CORING ARCHAEOLOGICAL SITES

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The history of coring and augering at archaeological sites is traced to two periods in the twentieth century. In the first period, Period I (1935–1955), the technique was used primarily to correlate archaeological deposits with river sediments for dating purposes. Rarely were the deposits containing artifacts cored or augered; rather the stratigraphic relationship of cultural to non-cultural deposits was sought. Most of this work was done in the Lower Mississippi River Delta where geologists had calculated absolute dates for river deposits. This period seems to have ended with the availability of radiometric dating and was followed by Period II (1964–present). After 1964 there is a renewed interest in coring and augering, mostly following a shift in archaeological research interests from culture history toward ecological questions. This shift coincides with the availability of a new device: a mechanical corer. During Period II, coring is utilized in many different projects, including reconstructing the environment surrounding sites, collection of samples from subsurface deposits, and locating buried archaeological sites. Following the discussion of the history of coring and augering, a description of equipment, techniques, and data potential is presented.

Traditionally archaeologists have used two methods to determine the subsurface configuration of a site: excavating trenches where stratigraphy is exposed in long continuous sections, and examining profiles in discontinuous test pits with stratigraphy interpolated between exposures. Both methods involve large-scale excavations that consume a great deal of time, labor, and money and contribute to the destruction of a site.

Geologists provide us with other techniques (coring, augering, and drilling) by which subsurface deposits can be readily examined. These techniques result in little site destruction and require only a moderate amount of effort. Coring, augering, and drilling have been utilized by many earth scientists: by geomorphologists to examine stratigraphic relations of buried surficial deposits, by economic geologists to reconstruct ancient depositional environments and to locate oil and gas reserves, and by soil engineers to determine the nature and strength of material that will support structural foundations. The coring, augering, and drilling equipment and methods have been highly refined by these scientists. The opportunity is ripe for archaeologists to adopt the technology and use it to answer archaeological questions.

A core is defined as a continuous section of sediment or rock obtained by using a hollow cylinder called a corer or coring device. The core is a minimally disturbed section of subsurface material. An auger or drill is a device that cuts the sediment or rock in a helical motion, disturbing the context of the material. Cuttings (samples) can be obtained only from the bottom of the bore hole or from material adhering to the cutting attachment itself. Augers usually have screw bits, while drills have diamond cutting bits. Because drills are usually used to cut bedrock, and archaeological sites are rarely found in bedrock, my discussion is limited to augers and corers.

All sites are candidates for coring or augering. If archaeological research is concerned with a site's vertical or horizontal extent, the relation of cultural and non-cultural deposits, or the sampling of subsurface material, then coring or augering may be the best means to obtain the necessary data. The most difficult obstacle in adopting these techniques is the differentiation, within the core or auger, of cultural deposits from non-cultural deposits. Sites containing shell refuse are well suited for this analysis because the shells are recognized easily in small-diameter cores or bucket augers. But any site with perceptible soil-color variations would qualify.

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USE OF CORING AND AUGERING IN ARCHAEOLOGY—PERIOD I (1935–1955)

The history of coring or augering in archaeological research can be divided into two periods. The early period, from 1935 to 1955, is represented predominantly by research at Louisiana State University, Department of Geography and Anthropology. At this time in the rest of the country, coring was not considered an acceptable excavation technique. For example, Fay-Cooper Cole (1937: 28), summarizing archaeological techniques used in Illinois, states that "sampling a site by means of posthole-diggers, steel probes, and similar devices is to be discouraged. Such a method is almost without value as it seldom reveals the conditions beneath the surface, while it often destroys valuable objects."

Cole is probably referring to the probing of archaeological deposits in search of artifacts or burials. Probing of this sort was conducted at some mounds in the eastern U.S. But other people were probing to determine whether mounds were natural (bedrock knobs) or artificially constructed features (e.g., Crook 1922; Leighton 1923; Emert in 1880s, reported in Polhemus [1982]). In the majority of cases professional archaeologists discouraged probing in search of artifacts and recommended excavating long trenches (e.g., Webb 1946), as advised by Cole. Researchers examining the Lower Mississippi River Delta shared Cole's view and used trenches to examine the archaeological deposits. However, they did use coring. They used coring, not to search for artifacts as implied in Cole's quote, but to date their sites and their ceramic sequences. Their "bore holes" were located, almost exclusively (before 1953), in non-cultural deposits.

The reason that archaeologists adopted the technique of coring in the Mississippi River Delta is related directly to the problem of dating prehistoric deposits. Both geologists and archaeologists, during the early twentieth century, were limited in their ability to determine the absolute age of geomorphic or archaeologic units. Archaeologists were building chronologies on the basis of ceramic typologies (Ford 1935). Geologists had only stratigraphy and fossils to establish chronological relationships. Most geologists had no time-telling device that was as responsive as are the changes observed in ceramic attributes.

In the Mississippi River Delta the stratigraphic relationship of various river channels, overbank deposits, and deltaic sediments enabled geologists to construct a physiographic history. A chronology was published in 1940 and 1944 by Harold N. Fisk, who used historically calculated rates of river-channel meandering to determine the absolute age of different Mississippi River stages. Fisk's dates were based on the pioneer work of Russell initiated in 1935.

Archaeologists had one method of telling time, geologists another, and in 1935 the members of the Department of Geography and Anthropology at Louisiana State University attempted to utilize the two chronological techniques. Richard J. Russell initiated a study of the physiography of the Mississippi River Delta in 1935 (Russell 1936), with the major objectives of calculating the rates of delta progradation and delta submergence, and thus chronologically ordering the various delta distributaries. Meanwhile, James A. Ford (1935) published a chronological outline of pottery horizons for the delta area. Ford's chronology was applied to Russell's chronology initially by Fred B. Kniffen (1936, 1938), providing a system of checking their methods of dating the delta. Kniffen mapped the distribution of archaeological sites across the delta, collected the ceramics found on the site surfaces, and used the artifactual assemblages from them to date the progradation of the delta.

In 1935 Russell used coring and augering in the delta region for two purposes: to measure the thickness and the depth below the surface of archaeological sites (Russell 1936:169), and to examine the nature of riverine, deltaic, and lacustrine sediments not exposed on the surface (Russell 1936: 363–374). Russell did core the actual archaeological deposits, but to measure delta subsidence rather than to obtain information concerning the prehistoric inhabitants. The study of the delta allowed archaeologists to participate in geologic research and exposed them to the coring procedure.

The collaboration resulted in the use of coring and augering in archaeological excavations conducted after 1935. Bore holes were, in the majority of cases, used to establish the context of the archaeological deposits with respect to surrounding riverine, lacustrine, or deltaic sediment. Archaeologists used coring and augering, just as the geologists did, to examine the stratigraphic relation of various geologic deposits seen in the subsurface. The primary purpose was to relate the archaeological occupation to the Mississippi River deposits and in turn to correlate the prehistoric occupation to a chronology developed for the Mississippi River.

An interesting result of these cooperative efforts is noted by Morse (1975). He suggests these researchers were participating in an exercise of circular reasoning. The geologists built their chronology on the basis of stratigraphic relations between archaeological sites on the one hand and river channels and delta deposits on the other (see Saucier 1974). In turn archaeologists used the relations of river channels and delta deposits to date their archaeological sites (e.g., Phillips et al. 1951). And they all used coring and augering to establish those aforementioned stratigraphic relations.

The first use of augering in archaeological excavation occurred at the Greenhouse Site, Avoyelles Parish, Louisiana, September, 1938. James A. Ford, then a member of the Department of Geography and Anthropology at Louisiana State University, was directing the archaeological work of the Works Projects Administration (WPA) in Louisiana. In 1938 the Greenhouse Site was examined under the field supervision of Robert S. Neitzel and Edwin B. Doran. They excavated two trenches across the site, extending to the eastern edge of the plaza. Here the cultural deposits (resting on an old Mississippi River surface) dipped sharply downward and overlay Red River deposits. Because the cultural deposits dipped downward to such great depths Neitzel and Doran used bore holes to examine the stratigraphic relation between the buried cultural and overlying river deposits. Ford (1951:23) reports "bore holes found the contact some 20 feet below the surface . . . black midden soil and potsherds were brought up from the top of the Mississippi surface by the auger." These bore holes were evidently drilled by hand using a screw-type auger, although Ford never describes the apparatus explicitly.

