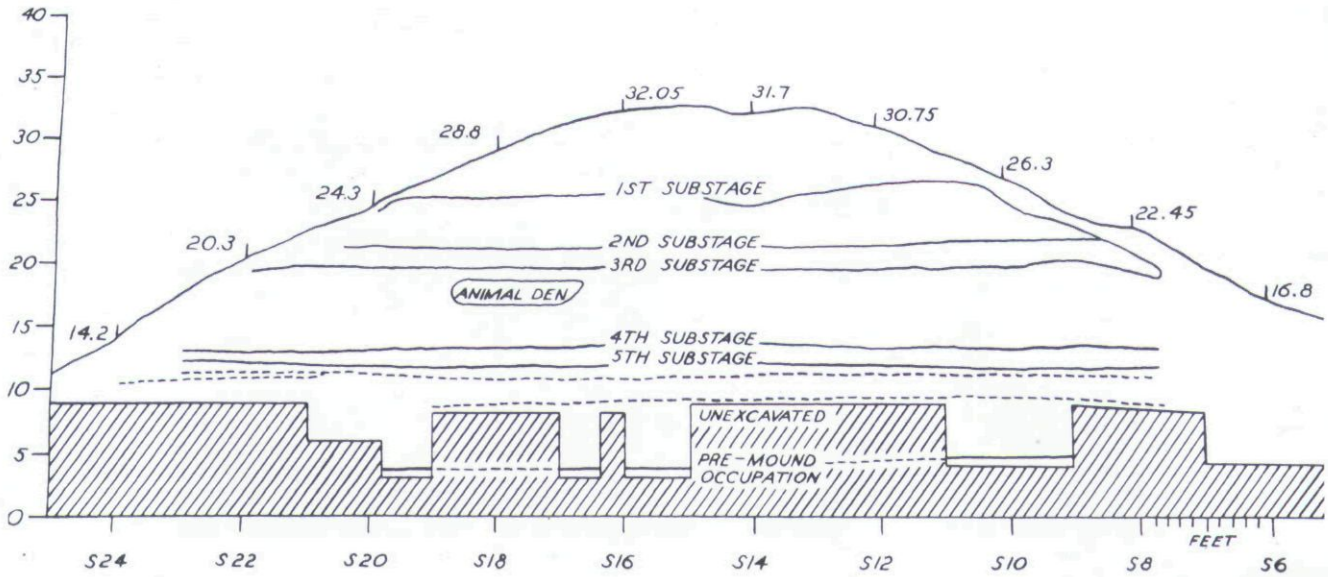

Figure 4. Profile drawing from Caldwell (1948). The deposit between the fourth and fifth substages on this profile likely corresponds to our stage 4 (see Figure 11). The top of the mound was completely excavated down to the third substage in 1948.

Platform mounds are the largest earthen structures found in the Arkansas River Valley. They are generally large, round or rectangular flat-topped structures. The fill is commonly found to be devoid of artifacts. They generally contain no burials except intrusive protohistoric and historic ones, which are common. Norman Mound I-1 is typical of area platform mounds and reveals a general building sequence typical of that reconstructed from other platform mounds: first a mound stage consisting of a few decimeters of soil with a flat surface was constructed, then numerous large pits were excavated into this stage, exposed for an unknown amount of time, and refilled. The function of these pits is unclear; evidence for their form at the Norman site is discussed below. The initial soils used for each mound stage and the soils used to refill pits appear to have come from many different sources—some of them probably local, some of them perhaps from far away. After one or more mound stages were emplaced, the surface was capped by a compacted and burnt layer of clay, and another cycle of construction commenced. Subsequent pits in higher mound surfaces never penetrate previous capping layers. Evidence for mounded berms, large posts, and other structures (some within pit basins) exists within many of these platform mounds as well, but the basic unit of construction seems to be a cyclical sequence of filling, pitting, and capping.

Several hypotheses were proposed concerning the cyclical nature of mound stages (Story 1998): (1) they began and ended at regular intervals according to a calendar, (2) they began or ended at the death of a strong political or religious leader, and (3) new construction commenced only when enough community resources were stockpiled to allow for renewed effort. The building cycles of structural mounds and accretional burial mounds may have coincided with cycles in the construction of platform mounds, although this has not been established.

Groupings of several mounds are termed civic ceremonial centers and likely served as the location of important community ceremonies tied to regional political power (Brown 1996; Knight 1986; Rogers, Wyckoff, and Peterson 1989). The offerings, burials, enclosed structures, and massive earthworks at these sites suggest a wide-ranging, cohesive social organization. The labor involved in the construction of these mounds and the structures and artifacts they contain represent an enormous community investment and a large expenditure of accumulated surplus.

The details of mound use and construction are not well understood. Theories concerning how the mounds were used and what they represented have therefore been vague and tentative at best. Early studies of mounds generally entailed large trenches cut for the purpose of artifact mining, and the coarse excavation techniques of the time did not allow for the expression of detailed stratigraphy within the mounds. Photographs from early excavations sometimes show stratigraphy that is not reported or only briefly considered in the original site literature, indicating that the internal structure of mounds was not well understood or simply not a concern of the excavators. More recent archaeological research into mounds has included little excavation, usually consisting of only a few carefully located test pits. These excavations are often too small to reveal overall mound structure.

Brown, Bell, and Wyckoff (1978) recognize a hierarchy of civic ceremonial centers, termed first, second, and

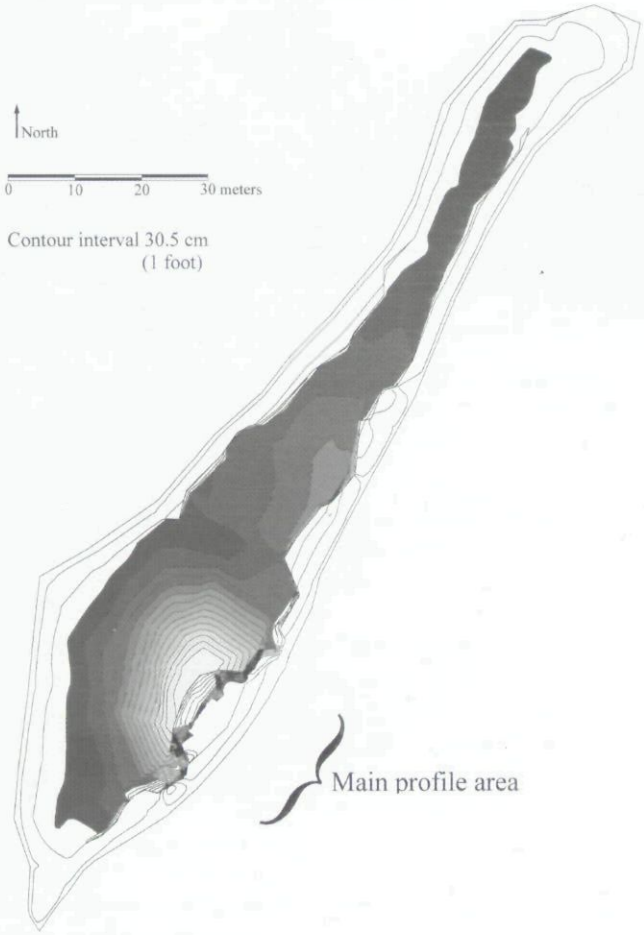

Figure 5. Contours of the remnants of Mounds I-1 and I-2 as mapped in 1998 by the U.S. Army Corps of Engineers, Tulsa District. Fluctuating lake levels have eroded all of the material to the east of Caldwell's main trench and may have eroded the western edge, causing the mound to appear wider than it was originally.

third echelon. First echelon centers contain at least one burial mound and an associated structural mound. Second echelon centers contain several structural mounds, at least one accretional burial mound, and an additional platform mound. Third echelon centers are essentially large second echelon centers with the addition of a fourth mound type or other large architectural element. The additional mound type or architectural element is generally unique to the center, suggesting an "organizational discontinuity with the lower-order centers" (Brown, Bell, and Wyckoff 1978:189). The unique structures often contain burials with large associated caches of finely made artifacts and likely served as burial places for regional elite. The Spiro, Harlan, and Norman sites are the only third echelon centers recognized in the Arkansas Valley region. Given the size and visibility of these centers, it is unlikely that any others will be found in the future. In the case of the Norman site, the unique

Figure 6. Excavation of the eastern, eroded edge of the mound to create a clean profile. The western profile of Caldwell's main trench was likely close to this profile.

architectural elements consist of a platform mound (Mound I-1) connected to another platform mound (Mound I-2) by a broad "saddle" of earth and a similar connection of two other mounds, probably both accretional burial mounds (Mounds II-1 and II-2).