By using the bore holes, in an area of the site in which trenching was impossible, Ford was able to trace an archaeological surface that was in contact with a buried Mississippi River channel and to determine that only after the midden was laid down did the Red River alluvium begin filling a lake basin and bury the midden. Once he knew to which geological deposit the site related, he could use the geographer's Mississippi River chronology to date the site. Because the results of the excavation of the Greenhouse Site were not published until 1951, Ford was able to utilize Fisk's chronology to date the abandonment of the Greenhouse Site.

The next use of augering in archaeological (WPA-sponsored) excavations occurred in 1939 at the excavation of the Little Woods Area sites, near the shores of Lake Pontchartrain in Louisiana (Ford and Quimby 1945). Between July and October, 1939, Ford directed Preston Holder to supervise the excavation and Edwin B. Doran to assist. Doran had been a field supervisor at the Greenhouse Site and therefore was familiar with the bore hole technique. The Little Woods Area Sites were augered to establish the depth below the surface to which archaeological shell extended. The archaeologists were trying to establish that these shell middens, which now were located away from the lakeshore, were once adjacent to it. The depth below the surface of the shell as well as the discovery of waterlain sands below the shell established this relation to the satisfaction of both Ford and Quimby (1945).

Augering of other sites, Big Oak Island Site in September, 1939, and Tchefuncte Site in January and February, 1941 (Ford and Quimby 1945:7–12), allowed Ford to date these sites by again referring to the delta (Russell 1936). Again augering was used, but only to relate the archaeological deposits to the geologic sediments, providing relative ages for the archaeological deposits. Although in this case archaeological deposits were probed, they were not augered in search of artifacts, only to trace the boundary of the cultural and noncultural deposits.

Following World War II the Jaketown Site (Ford et al. 1955) was augered on two separate occasions: in 1946 when Philip Phillips and Paul Gebhard tested an area of the site with an auger to determine the depth of the deposit before digging, and in 1951 when Ford and Phillips used bore holes to establish the relation of the Jaketown middens to an underlying Mississippi River channel deposit. Using a soil auger, borrowed from the School of Geology, Louisiana State University, the authors were able to determine the location of a Mississippi River channel under the site and to differentiate a preceramic midden from a later midden containing ceramics.

Ford was again augering to obtain geologic information to relate the archaeological deposits to

Fisk's river chronology. But in addition Ford was attempting to establish the stratigraphic relation of two archaeological layers. Before World War II, while vast WPA labor forces were available, Ford may have been inclined to establish the relation of the two middens using exposures in trenches. But in 1951 (and later in 1953 at the Poverty Point Site) only he and Phillips were digging, and a technique that saved time and that allowed them to observe the surface deposits quickly, was a welcome technique. As is evident from their 1946 augering, they were even using the technique to decide where to locate their trenches.

Ford was not the only person at Louisiana State University to use augering in the investigation of archaeological deposits. Fieldwork completed before 1954 by William G. McIntire expanded the work done in 1935 by Russell and Kniffen when he explained the distribution of sites across the Lower Mississippi Delta. McIntire (1958:1) examined 500 sites, augering many of them, in an effort "to use cultural remains as an aid in unraveling some of the geological history of the deltaic plain." McIntire acknowledged Russell and Kniffen for their assistance in fieldwork and was obviously carrying on with their research.

McIntire's contribution to the construction of delta chronology appeared at the end of the earliest period of coring in archaeology. Between the time when the fieldwork was completed and the work was published, radiocarbon dating was introduced. McIntire (1958:102) refers to this new technique and summarizes some of the dates reported. He suggests that further dating of both delta and archaeological deposits be suspended until more ^{14}C dates are analyzed.

The last augering effort during this early period is represented by the excavation of the Poverty Point Site (Ford and Webb 1956), which was started after World War II. Bore holes were used in 1953 and again in 1955 for a purpose that was new to the researchers of the Delta region, but that was to become very familiar. In both years bore holes were used to determine the nature of the archaeological record itself, not to correlate archaeological deposits with delta sediments.

The archaeological record was examined by using a 4-inch auger to drill to the base of the largest earthen mound at the site. Starting at its highest point they penetrated to a depth of 61 feet, not quite reaching the base of the 70-foot-high mound. Ford and Neitzel were trying to resolve the question of the mound's origin. Was the mound situated on a small "island of pre-Wisconsin age, such as are found projecting through the outwash fan deposits of the Arkansas River further to the south?" (Ford and Webb 1956:21). During the drilling they observed sediments that "continually changed in both color and texture, which indicated that the drill was passing through artificially loaded soils" (Ford and Webb 1956:21). Here Ford and Neitzel were using the augering technique to answer a question concerning the archaeological record (i.e., was the mound made of culturally derived material). They were not using it to obtain stratigraphic information for the purpose of dating, but rather were augering the archaeological deposits themselves.

The discovery of radiocarbon dating provided an alternative method for estimating the age of a site. No longer was the geologic relation of archaeologic deposits and ancient river deposits the only method of determining the age. In discussing the Poverty Point Site, Ford and Webb devote a great deal of time to establishing the stratigraphic relation of the site to the surrounding physiography and to the Mississippi River chronology of Fisk (Ford and Webb 1956:12–21). In one of the last sections of the report (Ford and Webb 1956:116–124), Ford summarizes the results of geologic dating, relative cultural dating, and radiocarbon dating (which was described in *Science* the following year by Brannon et al. [1957a, 1957b]). Ford is suspicious of the radiocarbon results, but chooses a probable date from "the embarassing wealth of dates" (1956:124).

It is interesting to note that, although radiocarbon dating now provides archaeologists with an absolute dating method, coring and augering are still being utilized in the Lower Mississippi River area. Ann Ramenofsky of Louisiana State University is utilizing a mechanical corer at an Archaic site, Cowpen Slough, in southcentral Louisiana. Through coring, the lateral and vertical extent of the midden have been determined, as well as its stratigraphic position relative to the three modern rivers (Red, Black, and Ouachita rivers) and the two ancient ones (Arkansas and Mississippi rivers) adjacent to it. Thus, the tradition of coring continues to the present in Louisiana.

Another archaeologist who used augering to delineate the horizontal and vertical extent of an archaeological stratum during this early period was Glenn A. Black. He was not connected with the investigators at Louisiana State University, however, and he was not working in the Lower Mississippi River delta. Black (1967) used "auger tests" in excavations at the Angel Site, Indiana, during fieldwork conducted in 1939. His excavations had uncovered a midden located outside the stockade of this Mississippian town, and he was "determined to trace the stratum bearing man-made debris in some way, for it might well indicate the depth of the slough at the point of time of aboriginal occupancy" (Black 1967:108). Black decided to use a soil auger to determine the depth and extent of the midden. One of the problems generated by the discovery of a deeply buried midden was how to explain the source of the overburden. Very little research on the history of the Ohio River and its floodplain had been conducted, and Black had to determine how the prehistoric material had been buried by 7 m of sediment.

The origin of Black's decision to auger the Angel Site midden is not readily traced. Black used the auger in connection with excavations sponsored by the WPA in Indiana. He was not directly tied to Ford's research conducted in the Mississippi River Delta, but he was a member of the Society for American Archaeology and a friend of James B. Griffin, who in turn was a close friend of Ford's and visited both Ford's and Black's excavations. Black never refers to the use of augers by any other researcher, nor does he refer to Ford's work in the delta, although in his discussion of auger testing (1967:108–113) he painstakingly describes the method and his justification for using it. The thoroughness of his discussion implies that the technique had not been used before, to his knowledge, and that he was prepared for some criticism. Black was known to be a resourceful person (he was the first to use a magnetometer as an aid in tracing subsurface features, for example) so the idea may have been an original one so far as he was concerned.