Methods

Documentation of mound stratigraphy began with hand excavation to straighten and clean the existing wave-cut profile (Figure 6), removing no more sediment than necessary to obtain a useful profile view. The eastern face was thus stepped back as a set of short vertical profiles, each containing a segment of the overall profile (Figure 7 shows the locations of the main profile segments). Each profile segment was cut with trowels to create a clean surface. A 1-×-1-m grid was surveyed onto each profile segment, creating a system for recording and provenience control. Each grid cell was assigned a number and documented separately using 35mm slides, black-and-white film, and digital imagery. The images were framed to extend slightly beyond the 1-×-1-m cell being documented to allow for easier edge matching. Cards containing the profile segment provenience were placed just outside of the 1-×-1-m cell, making the images "self-cataloging."

This system of profile recording was used because of the short period of time allowed for fieldwork, which could only be conducted when lake levels were low enough to reveal the entire profile. Ten days of fieldwork sufficed to clean, sample, and document the mound profile using these methods with a crew of five. Three types of photographic recording were used to document each 1-×-1-m cell because it was unknown at the time of fieldwork which method would prove most useful to stratigraphic reconstruction.

The digital imagery (taken with a Sony Cybershot 3.3 megapixel camera) was quickly discovered to be the

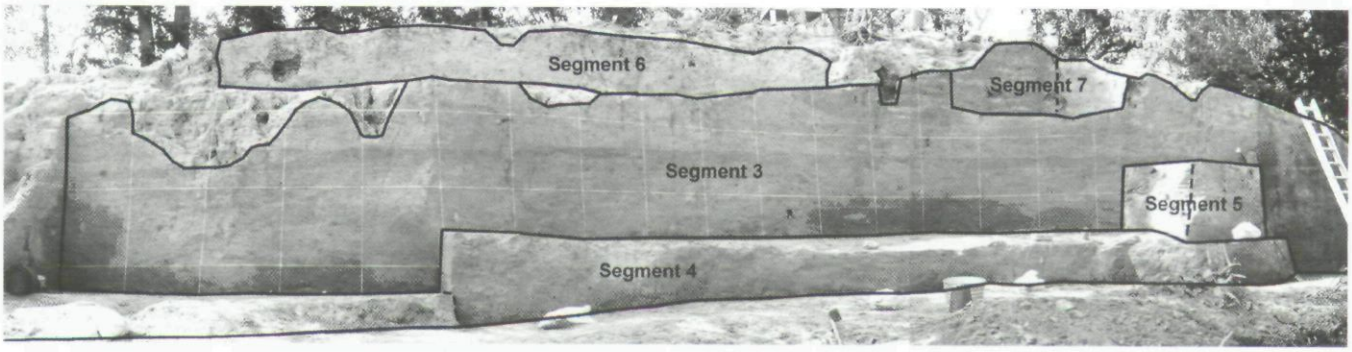

Figure 7. Location of contiguous profile segments on the main profile of Mound I-1. String grid is 1 × 1 m. North is to the right. Segments 1 and 2 are to the south of this view. Segments 9 through 12 are to the north, consisting of small exposures of the remnants of Mound I-2.

most useful. At the end of each day, all digital profile images were printed in color on standard 8.5-×-11-in paper. The width of each 1-×-1-m cell on the paper is about 14 cm, resulting in a detailed, color map of each cell with a scale of about 1:7. These printouts were taken into the field each day, where the locations of various samples taken from the profile were drawn directly onto the printed profile images. This proved to be a very effective method of provenience control without the time-consuming process of measuring in the field the exact locations of each of several hundred samples. Other notes concerning the profile and field interpretations of stratigraphy were also written directly on the printouts. Sample locations marked on the printouts were later translated to site XY coordinates so that they could be placed in context even without the original paperwork.

The digital imagery has a somewhat lower resolution than most 35mm film, although comparing the resolution or "information" of film versus digital imagery is a complicated task. Several factors contribute to how much information may be contained in each. The potential resolution of film, for example, depends on the film grain size and dynamic range of the sensing chemistry, the intensity and duration of the light striking the film, development techniques, and of course the size of the negative. The potential resolution of digital imagery depends on the number of sensing elements within the light sensing array (charge coupled device or CCD, commonly given in megapixels) and the sensitivity and arrangement of the sensing elements. The resolution potentials for film and digital images are both limited by various factors that include lens quality, depth of field and distance to subject, and camera shake. In general, though, fine-grained 35mm film has a resolution on the order of 7 to 10 megapixels from a digital camera.

With the framing employed, each 1-×-1-m cell was recorded within the images by a square about 1,200 by 1,200 pixels. This equals about 12 pixels per linear centimeter, or 144 pixels per square centimeter. At this resolution, details slightly larger than fine roots are visible, and even fine roots and biopores are visible if they contrast very sharply with their background. Features smaller than this are therefore not documented in the overall profile. However, pictures taken from closer distances can show finer detail. A picture of charcoal taken for a radiocarbon sample, for example, shows enough detail to distinguish patterns in the wood grain (Figure 8). The charcoal is about 2.5 cm long, and the resolution is about 180 pixels per linear centimeter, or 32,400 pixels per square centimeter. A very fine root and even fine biopores can be seen in this image.

Digital images from each profile were concatenated using corner nails for edge matching. We attempted to standardize the images as much as possible as they were taken. Each was taken at the same distance from the profile wall (170 cm, measured by a string attached to the camera) and as centered within the grid cell and orthogonal to the profile wall as we could easily estimate

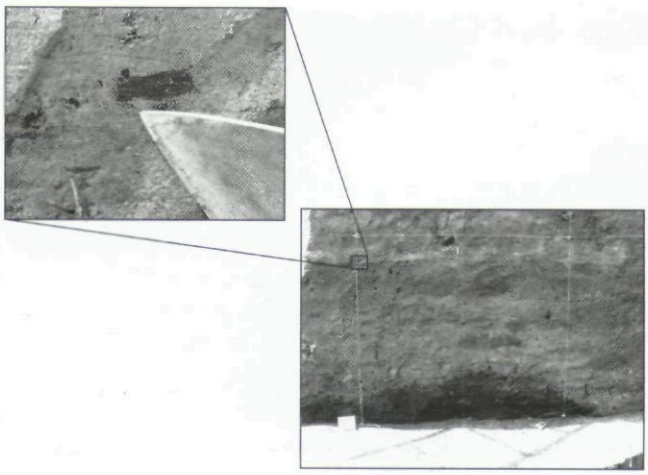

Figure 8. Digital images for each 1-×-1-m cell have a resolution of 3.3 megapixels. The cells themselves (outlined by a string grid) are about 1,200 pixels on a side. Detailed images were taken to express fine detail when desired; the piece of wood charcoal is about 2.5 cm long.

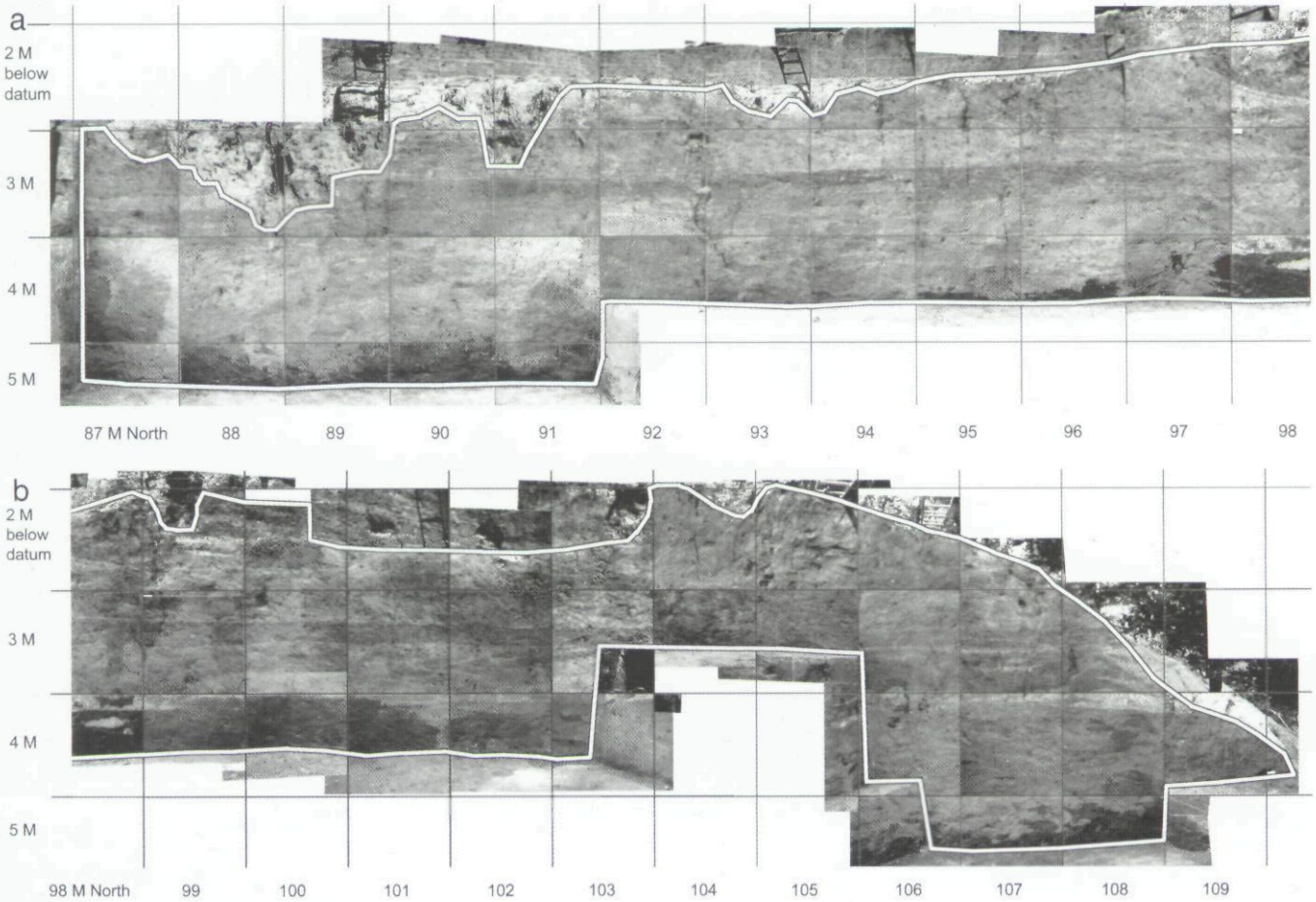

Figure 9. Concatenated grid cells for profile segment 3, west half (a) and east half (b). Grid cells are 1 m on a side. North is to the right. Figures 13–15 are closer views of this profile segment.

in the field. There were slight variations in the angles of the images that had to be rectified before they could be correctly joined together. Most geographic information systems (GIS) software is capable of this through "rubbersheeting" operations that stretch an image once the location of specified points is given. In this case, a large grid representing a profile segment could be constructed and the corner nails on individual images given their proper coordinates within this grid system. The GIS could then "stretch" each image to fit properly into the matrix. We found this to be a time-consuming process for a relatively simple operation.

We tried the operation with both IDRISI GIS and Adobe Photoshop image processing software. We found Adobe Photoshop (version 4.0) to be easier to use and appropriate for the operation using the "stretch" module under the "layer transform" menu. To do this, a (very large) blank layer was created and a square grid drawn onto it using the line-drawing module. The images were copied to the grid image and stretched so that the corner nails on the profile corresponded to the appropriate grid points. Because the profile square surfaces are flat, this operation perfectly served to adjust for any distortion due to perspective or minor distance differences between the images. Figure 9 shows the main profile segment concatenated in this way. Rendering this large-scale photomosaic in black and white is difficult because the grid cells were photographed under different lighting conditions (direct sunlight, diffused by clouds, full shade, etc.) and many of the sediments differ by color but not by value (lightness). Profile segments are enlarged below to illustrate features discussed in the text.

Likely any modern image processing software would work for concatenating images, as would any standard GIS package. Our choice of Adobe Photoshop was simply due to our familiarity with the software and its relative ease of use. GIS and photo editing software seem to be converging. In fact, most GIS packages now are much easier to use than even a few years ago, and most photo editing packages are now equipped with sophisticated raster and vector modules rendering them capable of some GIS-like image manipulation and analysis.

The digital images were also easily manipulated with digital processing techniques to enhance contrast be-