During this early period in the history of coring and augering, the technique was learned from geologists and was ordinarily used for purposes similar to those of the geologist and geographer, i.e., to examine subsurface deposits for purposes of paleophysiographic reconstruction. But there were other reasons for examining the deposits. Archaeologists needed to relate archaeological deposits to the surrounding river deposits because only through this correlation could the archaeological chronology, based on ceramic typology, be tied to the Mississippi River chronology, which could provide calendrical year estimates. Coring and augering were the most efficient way to correlate the archaeology with the geology.

With the invention of radiocarbon dating, the need for coring and augering archaeological sites to establish a site's relative age, at least in the Mississippi River Delta, was alleviated. Archaeologists were still interested in reconstructing the environment of the site at the time of occupation (e.g., Black 1967). But the most pressing issue to the archaeologist of the 1950s was the building of a culture history, and that could now be accomplished without coring or examining river deposits. The archaeologists working in the Mississippi River Delta were no longer the only archaeologists in eastern North America to be able to date their sites using a technique other than the building of typological chronologies. Every archaeologist could now relate typological horizons to radiocarbon years. Coring and augering, which had been utilized rarely in other areas of eastern North America, were now also of rather minimal importance to the archaeologists excavating in the Mississippi River Delta.

USE OF CORING AND AUGERING IN ARCHAEOLOGY—PERIOD II (1964–PRESENT)

Coring and augering were essentially ignored by archaeologists publishing in the 19 years following the availability of radiocarbon dating. When these techniques were again utilized by archaeologists, their rationale was slightly different from that of the earlier period. No longer was it necessary to determine, for the purposes of dating, the stratigraphic relations between archaeological and geological deposits. The new uses of coring and augering pursue two objectives: to observe subsurface deposits for reconstruction of site physiography, and to obtain samples of buried strata for radiocarbon, biological, or chemical analysis.

The late 1960s was also a period when archaeologists were asking new research questions. They were beginning to transcend construction of cultural histories and to initiate reconstructive studies of the environmental circumstances influencing prehistoric peoples. Therefore, after 1964 reconstruction of the environment surrounding a site was more commonly sought (e.g., Byers 1967). Collecting of faunal and floral remains and addressing subsistence-related problems was beginning (e.g., Struever 1968). These new research questions are often referred to collectively as the ecological approach (Watson et al. 1984).

Another critical factor, introduced in 1964, influenced the reappearance of coring and augering in archaeological fieldwork. Small, truck-mounted hydraulic soil sampling devices were being purchased by regional offices of the U.S. Geological Survey, Soil Conservation Service offices, highway departments, and local engineering firms. No longer was the use of mechanical drilling rigs and soil samplers restricted to the large oil-exploration companies. Sites that had been too deep or too rocky to auger using hand-operated augers could be penetrated with easily acquired mechanized soil samples.

The first reference to coring and augering during this period is by Price, Hunter, and McMichael (1964) of the West Virginia Geological Survey. McMichael was the archaeologist collaborating with geologists Price and Hunter. The office of the State Archaeologist is part of the West Virginia Geological Survey, explaining why McMichael was exposed to the technique of coring and augering. As geologists, Price and Hunter were presumably very familiar with the Geological Survey's "recently acquired Acker 'Hillbilly' Core Drill Rig." The geologists must have suggested the drill rig as the appropriate device for resolving an archaeological question posed to McMichael by a member of the West Virginia Archaeological Society. The question concerned a buried stratified sequence of occupation debris exposed in the banks of the Kanawha River, West Virginia. The extent, thickness, and condition of this deeply buried site was unknown, yet the portion exposed in the bank indicated that the stratified sequence spanned a long period of time and contained artifacts whose stratigraphic relation was in need of clarification. Coring could predict whether the site was extensive enough to warrant excavation.

Price et al. (1964) were introducing not only a technique which had not been previously utilized in most areas of the United States, but also a new type of machine. Others had thought of using augers or probes to test the thickness of archaeological debris, but Price and Hunter introduced a mechanical drill that could extract a solid core of the buried deposits. Although the diameter of these cores was smaller than the traditionally examined excavation profile, they were more similar in nature to traditional profiles than were the samples of unconsolidated dirt brought up by screw-type augers.

Many studies followed the example provided by the West Virginia study. For example, Monk's Mound at the Cahokia Site, Illinois, was cored using a large hydraulic soil sampler (Reed et al. 1968). The subsurface of Monk's Mound had been explored prior to this by Crook (1922), who penetrated 25 ft, and by Leighton (1923), who examined 20 ft. Both researchers used augers to see whether the mound was a natural formation or the result of human construction. Crook, a geologist with the Illinois Geological Survey, was sure that the mound was natural, while Leighton, also a geologist, was convinced that it was artificial. Their use of augering had little influence on the archaeological community because in the 1920s archaeologists were primarily interested in other research questions, i.e., those concerned with artifacts rather than the nature of the matrix containing them. Although the early attempts confirmed that the upper portions of the mound were artificially constructed, the question was not resolved until the work of Reed et al. (1968).

Reed et al. wanted to determine how much of the Monk's Mound content was natural and how much artificial (as per Crook [1922] and Leighton [1923]). Their purpose in coring the mound was more similar to Ford's and Neitzel's for augering the Poverty Point Site mound (Ford and Webb 1956), than to that of Price et al. (1964). Ford and Neitzel wished to observe the nature of the deposits inside the mound and to determine whether they were cultural or at least partly natural. Ford had only a screw-type auger at his disposal, but Reed et al. had a mechanical corer that could retrieve solid cores. They selected such a corer because "our work was based on the suggestions of Price et al. (1964) who localized a buried archaic occupation through drilling" (Reed et al. 1968: 138).

Another discovery of the Monk's Mound research was to pinpoint surfaces in the cores defined by dark areas. Reed et al. proposed that these dark bands were organic horizons formed while the levels they represented were exposed at the surface. These surfaces indicated prehistoric stages of construction and documented the incremental growth of the earthen mound. Because many dark bands were observed in cores, a "test of core interpretation" (Reed et al. 1968:141) had to be performed to ensure that construction phases, and the dark areas produced on those surfaces, were differentiated from such things as hearths, "basket-loaded" organic soils, or burials. A portion of one core hole was exposed through standard excavation techniques, providing for a comparison between the stratigraphic interpretations based on the core data and those based on the archaeological profile. Using criteria generated in this test, the researchers were able to identify 15 surfaces and bracket them in time on the basis of two radiocarbon dates obtained from the cores.

At Avery Island, Louisiana, a mechanical soil sampler was used to aid excavations. Gagliano (1967), a graduate of Louisiana State University who was strongly influenced by Russell, Kniffen, McIntire, and Haag, utilized a small rotary drilling rig and piston corer, back-hoes, and archaeological excavation to determine the earliest occupation of Avery Island and the utilization of the vast salt deposits that crop out on the island. Because Avery Island is a salt dome, commercial companies are active in the area, exploring and mining salt, oil, and gas reserves. In fact, the archaeological research was funded in a large part by Avery Island, Inc., the company presently mining the area.

Piston-type cores (a core tube with a piston inside that creates a vacuum and holds the core contents inside the tube) were taken and stored in 3-inch diameter plastic liners. These cores were used to obtain samples for sediment, floral, faunal, and radiocarbon analysis, but most importantly to reveal the complex sequence of deposits overlying the rock salt (Gagliano 1967:25). The reconstruction of the general physiography of the region and the location of the historic mining disturbance were all accomplished by using the core data.

Gagliano's use of a coring device was in the tradition of Russell and Kniffen, to reconstruct paleophysiography and chronology. But Gagliano, a student of geography, was influenced not only by his exposure to geomorphology, but also by the Avery Island, Inc., mining company, where drilling rigs and back-hoes were used daily. As with Price and Reed et al., this Louisiana research and the use of coring in this early stage in Period II can be linked directly to the influence of geologists and physical geographers and to the availability of mechanical coring devices.