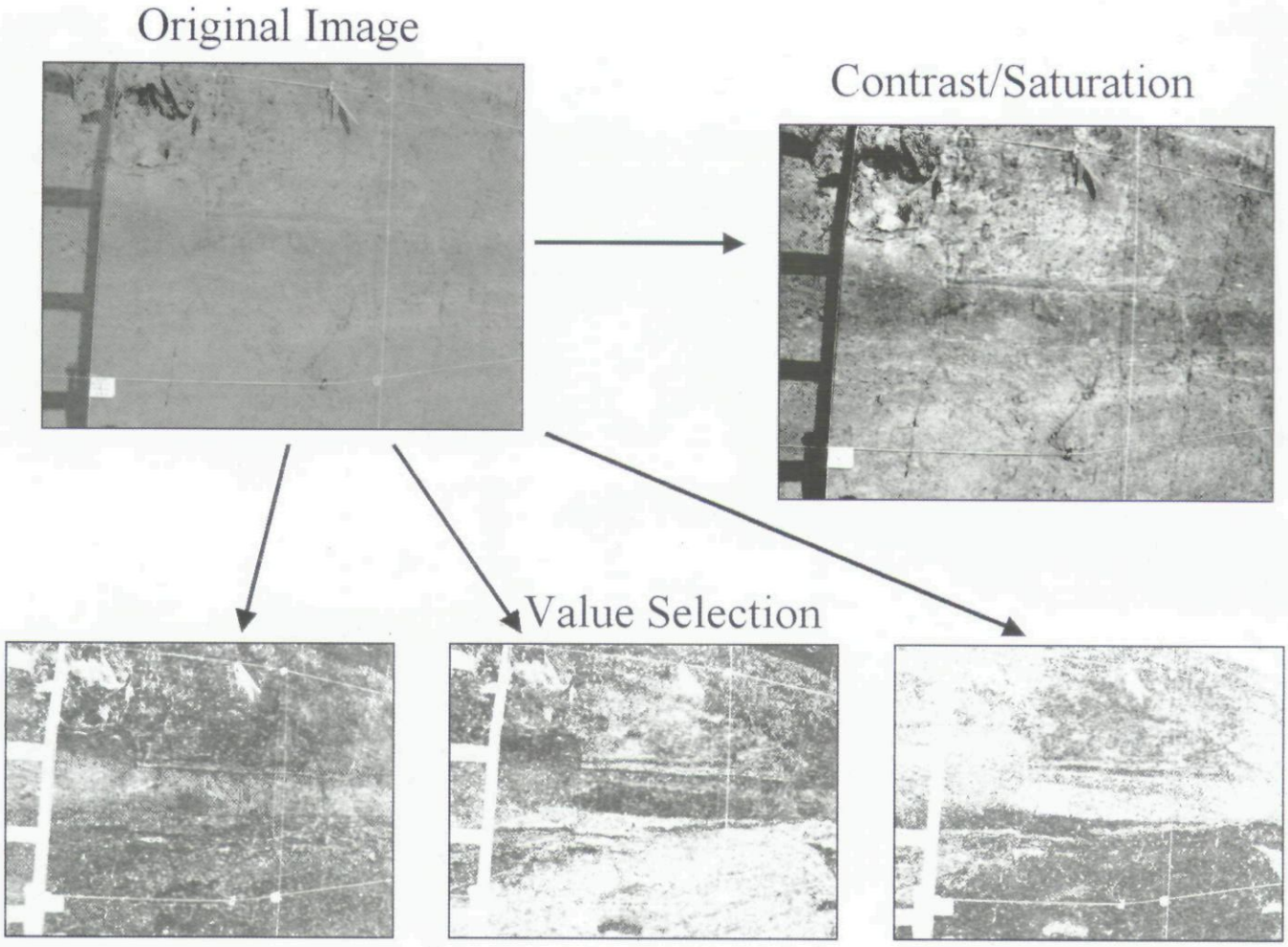

Figure 10. Digitally manipulating images. Note that these manipulations are performed on the original (unregistered) image.

tween different sediment types (Figure 10). Various combinations of manipulations of contrast, color saturation, and color balance were attempted in order to visually differentiate fill of different colors. Many contacts difficult to discern in the field were clearly expressed with these manipulations, and thus allowed sediment profiles to be digitized from the concatenated images. Figure 11 shows a large-scale profile schematic (centering on profile segment 3) constructed in this way.

It is important to note that the digital manipulation techniques employed added no new information to the images, but allowed the information to be viewed in ways that made certain patterns more easily recognized. The techniques actually do this by selectively removing information from the images. Increasing image contrast, for example, moves pixel values closer to either end of a spectrum defined by the range of values within the image. At its most extreme, this process results in an image composed of only two values: the highest and lowest represented in the original image. Selecting for individual value ranges (the bottom three manipulations in figure 10) also simplifies the images by retaining only the particular color value selected, and a specified range of values on either side of it. Different selections in figure 10 highlight higher or lower values (different colors) within the image, and each selection may more clearly express certain color differences within the stratigraphy. The original manipulations are performed on color images, allowing for quite a wide array of selections based on chroma, value, and hue. Note that the manipulations in figure 10 show an image uncorrected for perspective and with the area outside the grid cell not cropped. The photograph was taken from a ladder, and its shadow is visible just to the left of the grid cell.

Note also that the manipulations aid in the expression of only color differences within the profile, so that if no color difference exists between adjacent fills that are otherwise distinct within the profile (by texture, for example), the difference would not be expressed through these manipulations. Further image work and sediment analysis will allow for more detailed, fine-scale profile interpretations in the future.

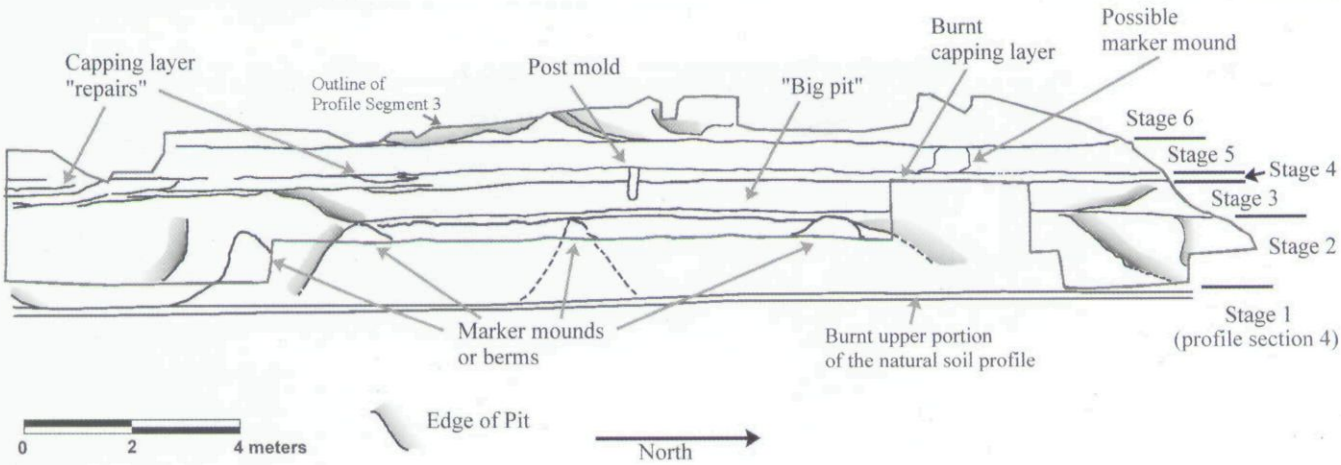

Figure 11. Large-scale mound stratigraphy and stages centered around profile segment 3. Detailed explanation of profile is in text.

No standard color card was used in the images, although in hindsight this would have been useful. Digital sensors and films have many different color-spectrum responses, and different lighting conditions (full sunlight vs. shade, for example) alter the reflected values of similar sediments even for the same sensor. Having a surface with known, uniform colors in each image would allow for better color-correction between images and serve as a baseline for color manipulations. Standard photographic color cards are widely available, and International Federation of Rock Art Organizations (IFRAO) color cards even contain a metric scale (Bednarik 1991). IFRAO color cards are available from the Australian Rock Art Research Association: AURA, P.O. Box 216, Caulfield South, Australia.

The intangible nature of digital images also raises issues of curation and archival stability. Under ideal conditions, black-and-white prints and color slides are potentially stable for 100 years or more and procedures for their curation are well established. For this project, however, they served as backup recording systems only; the digital images served as our primary source of information. Little has yet been written about the long-term stability and curation of digital imagery (or any digital information, for that matter) in an archaeological context. (Although see Besser and Trant 1995 for a discussion of many issues related to digital imaging and image databases.) Archival-quality photographic prints could be made of each digital image, rendering the information at least as stable as other photographic material, but of course this undermines the cost effectiveness and space-saving advantages of digital images.