In 1970, another report appeared that discusses the use of coring. Casteel (1970), acknowledging previous reports, experimented with coring as a recovery technique for midden material that would be subjected to microanalysis. Casteel systematically compared carbonized seeds, charcoal, shell, bone, artifacts, and fish scales with similar remains taken from column samples. Casteel's continuous cores were 9 inches in diameter and therefore were comparable volumetrically to column samples. His results indicate that no statistical difference existed in the two sample-collection techniques. Therefore, this size of core could be substituted for column sampling in microanalysis of archaeological strata.

Hemming (1977) used hydraulic 1½-inch cores to drill holes into the deposits of Grave Creek Mound at Moundsville, West Virginia. He discovered that the mound was constructed on a small hill, 2–2.5 m above the surrounding plain. The mound's contents are composed of heterogeneous material indicative of "basket loads" (Hemming 1977:62), and contains no evidence of structures.

Aside from these projects, none of the research reported after 1975 acknowledges previous investigators as the inspiration for coring. Apparently coring was independently discovered and applied to new geographical regions or new ecological problems. Yet all these projects use the technique for the same two basic purposes: to examine subsurface stratigraphy and to collect samples from buried deposits.

Gordon (1978) demonstrates the utility of coring frozen archaeological deposits, and of subjecting samples from the cores to a wide variety of soil-chemical analyses. He introduces a new instrument, a portable diamond drill powered by a 10 h.p. engine and weighing only 37 pounds. With this machine two people were able to extract a total of 30, 1⅝-inch-diameter cores in a remote area of the Yukon.

Scarborough (1983) used data from 50 holes, dug with a posthole digger in a 1,600 m^2 area at the site of Cerros, Belize, to construct a subsurface contour map of the original surface underlying earthen platforms and adjacent canals. He was trying to determine whether the platform fields were constructed artificially. He demonstrated that the platforms were underlain by elevated caprock and created (at least in part) merely by excavating the margins of the caprock. He used the postholes for quick examination of a portion of the subsurface too broad to observe through excavation.

Stein et al. (1983) used a manual corer to trace the lateral extent of deposits observed in the profiles of a 2 × 2 m pit while searching for historic Fort Jefferson in Kentucky. Strata, identified in the larger exposure, were traced laterally through coring. These efforts resulted in a reconstruction of the depositional processes responsible for the observed stratigraphy, and also answered questions concerning the location of the historic site.

The Modoc Rock Shelter was recently re-examined (Styles et al. 1983) to answer questions concerning the site's depositional history and human adaptations during the Holocene. The excavation program included removing back dirt from previous excavations, digging new test pits, and collecting hydraulically extracted cores from the area outside the overhang and in the floodplain of Barbeau Creek and the Mississippi River Valley. Six locations were cored with a trailer-mounted mechanical corer. The stratification exposed in the cores correlated with the stratigraphic units exposed under the rockshelter. Samples taken from these cores were analyzed chemically and texturally and compared to on-site samples collected from profile columns.

Stein (1980, 1982) used a manual, core-tube soil sampler to determine both the configuration of the pre-occupational surface and the stratigraphic relation of shell middens and shell-free middens. A mechanical soil sampler was used to probe deeply buried deposits as well as those that contained abundant amounts of gravel-sized sandstone. Evidence from both types of cores was used to correlate the stratigraphic relation of the midden to the surrounding floodplain (Stein 1985). Cores were also extracted in areas beyond the archaeological site, documenting the presence of Pleistocene lake deposits and enhancing interpretation of the effects of the lake sediment on the modern Green River (Stein et al. 1981).

Another study relating archaeological sites to Pleistocene and Holocene river dynamics was conducted by Leach (1980, 1981) in the Tennessee River Valley, western Kentucky. She cored extensively in the area surrounding the Morrisroe Site to delineate the extent of channel migration during the Holocene. A total of 77 cores, which were collected using a manual core tube soil sampler, helped delineate the extent of the site and the boundary between Pleistocene lake deposits and Holocene river alluvium. Coring has continued as part of the Lower Cumberland Archaeological Project, directed by Jack Nance (Simon Fraser University), and the resultant data have allowed Leach to redefine the terrace system of the Tennessee River.

Gardner and Donahue (1985) used drilling in their investigation of the Little Platte Drainage, Missouri. Holes drilled by a Bombadier-mounted drill rig, which was capable of drilling and sampling several tens of meters, were used to reconstruct the geologic and geomorphic history of the valley. This reconstruction allowed the investigators to predict where archaeological sites should be found for each period represented in the study area.

The Center for American Archaeology, Kampsville, Illinois, has made considerable use of coring in archaeological research (Wiant et al. 1983). At the Napoleon Hollow Site, coring was used extensively to document the stratification of the site and to correlate stratigraphic units between Napoleon Hollow and Koster, in an attempt to reconstruct the regional environment. They employed a hydraulic core rig that could penetrate and retrieve cores to depths of 15 m. A coring program was also employed at the Koster Site, again to correlate archaeological occupation with stratigraphic units located beyond the limits of excavations as well as to reconstruct the geologic history of the site. Also at Koster, the cores aided in the identification of nine paleosols, many in association with major cultural horizons (Wiant et al. 1983:156).

A second example of a large project that relied heavily on core-derived data is the work done in the Mississippi River's American Bottoms. The project, funded by the Illinois Department of Transportation (IDOT) is known as the FAI-270 project. Cores were utilized to identify subsurface cultural and non-cultural strata and to obtain radiocarbon samples for strata correlation (Phillips and Gladfelter 1983). A hydraulic core rig was used to core areas located near sites. For areas away from sites, Gladfelter was able to examine and to collect samples from localities drilled by the IDOT in their studies of subsurface stability and highway engineering. Gladfelter also had access to cores stored in Urbana, Illinois, that had been saved by the transportation department for laboratory analysis (Gladfelter 1980, 1981). These data provided the information necessary to reconstruct the paleogeographic setting.

Research conducted along the Ohio River, primarily through the Glenn A. Black Laboratory of Archaeology, Indiana University, has included coring and augering in almost all phases of archaeological fieldwork. Coring has been used to delineate the subsurface extent of surficially exposed cultural deposits (Munson 1980), to determine horizontal and vertical extent of other buried cultural deposits (Brinker 1982; Myers 1981), and to relate cultural deposits to Holocene environments (Reidhead and Limp 1974). Investigators have also used coring to survey for deeply buried archaeological strata (Dorwin 1978; Dorwin and Kellar 1968; Munson 1977; Vickery 1970). But perhaps the best example of the use of a corer at every stage of investigation is the research conducted at the Mississippian village site of Southwind (Munson 1982). Here features exposed at the surface, such as soil discolorations, were sampled with a core tube soil sampler during the survey stage. Then after the plowzone was stripped, all subsurface features—such as postmolds, pits, and house basins—were cored to determine their depth and stratification. And, finally, the cores were used for selecting a sample of pits for excavation, and in designing the excavation strategy for subterranean house floors to ensure collection of representative samples and the best contextual data. Thus, cores were critical in all stages of the research at this site.

Numerous contract projects in Tennessee have been conducted by the University of Tennessee, Deparment of Anthropology, where soil augers and corers were used to obtain information vital to the research. Perhaps the most consistently sought information acquired through the use of coring is the depths of postholes, especially at eighteenth-century Overhill Cherokee Sites (Baden 1983; Chapman 1980; Polhemus 1984; Russ and Chapman 1983; Schroedl 1982).

A paper by Polhemus (1982) summarizes how coring has been used in archaeological investigations in the eastern portion of the Tennessee River valley. This paper is exceptional in that it presents details of the procedure and equipment utilized as well as providing three examples illustrating the potential of coring. In the survey of the John Sevier Steamplant Ash Pond, coring was used to detect buried deposits. At the nineteenth-century town of Morganton, deposits were cored to define the limits of the town noting the presence of brick or other limestone structural remains in the subsurface. Finally at the Loy Site, dating to the Late Mississippian Dalles phase, coring data defined the vertical and horizontal extent of the site and determined the nature of the negative anomalies recorded during proton magnetometer survey of the site.