Although a thorough treatment is beyond the scope of this paper and expertise of these authors, we suggest the following broad guidelines to help promote the long-term preservation of digital imagery:

1. The images should be taken and stored in an image format that maintains complete image integrity, such as uncompressed TIFF (Tagged Image File Format). Many JPEG (Joint Photographic Experts Group) algorithms and other image compression systems result in loss of information by aggregating adjoining pixels of close value.
2. The images should not be stored in proprietary formats (e.g., Adobe Photoshop). Such formats require specific software that may not be universally available and may not always be backward compatible with earlier versions.
3. Original images should be stored intact and manipulations performed only on image copies.
4. Multiple copies of the images should be made and stored separately. For this project, the original images were burned on CDs and copies sent to the University of Arkansas, the U.S. Corps of Engineers Tulsa District, and other interested institutions and individuals. Backups are also kept on the hard drives of at least two computers.
5. Metadata concerning the camera and its sensing capabilities, and any manipulations performed on the images, should be kept in a file that stays with the images themselves. Some cameras automatically embed this information in the image file header, while others do not.
6. A basic catalog of the images with provenience and subject identification should be stored integrally with the images (e.g., as a digital file in the same folder that migrates with the images) to help ensure that the image context is not lost.
7. Procedures should be set in place to ensure the upgrading of images whenever necessary.

This last point is particularly important. Digital imaging is a very young technology and evolving quickly. Little is known about the integrity of certain storage media (many CDs, for example, may not be stable for more than 10 years), and storage media as well as software and file formats are experiencing increasingly

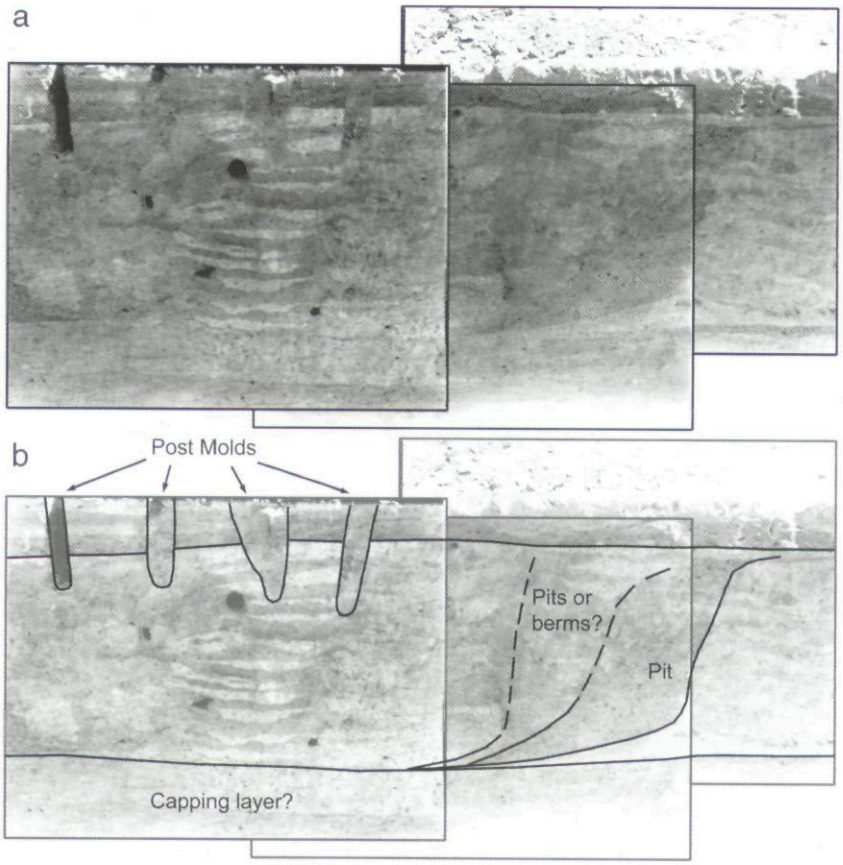

Figure 12. (a) Photograph from Caldwell (1948), showing what appear to be a series of overlapping pits or soils "stacked" against a pit wall. Caldwell's caption reads "Facing E ... [showing basket] loading in L6 profile. [Note] the curious 'non-gravitaic' arrangement in vertical areas." (b) The pit or berm features are outlined along with post molds and a relatively shallow horizon that may be a capping layer.

rapid turnover as new technologies are developed. The cutting-edge computer technology of twenty years ago is already obsolete in many contexts. Data generated and stored on early digital media such as punch cards, various magnetic tape formats, and large-format floppy disks is difficult if not impossible to retrieve today. Even when the appropriate reading hardware and software can be found, in many cases the media itself has experienced unforeseen corruptions from exposure to sunlight, magnetic fields, or other sources. The preservation of digital records thus involves not passive storage, but active curation and periodic migration to maintain files in contemporary format. These early days of digital information will be an infamous data void if we do not take steps to ensure that what we know is not lost to the future—a point that should not be lost on archaeologists!

In addition to profile photography, documentation efforts for this project included intensive sampling of mound sediments. Archaeomagnetic, radiocarbon, bulk density, soil sediment, and thin-section samples were taken from carefully chosen locations throughout the profiles. This article does not include information from these samples; the project funding was limited, and they are as yet largely unprocessed.

Mound Stratigraphy

Incomplete as these analyses are, several interesting points have emerged. At least six mound stages are visible, including one complete fill and capping layer set (see Figure 11). Several stages contain multiple, overlapping pits, some of them quite large. The edges of these pits are visible as diagonal lines that form disruptions within the pattern of fill, cross-cutting individual loads and other fine-scale sedimentary structures of the surrounding matrix. These disturbances reveal that the pits were actually excavated into existing mound material, and do not represent basins formed by mounding material around the edges. Other diagonal lines within the fill appear to represent the edges of discrete fill episodes (marker mounds or berms, discussed below) against which mound material was later added. These lines do not appear to cut into previously existing mound fill, and discrete loading episodes next to

them appear to be complete. Because the profiles expose only a single plane bisecting the mound features at an arbitrary angle, these interpretations are provisional and the shape and full extent of the pits and berms cannot be determined.

Although many of the pits extend down to the very top of the previous stage, none breach an underlying capping layer. Each fill layer contains many large pits, often almost completely overlapping one another. The largest extent of a pit found during this investigation was over 16 m in length, nicknamed the "big pit" (see Figure 11). Again, because it is only revealed in a single arbitrary profile, it is unknown whether this is the full extent of the pit.

The profile is thus a complex palimpsest of filling and pitting episodes, and it is possible that many excavated pits were completely obliterated by subsequent pits, leaving no trace at all. An apparent "rule of pits" observed by the moundbuilders is that mound material within the same active layer may be disturbed, but material below the active fill layer may not. Several pits were clearly excavated down to the previous capping layer, with the capping layer exposed at the base of the pit, but none were excavated into the capping layers. The capping layers would have been easily recognizable as a compact fill of different color and texture.

At least one and possibly several pits are revealed in a series of photographs from the 1948 excavations as well (Figure 12). The stratigraphic discontinuity on the far right appears to be a pit, as loading features to the right of it are truncated. The other discontinuities are not as clear and may be pits or discrete filling episodes "stacked" against the edge of the pit. Four post molds (one of them excavated) extend below a discrete stage, and below the pits or berms there appears to be a capping layer. Caldwell's notes next to the photographs show that he recognized them as stratigraphic discontinuities but did not recognize what they were. His notes below the photograph read: "Facing E. Loading in the L6 profile showing the curious 'non-gravitaic' arrangement in vertical areas." This area would have been somewhat east of the profiles revealed in 2000, and the pits revealed are likely some of the same ones revealed in 2000. With no common reference point between the two excavations, however, we cannot determine exactly how they correspond.

The 1948 investigations of Mound I-1 revealed several well-defined structures through post mold patterns, most of them constructed directly on top of capping layers. Our investigation revealed only one post mold, originating from the top of a capping layer (Figure 14).