Another example of research that utilized coring was conducted by Campbell (1981) who used a manual auger (screw-type) and posthole digger to penetrate 1 m of sediment in 146 locations at the Duwamish Site, Washington. Campbell concluded, on the basis of the augering, that the site was composed of only one stratigraphic component. She also discovered that the horizontal variation of the cultural component was significant and that historic disturbance of the deposits was extensive. Obtaining the subsurface information through augering and digging postholes, rather than through excavation of test pits, saved considerable time and money.

Perhaps the most practical type of coring data for archaeology is represented by the study of a large, deeply stratified occupation site on the banks of Hamilton Island, Washington (Dunnell and Campbell 1977; Lewarch and Reynolds 1975). The U.S. Army Corps of Engineers requested that an accurate definition of the site's boundaries be made to facilitate the planning of disposal sites in the area. A total of 37 cores was obtained using a posthole digger and a manual soil sampler with a core-tube attachment. The stratigraphy observed for each core illustrated that the depth and extent of the cultural material was 1.5–2.5 m below the surface and restricted to within 70 m of the southern bank of the island. This use of coring in 1975 was similar in every respect to the project of Price, Hunter, and McMichael conducted in 1964.

Figure 1. Manual coring device with the sampling tube attachment.

There are many other examples of archaeologists using coring to aid in archaeological research. Those included here, however, suffice to illustrate the variety of ways that coring can assist in all stages of survey and excavation. Researchers who have not been aware of the technique can assess the potential of this tool as an alternative to the shovel and the back-hoe.

THE METHOD

Because many people have never used a coring or augering device in archaeological research, I present a discussion of equipment and procedures.

Equipment

To extract a sample from the subsurface of an archaeological site one of many devices may be selected; a manual soil sampler with either a sampling tube or screw-type auger attachment, a bucket auger, a mechanical soil sampler with either a core-tube or auger attachment, or finally a posthole digger.

A sample can be extracted manually using a soil sampler with a sampling tube attachment (Figure 1). The sampling tube (Figure 2) can be purchased with either a ¾ inch or 1 inch diameter and from 11 to 18 inches long. The tube is attached to extension rods that are in turn screwed to a handle. These manual coring devices can be obtained from any soil-equipment supplier, and are referred to as soil sampler, or Oakfield soil sampler. Manual samplers can penetrate most types of sediments that are not composed of greater than 20% clay, 90% sand, large gravel-size objects, or that are not

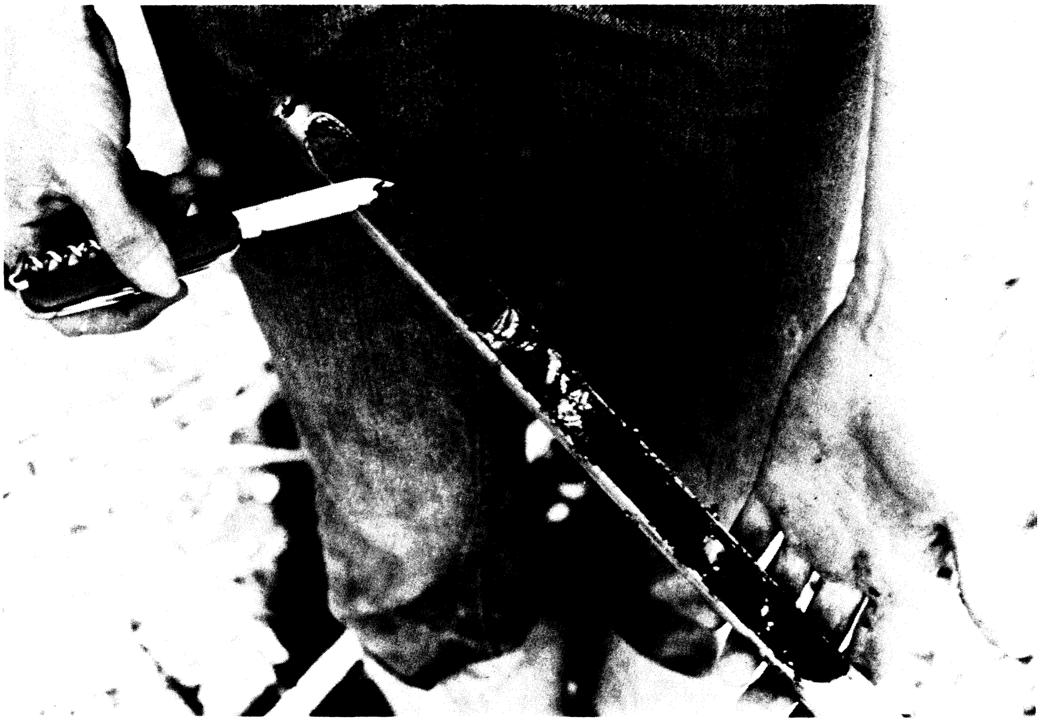

Figure 2. Close-up of sampling tube attachment on manual coring device.

too dry. These subsurface samplers are sometimes preferable to mechanical devices because of their portability and inexpensive operating costs.

Besides sampling tubes, manual soil samplers can be purchased with auger attachments. The screw type auger is difficult to use in archaeological deposits because of the problems associated with extracting the auger once it has been screwed into the ground. A more useful auger soil sampler is the bucket auger. As the auger is rotated, two cutting bits cut into the deposit and force the cut portions up into the interior of the cylinder bucket. When the 6-inch-long bucket is full, the auger is lifted out of the hole and a portion of the material collected can be examined and saved. Bucket augers can be obtained with a variety of cutting bits designed for mud, sand, boggy deposits, or silt (the latter is called a regular bucket auger), and in a variety of diameters (2 inch, 3 inch, or 4 inch). These augers are especially useful for moving through any deposit not penetrable by the sampling tube. Although the sample is mixed within the bucket, if small-interval depths are collected and extracted separately, one obtains a fairly accurate picture of the subsurface.

Mechanical sampling devices are more efficient than manual ones when extracting either larger-diameter cores, cores from clay-rich sediment, or those from dry deposit, and the devices can also penetrate to much greater depths. These larger-diameter cores provide enough sediment for chemical analysis of sediment extracted. These machines are usually driven by hydraulic pressure and are available in many sizes (Figure 3). They are either mounted on trucks, pulled on trailers, or hand portable. Johnson and Alexander (1975) describe some mechanical sampling devices in detail.

There are two basic kinds of mechanical sampling devices, those that use core-tubes and those that use auger (drill) attachments. A sampler with a core-tube attachment recovers a continuous core in 48 to 60 inch depth intervals. Each time that the core-tube is filled (every 48–60 inches) it must be retrieved from the subsurface. The tube is then reinserted to the next appropriate depth interval, at which time the next core can be collected. A sampler with an auger attachment can

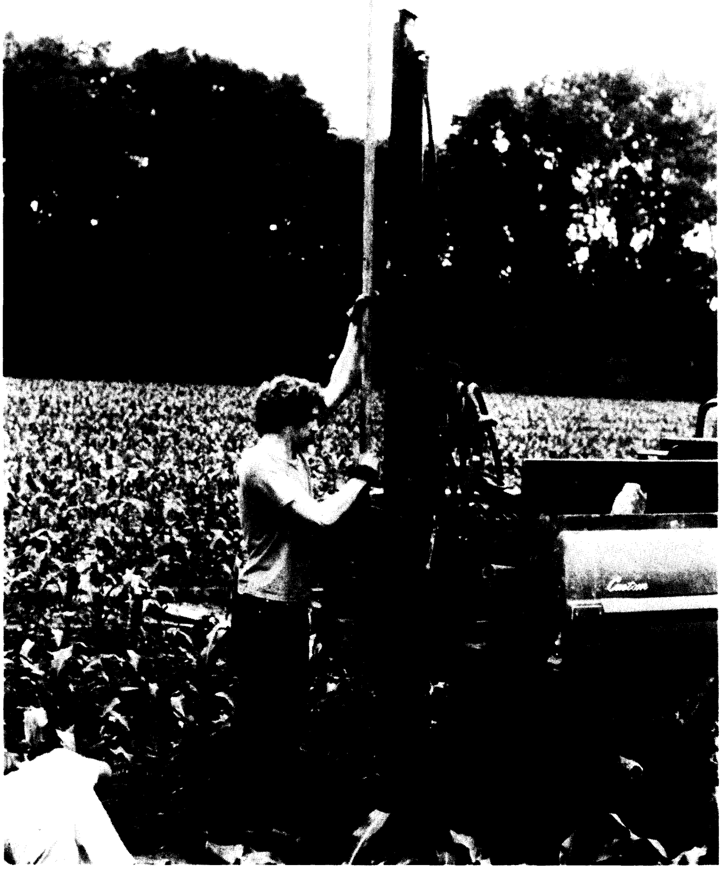

Figure 3. A mechanical coring device, called a Giddings soil sampling machine, with a coring tube attachment (owned by Dr. R. Ruhe, Indiana University).

either drill continuously to a specified depth or can drill to a depth equal to its length (48–60 inches). The only sample that the auger provides is the churned material adhering to the auger itself, which can be observed only when the auger is extracted from the hole. Some hollow-stem augers push the augered sediment into this hollow stem. But without special equipment-modification, this material cannot be recovered.