Fine-scale observation of the contact between stages 4 and 5 revealed areas of thin laminations of sands and silts. These probably do not represent sediment layers deposited after stage 4, but appear to be residual coarse material left after removal of finer particles by water. Sheetwash erosion on a bare sediment surface could easily produce this effect after only one or a few rain events.

The surface of stage 4 (a clay capping layer) deviates no more than 20 cm in elevation across the entire profile. It is composed of homogenously colored sediment except for two "patches" of slightly darker fill (Figure 15), which appear to be material added to the mound in order to fill in erosional channels or areas of the mound that subsided from compaction of the underlying sediment. In either case, they reveal the importance to the moundbuilders of a smooth, horizontal, and mostly homogenously colored surface. Although the color of the "patches" is slightly different from the capping layer, they are both largely composed of clay.

Small, distinct, cone-like structures (about 1 m across and 1 m high) were also found in profile near the base of the mound (see Figure 11). Because they are only expressed in profile, it is not possible to determine at this time whether they represent short conical mounds or cross-sections through linear berms. No berms or conical mounds of this size have been reported at the Norman site or any other Arkansas River Valley mound site outside of the context of large mounds. They may therefore represent some sort of engineering marker or unique "pre-platform mound" structure. A somewhat similar structure found within stage 5 may represent a similar berm.

Other berms have been found on prepared mound surfaces at the Huntsville and Goforth-Saindon sites in northwest Arkansas (Kay, Sabo, and Merletti 1989; Sabo 1986). They may be analogous to "marker mounds" or similar constructions at other Caddoan area mounds in east Texas and northwest Louisiana (Newell and Krieger 1949; Story 1998; Webb 1959). At the George C. Davis (Story 1998), Mounds Plantation (Webb and McKinney 1975), and Boxed Springs site (Perttula, Wilson, and Walters 2000), berms are present around centrally located burial pits in mounds. At Norman Mound I-1, what may be either berms or "marker mounds" appear to serve, in part, as a way to establish a vertical point of reference for further mound construction. These architectural features were erected on one prepared flat-top surface and their apex marks the spot at which a second surface was laid down.

In interpreting the mound-building sequence, we use Sabo's (1986) characterization of mound stages as representing what appear to be "discrete episodes of mound building activity and/or utilization" (1986:61). Each mound stage is composed of numerous stratigraphic units consisting of spatially contiguous though not necessarily homogenous fill.

The first mound stage represented in the recent (2000) profiles consists of the burnt upper A horizon of the site's natural soil profile. This surface preparation appears to represent the earliest spatially extensive modification of the Mound I-1 and I-2 area. A similar prepared surface

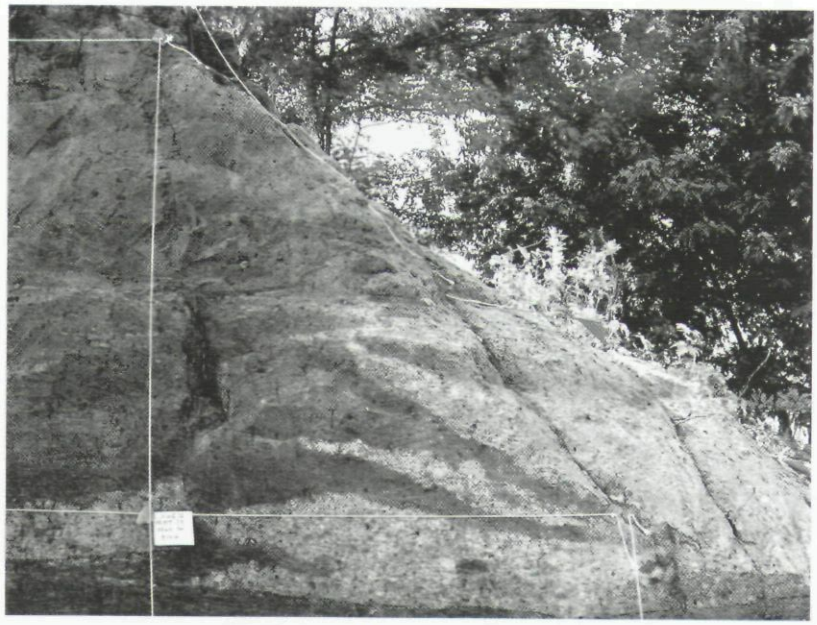

Figure 13. Loading features near the northern end of profile segment 3. Note that even though the individual loads are composed of mixed soils, they maintain a highly contrastive relationship. The edge of the mound as shown in this image was disturbed by excavation and construction in the 1940s.

was found to cover structures at the Goforth-Saindon site (Sabo 1986). No post molds or other evidence for structures was found beneath this stage of Mound I-1. A series of superimposed, burnt structures was found by Finkelstein (1940) near the base of Mound I-2, but from the existing report and field notes it is not possible to determine whether they were constructed immediately on top of the natural soil profile or were constructed only after the preparation of a burnt surface. Investigations in 2000 revealed evidence for two or more burnt structures within the remaining portions of Mound I-2, but limited time and exposure did not allow for close inspection. At least one of these structures was built on top of a prepared mound surface, and one may have been constructed immediately on top of the unmodified ground surface.

Stage 2 is approximately 150 to 170 cm thick. Marker mounds or berms represent the first construction activity in this stage and consist of mounded sediment "loads" of contrasting matrix. The apexes of these features mark the top of this mound stage. At least one of these features is constructed directly on top of the lower burnt clay surface. The others likely are as well, but profile conditions at this level (close to water level at the time of fieldwork) did not allow for detailed stratigraphic examination. The area between and around these markers is filled with contrasting sediment loads. This fill was pitted at least five times. Two pits are discernable at the south end of the profile in this stage, and a series of three are visible at the north end. All pits in this stage were backfilled with loads of contrasting matrix. At least one pit at the south end of the profile appears to have been excavated immediately against, but not cutting into, a marker mound or berm. This pit extends above the level of the berm feature. All discernable pits in this stage were excavated near the periphery of the mound, outside of the boundaries of the marker mounds or berms. If the current northern edge of Mound I-1 is not significantly truncated from its original position, it is possible that the northern "pits" actually represent terrace cuts made into the mound and subsequently built up again. None of the modifications to this stage disrupted the burnt surface of stage 1.

Stage 3 appears to represent a continuation of stage 2, separated by the top of the berms and at least one stratigraphic discontinuity across the majority of the profile. The earliest construction activity in this stage appears to be a generalized loading of contrasting matrices, separated from stage 2 by a discontinuity at the north end of the profile but not discernable at the south end. At least one pit (the "big pit") was excavated and backfilled within this stage, extending more than 16 m across the profile.

The loading features at the north end of the mound in this stage are among the most striking in this profile (Figure 13), but interestingly, neither the darker nor the lighter matrix is composed of entirely homogenous sediment. The darker matrix is composed of at least two different sediments, one generally brown and the other generally gray, and the lighter matrix contains abundant

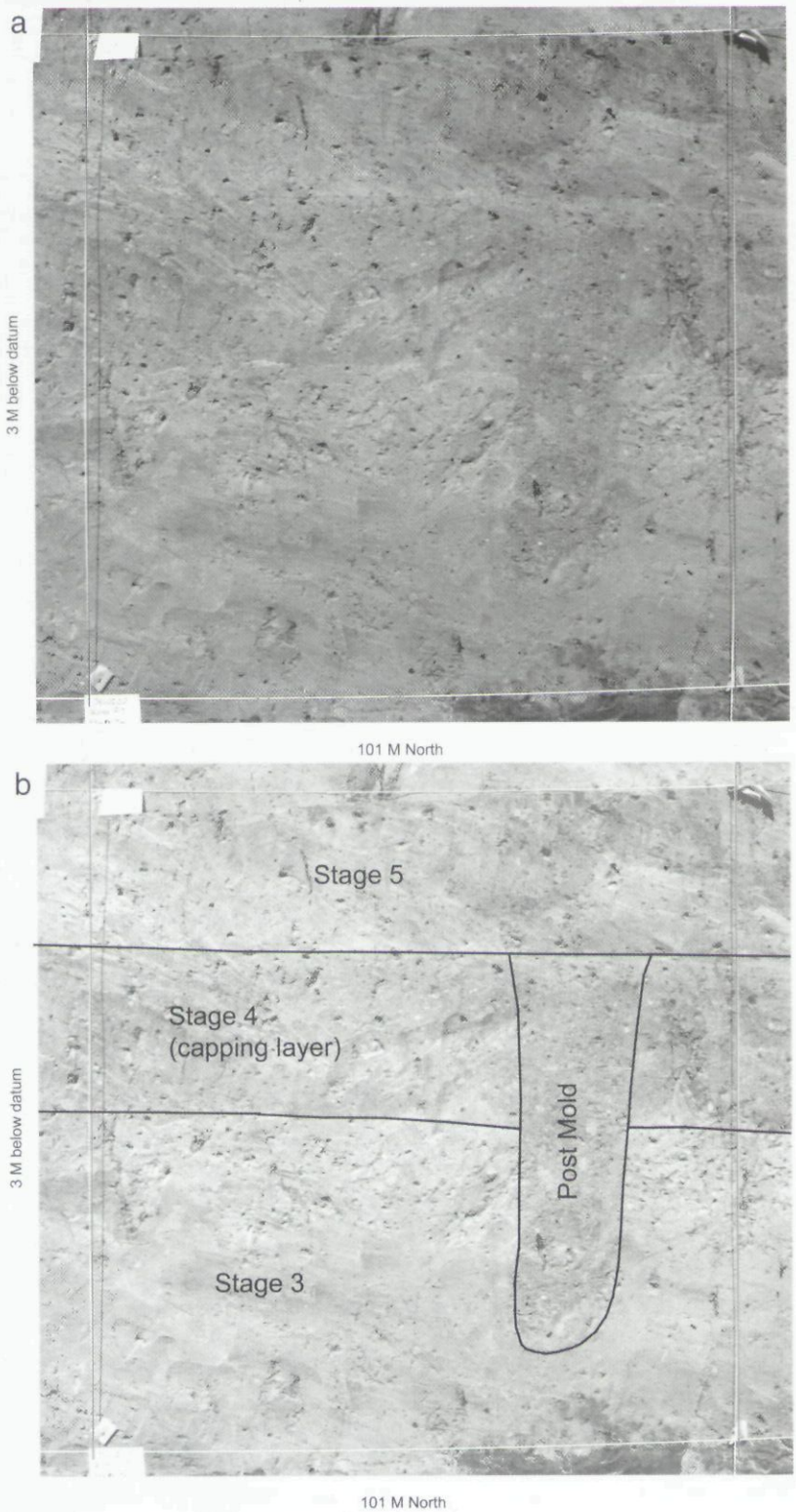

Figure 14. (a) Post mold originating on top of a capping layer. (b) The post mold and mound stages are outlined.

rip-up clasts of at least two sediments of different colors, one generally gray and the other a highly oxidized yellowish red. The sediments may have become mixed during pitting and backfilling or other activities, but the general contrastive nature of dark against light is maintained.

Stage 4 represents a typical platform mound capping layer, consisting of a relatively thin (15 to 20 cm), mostly

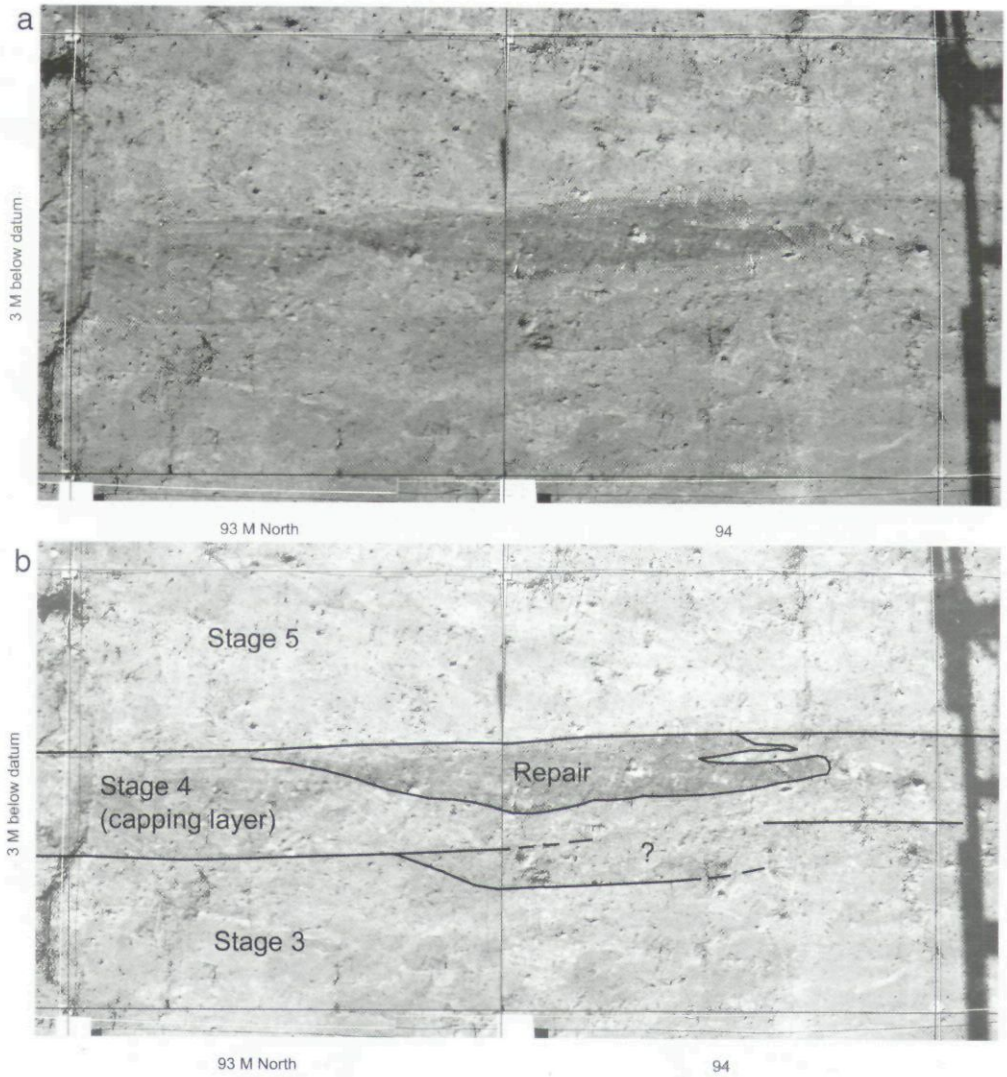

Figure 15. (a) Apparent "repairs" to a capping layer. The repairs are of darker soil than the capping layer but, as the capping layer, primarily composed of clay. (b) The mound stages are outlined.

homogenous clay deposit with a burnt surface. One post mold was revealed in the profile, originating from the top of this stage (see Figure 14). This stage consists of primarily clayey matrix, but a horizon 5 to 10 mm thick of thinly laminated clayey silts and sands covers the surface discontinuously. We interpret these as lag deposits of coarse material from sheetwash erosion of the surface.