One of the biggest drawbacks of mechanical samplers is their expense. In 1984 the daily rental rate of a machine and operator ranged from $500 to $1,000, depending on the location of the testing site. If one is using a coring tube, the acquisition of a continuous core can take from one to three days, depending on the type of substrate and depth of core, which means this technique can be expensive.

Another problem is that the sediment inside a coring tube is sometimes difficult to extrude. The core tube is usually nearly a meter long, and extracting a continuous core of that length is difficult (Figure 4). Many hydraulic coring devices are equipped with hydraulic extruders, which make the

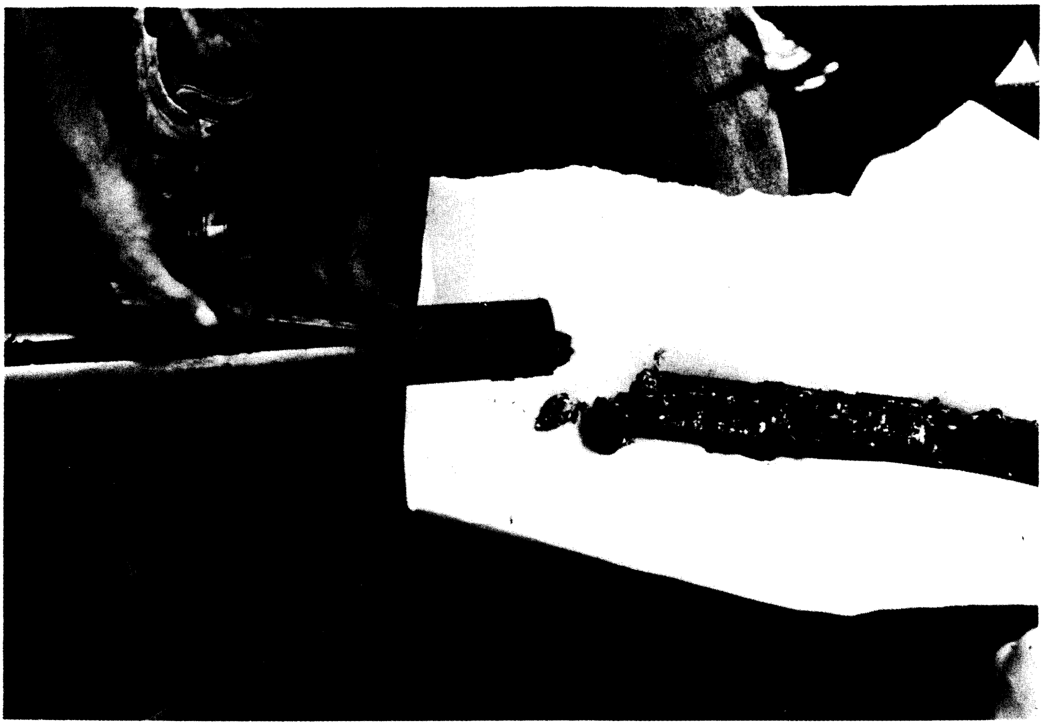

Figure 4. Extruding a core from a hydraulically driven corer.

removal of the core easier but can result in some deformation of the core. The most accurate procedure is to drive (or vibrate) casing into the ground and retract it with core intact. Core and casing can then be transported to a laboratory where the casing can be cut away. Although this technique is the most desirable, it is also the most expensive.

In addition to manual or mechanical solid earth coring devices, manual and mechanical posthole diggers have been used for collecting samples from the subsurface. Collection of archaeological samples with one of these devices has been discussed by Fry (1972). Unfortunately, posthole diggers do not facilitate sampling of sediment more than 50–125 cm below the surface, and samples are subjected to possible contamination because sediments are churned by the device rather than extracted in consolidated form. Manual posthole diggers provide a quick method for exposing material less then 25 cm below the surface. Mechanical posthole diggers can reach 125 cm and are much less expensive to rent than are mechanical sampling devices. Use of posthole diggers is highly recommended to obtain samples from shallow depths, such as just below the plow zone. Further, they can be used when sediments are too intractible for sampling tubes or when mechanical sampling devices are either too costly or are unavailable.

Procedures

The procedure presented below is designed for a manual soil sampling device with a tube attachment, but can be modified for use of either a mechanical soil sampler or a bucket auger. The differences in procedures affect basically the utility of the sediment extracted. Mechanically extracted cores usually have large diameters and display more of the contact between deposits as well as recovering more undisturbed sediment. Samples extracted from these cores can be used for chemical analysis as well as radiocarbon dating. Samples extracted from either mechanical augers or bucket augers are disturbed, and their context is poorly documented. Because the material is

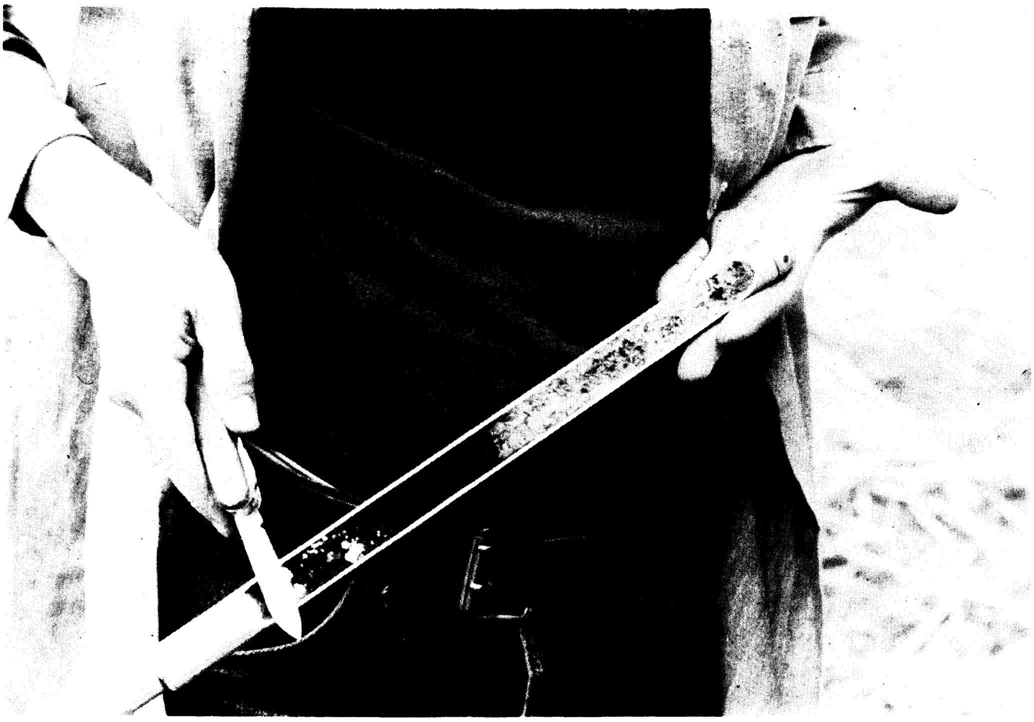

Figure 5. The contact between the shell midden and the lower non-cultural substrate.

churned by the cutting bit none of these samples should be used for either chemical analysis or radiocarbon dating.

In the procedure the initial core is collected by pushing the sampling tube straight down into the sediment until the hollow spoon is filled. The length of the tube will vary depending on the type of corer purchased; a 24-cm tube length is recommended because it is the easiest to push into and extract from the ground. Marking the handle at 24-cm intervals can be helpful because the porous matrix of many sites is easily compacted and depths greater than 24 cm can be obtained accidentally.

After each 24-cm punch, the tube is extracted and the contents extruded onto lengths of tin foil, freezer paper, or plastic wrap. Extrusion is accomplished by either pushing the whole section out the end of the tube or by prying the core from the opening in the tube. Once extruded, the cultural deposits (shell concentration, charcoal, sediment, etc.) can be examined and described. These cores can be wrapped and saved, but caution should be taken when subjecting them to chemical or textural analysis because they might be contaminated by material clinging to the narrow inner-chamber of the coring tube. If the material is to be used for further analysis and contamination is suspected, then the entire rind should be cut away from the core. This procedure usually leaves a core of only 1 cm in diameter. To obtain sufficient amounts of sediment for analysis, long segments of the rindless core must be analyzed together. One way to avoid this problem is to obtain a second core located immediately adjacent to the first.

The depth of the hole should be measured after each 24-cm punch. This is done by inserting a rigid measure into the hole. Because the tape can get caught on protrusions of material that have fallen back into the hole or on obstructions that extend from the sides of the hole, additional precautions should be taken by also measuring the portion of both the core and the extension rod extending below the surface. Measurement of the core itself, however, is not recommended as a

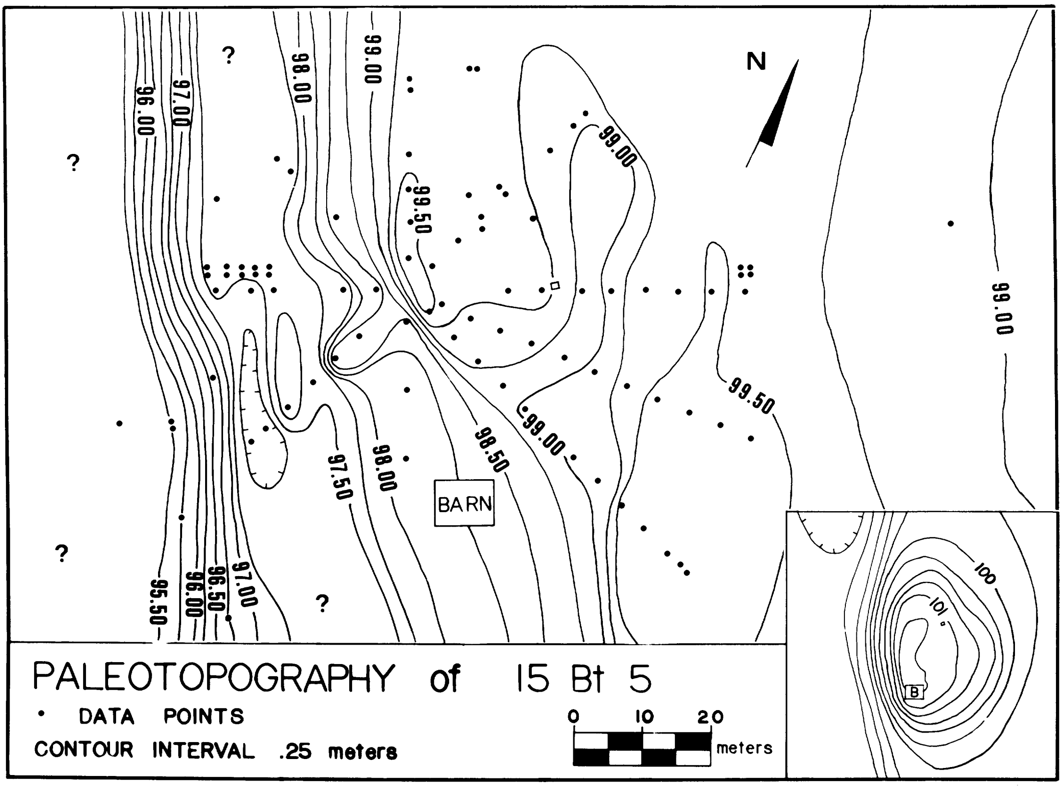

Figure 6. Paleotopography of the Carlston Annis site, Kentucky. This paleotopographic map was constructed by plotting points of elevation of the lower boundary formed by the midden and the underlying non-cultural deposit. Compare this paleotopography with the modern topography seen in the insert (the location of the barn [B] can be used to orient the two maps). The modern topography is dominated by a mound, the paleotopography by a steep drop-off located west of the barn. Because the configuration of this steep slope is similar to the topography of the modern river bank, it has been reconstructed as the location of the river channel associated with the prehistoric occupation and deposition of midden.

good indication of the depth to which the tube has penetrated because cores are often compacted in the tube of the corer.

Driving a tube 24 cm through site matrix is sometimes difficult. Rock fragments, pottery, and shell frequently resist punching. When this technique was tried on a Northwest Coast shell midden, the marine shells were found to be so resistant that the manual corer was only minimally successful and a bucket auger had to be used. However, shells of fresh-water species are penetrated more easily, especially if the tube head has a sharp cutting edge. Regardless of site location, at some point during the coring procedure an obstruction will probably be encountered that cannot be easily cored. In these cases the corer may be cautiously but forcefully pounded up and down until the obstacle is penetrated. On those occasions when the obstruction cannot be cut, a new hole should be started adjacent to the abandoned one.

As the coring continues, extension rods are added until the depth of the hole exceeds that of the cultural debris. For sites with cultural debris thicker than 3 m, manual coring is difficult and a mechanical sampler is recommended. In archaeological sites composed of shell, the contact between shell and substrate is usually well defined and can be used as the boundary signalling the bottom of the cultural deposits (Figure 5). Other archaeological deposits, defined by subtle color changes in the sediment, may be more difficult to define. The boundaries of such deposits are often diffuse and

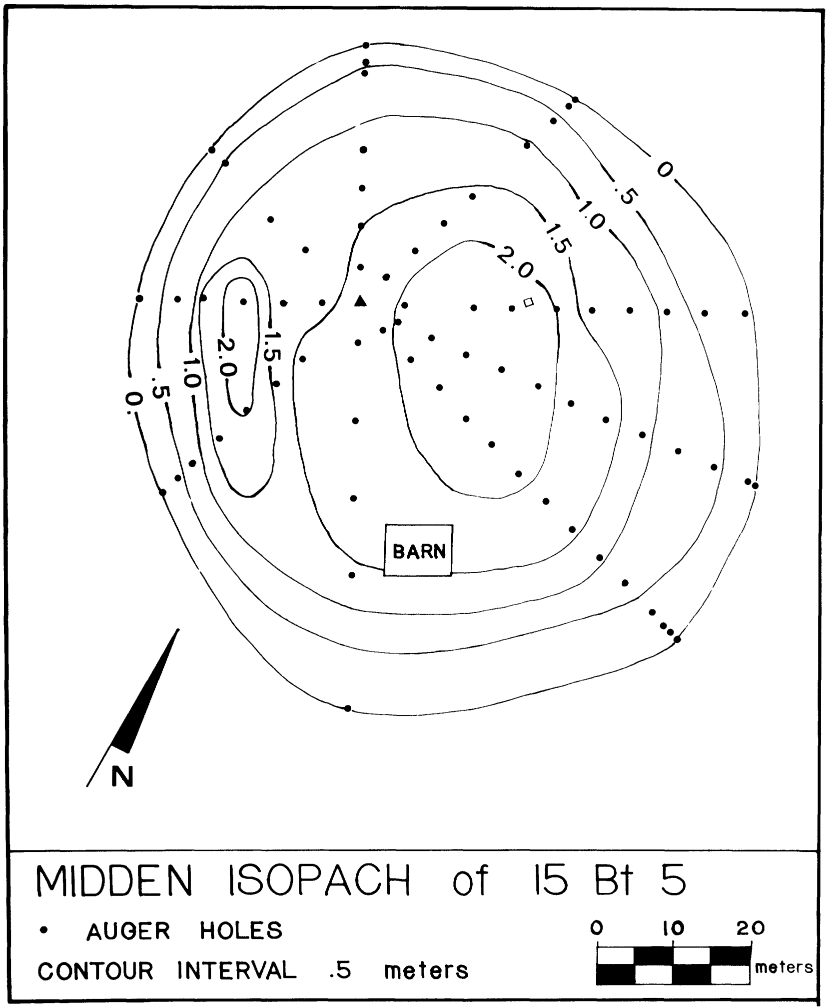

Figure 7. Shell-midden isopach of the Carlston Annis mound. Contours represent lines of equal midden thickness.

their exact depth difficult to determine, even in continuous stratigraphic exposures. Such boundaries will be even more problematical in cores.