Discrete patches of slightly darker matrix are visible near the southern end of the profile in this stage (Figure 15). These were deposited after construction of the main surface, and may represent repairs to the capping layer necessary due to subsidence or erosion. Several "repair" episodes are apparent immediately above series of deep pits in stage 2 at the southern end of the profile, possibly suggesting that continued subsidence of the pit backfill necessitated continued buildup of the capping layer in order to maintain a level surface. The repairs are composed of matrix similar in color but not exactly matching the rest of the capping layer.

Stage 5 is a layer 50–60 cm thick with no visible pits within the recent profile. The matrix consists of lighter and darker fill, but most of it is highly mixed, and loading features are not strongly expressed in this stage. A somewhat puzzling feature of this stage consists of a block of relatively homogenous dark sediment, roughly rectangular in profile section. The top of this feature is in line with the top of the stage, but it is unclear whether it was originally constructed as a block or berm to this elevation (possibly as a marker mound or berm for this stage?) or was truncated by construction activity on stage 6.

Stage 6 represents the top of the profile visible in 2000 and the highest portion of the mound still intact. It consists of about 80 cm total depth of sediment. This stage is highly pitted within the visible profile. At least

four pits were excavated and backfilled within this level, one originating from near the center of the profile and extending west and three successive pits beginning near the center of the profile and extending east. None of the outer edges of these pits is visible.

A horizon 15–20 cm thick with abundant fine roots and biopores and weak granular structure near the southern and northern edges of the profile attests to incipient soil formation in these areas, although whether they represent the surface of the mound prior to or after earlier mound investigations is unclear. No other signs of *in situ* soil formation were found within the mound profiles. Vegetation was growing on the near-vertical eastern edge of the mound prior to its cleaning for profiling, and the roots and biopores visible in the profiles are likely from this vegetation and do not represent roots penetrating from the current top surface of the mound. Thick vegetation covers the current top surface of the mound, corresponding to the base of previous mound excavations. Unstable conditions did not allow for a careful cleaning or close inspection of much of this area.

Discussion

Researching various aspects of the sediments used in mound construction at the Norman site holds great potential for gaining insight into the use and construction of the mounds. Sabo (1985, 1998) analyzed Hasinai Caddo ritual symbolism as represented in historic ethnographic accounts in an attempt to tie Caddo ideology to mound form and structure. He concluded that five properties of ritual symbols emerged as part of the "deep structure" of Caddo ritualism, representing the ideas most likely to persist for a long period of time:

> *Five basic properties of Caddoan ritual symbols were identified as a result of this analysis. One set of symbols (e.g., fire, eagle feathers, woven mats) is meaningful because of direct, formal association with the objects or qualities they represent. Other symbols including use of ceremonial stools, alignment of stars, and the arrangement of people in ranks, make use of position or alignment and hierarchy or superposition to represent a specific category, quality, or status. The symbolic use of the circle, and the offering of food and blowing of smoke to various significant directions provides a dimensional representation, usually denoting sanctity via association with the sacred order of the cosmos. Finally, the symbolic usage of color in Caddoan ritual employs, at the very least, a contrastive quality along with conventional association (e.g., white = peace) [Quoted in Kay, Sabo, and Merletti 1989:152].*

The contrastive color aspect of Caddo ritual is certainly mirrored in the structure of the mounds. Sediments of highly contrasting colors are often employed as fill in large sections of the mounds, forming a pattern resembling "zebra striping" in its appearance in cut profile walls (see Figure 13). This type of deposit is visible in several locations within Mound I-1 profiles, composed of individual deposits, usually interpreted as individual basket loads. These sediments would not have appeared as zebra striping to the builders of the mounds, of course. Viewed during construction of the mound phase, these deposits would have presented a pattern of dark and light colored patches on the surface. Whether this pattern was visible for a significant length of time has yet to be determined. Some of the loads appear homogenous throughout, and some are heterogeneous mixtures of sediment types. The heterogeneous sediments may represent sediment not intentionally mixed before inclusion into the mound but could easily have become mixed during the course of excavating and backfilling pits. Note that even when differently colored sediments become mixed, the contrastive nature of dark and light loads is still maintained.

In this instance, it is clear that differently colored soils were used deliberately, but the meaning of their use may be impossible to discern. It is possible that the different types of soil represent "tribute" from different communities. The amount of labor and resources dedicated to construction at the mound centers implies input from more than one small community. Different communities may have brought distinctive soil representing their contribution to the mound center, and to the ceremonies performed there as a whole. No assessment of the origin of the sediments in the mounds has yet been undertaken. Samples were taken from the profile at Norman site for this purpose during recent investigations, each sample carefully extracted from individual load deposits. Particle size and other analyses will help in determining the depositional origin of the soils, that is, whether they derive from a stream channel, a floodplain, a colluvial slope, or weathered in place from local bedrock. Chemical analysis of the samples can reveal trace elements in the makeup of the finest particles, and the proportions of these may be unique to constrained areas. Comparing the results of these analyses with results from samples taken throughout the surrounding area may help determine whether the samples derive from near the mounds, which would argue strongly against the tribute hypothesis, or from far away, which would lend it further credence. The use of colored sediments has been noted in other mounds as well (see, for example, Anderson and Cornelison 2003; Welch, Anderson, and Cornelison 2003), and we suspect this will be a rich area for future investigations.

The apparent "rule of pits" echoes Sabo's (1985) assumption about the importance of hierarchy in Caddo ideology, and suggests an important historical aspect of the meaning of the mounds. Each fill layer is a dynamic platform for pit construction when active, but becomes something not to be breached again when covered by a subsequent stage. If particular stages of a platform mound have correlated stages in an associated accre-

tional burial mound, the "unbreachable" nature of the stages surely holds important implications for prehistoric ideas of death and mortuary practices.

Conclusions

Mounds represent a unique resource in North American archaeology. As large-scale structures, they are highly visible, and we can study their morphology, position, and patterning across the landscape through nondestructive observation alone. Beyond these parameters, the internal structure of mounds can reveal many of the processes of construction used by the builders of the monuments. Rather than the typical discarded or displaced artifact debris so common in the archaeological record, mounds are monumental artifacts in primary context, constructed for the purpose of ritual. Sears (1961) terms this type of structure "fossilized ceremony." Ceremonial mounds are thus one step closer to the human condition we try to understand as archaeologists; if we reconstruct the building techniques and sequences within and between mounds, we reconstruct something of the conceptual framework of the people who built them.

Consistent with Sabo's (1985, 1998) analysis of mounds at smaller civic ceremonial centers, Norman Mound I-1 stratigraphy expresses a strong vertical hierarchy of "unbreachable" mound stages and the importance of contrastive elements in construction. The surfaces of individual mound stages, burnt and unburnt, are uniformly smooth and horizontal. The nature of these surfaces was important enough to warrant repair when they were eroded or deformed through subsidence. The importance of maintaining the contrasting relationships is seen in the sediments apparently mixed through reworking of the mound that nonetheless maintain their principal color in the contrastive scheme. The amount of reworking of mound material through pitting and backfilling reveals an expenditure of community surplus and labor far greater than the size of the mound alone would imply.

The profile documentation technique we employed, while novel, proved to be a highly effective and appropriate way to document even the fine details of stratigraphy in a limited amount of time. The use of digital imagery (and other digital record keeping) is rapidly increasing in archaeology, and we must be careful that the records are not lost forever in the rush of technological change.

Notes

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