The contact between cultural and non-cultural material is frequently discovered in the tube, so the exact depth to the contact is measured by subtracting (from the total depth of the hole) the distance from the bottom of the corer to the contact. The thickness of the cultural deposit is represented by this measurement, and is used in the construction of paleotopographic and isopach maps. The final step, after each location has been cored, is to measure the elevation of the opening of the hole.

Site Coverage

The number of holes one uses to examine a subsurface stratum depends on the resolution desired. Initially, the lateral and vertical extent of the site must be determined, perhaps most efficiently by coring one line of holes through the suspected location of the site. But to determine the true nature

TABLE 1.

Components	Average of Total (%)	Range (%)	Volume (m^3)
Shell	23	1–88	1,350
Sandstone	12	9–20	700
Pore Space	45	30–70	2,630
Matrix	20		1,170
Total			5,850

of the site at least two lines, at 90° to each other, are needed. The result of these cores might be sufficient to answer questions concerning the depth and thickness of the cultural deposits and to collect small samples for preliminary testing. If more precise information is required, a series of equidistant locations must be cored. This is best done by laying a grid pattern over the area under study and coring at every point where the gridlines intersect.

The time necessary to core a site depends on the depth of the deposit, the size of the site, the ease with which the site matrix is cored (a function of the concentration of obstructions such as impenetrable bones, rocks, or sherds, and the dryness and composition of the fine-grained matrix), the type of sampler used, and the precision desired by the researcher. At a large shell midden in Kentucky, the Deweese mound (15 Bt 6), which was cored with a manual core-tube after the technique was refined on the Carlston Annis mound (Marquardt and Watson 1983), four radial lines were cored in three days using four soil samplers each operated by a crew of three. The site is 140 by 80 m and the maximum thickness of the deposits was 3 m. Every evening the thickness data were plotted on a base map and the elevation of the surface, the elevation of the top of the midden (sometimes buried by alluvium, etc.), and the elevation of the base of the midden were recorded in a table. This precaution enabled us to detect mathematical and identification errors and to re-core problem locations before the field season ended.

When calculating the time needed to core a site, one must allow a sufficiently long period to adjust this technique to individual site conditions. At the Carlston Annis site (Stein 1978), for example, eight radial lines were cored in two weeks by four people with one corer. An additional four days of coring by three people was needed to anwer questions raised after plotting the data. The total number of holes cored was 97; the maximum thickness of cultural deposit was 2 m.

USES OF DATA

After the subsurface data have been collected and the stratigraphic units identified, many kinds of maps can be constructed. The most informative are the paleotopographic map (describing the configuration of the pre-occupational surface), and the isopach map (illustrating the thickness of any one stratum or depositional horizon).

Paleotopographic Map

If at each core hole the depths recorded for the contact between the archaeological deposits and the non-cultural deposits are subtracted from the surface elevations, then the resulting points can be plotted and contour lines drawn to reconstruct the pre-occupational surface. Figure 6 illustrates a paleotopographic map constructed from data collected at the Carlson Annis site (Stein 1982). A contour interval of 0.25 m was chosen to emphasize fine detail. The data points, shown as dots, are derived from coring holes and excavations.

The paleotopography in this example indicates that the elevation of the pre-occupation surface was essentially coincident with the elevation of the modern floodplain surface. Two slightly higher areas (defined by the 99.50 m contour) are separated by a small gully. Toward the river (west) from these topographic features, the ancient surface dips downward 2 m to 97.50 m where there is a narrow flattened platform, 10–20 m wide, followed by a more-steeply dipping drop to 95.50 m. On the narrow platform a small elliptical depression (indicated by hachure marks) is prominent.

The steep paleo-slopes dipping to the west are believed to represent the river bank at the time of occupation. The configuration depicted in the paleotopographic map is very similar to the topography of the modern Green River bank (located 100 m west). The position of the channel is, therefore, thought to have moved 100 m during the past 5,000 years.

Paleotopographic maps illustrate the landscape available to the original inhabitants at any prehistoric site. The construction of one such map has also been completed at Nichoria, a Bronze Age site in Greece. Here the paleotopographic map provided the archaeologists with an explanation for the settlement distribution observed through excavation (Stein and Rapp 1978). The unusual distribution of houses over the ridge was difficult to explain until the archaeologists realized that gullies and bedrock projections were once adjacent to the ancient house foundations. Thousands of years of quarrying, dumping, and terracing had remodeled the natural landscape.

Isopach Map

An isopach map displays the thickness of any one unit. Figure 7 is an isopach map of the shell midden at the Carlston Annis Site. Volumetric estimates can be determined from an isopach map using a planimeter and inserting the values in the following equation (Wetzel 1975):

$$\text{Volume of unit bounded by } A_1 \text{ and } A_2 = \frac{h(A_1 + A_2 + \sqrt{A_1 A_2})}{3}$$

where:

h = distance between A_1 and A_2 (contour interval)
A_1 = area of isoline 1
A_2 = area of isoline 2.

The resulting number represents the volume between two isolines. The equation must be calculated for every pair of isolines. The sum of these volumetric measurements is then the total volume of the shell midden.

At the Carlston Annis site, after the total midden volume was calculated, the percentages of individual midden components were converted into volumes (Table 1). The total shell midden volume is 5,850 m^3. Shell and sandstone weights were converted to volumes by measuring the volume of water displaced by pre-weighed pieces of shell and sandstone. The shell, calculated from the shell weights of the heavy fraction in flotation samples, averaged 23% of the total weight of flotation samples, or 1,350 m^3. Sandstone, determined by weighing fragments caught on ½- and ¼-inch screens during wet sieving of excavated midden deposits, comprises 12% of the total weight of samples sieved, or 700 m^3 of the midden.

The pore space, or proportion of midden voids, is measured using a soil-density test, which compares the volume of a sample to its weight using a rubber-balloon apparatus (Blake 1965:379). Voids can be filled with either air or water depending on the height of the water table. During spring, almost 100% of the voids are filled with water; in the autumn as little as 6% are water-filled. The pore space in the midden ranges from 70% to 30%, depending on density of shell and abundance of earthworm burrows (Stein 1983), with an average of 45%.

The percentage of matrix, consisting of inorganic sediment, charcoal, artifacts, animal bone, and human burials, is the difference between 100% and the sum of the percentages calculated above. In this case the matrix represents 20% of the total midden, or 1,170 m^3.

Several possible approaches to interpreting volumetric data have been suggested in the past (see summary in Sorant and Shenkel [1984]). Volumetric estimates of sites have been used to estimate prehistoric populations (Parmalee and Klippel 1974), rates of sedimentation, population size, and (through extrapolation) time (Cook and Treganza 1950). They also have been used to relate prehistoric events either to the environment of the surrounding area or to the environment of a shell midden during its growth (Gifford 1916).

For the Carlston Annis shell midden the volumetric estimates were used to describe and contrast different areas of the site for the purpose of understanding site-formation processes (Stein 1980). For example, the quantity of large-sized (> 1 cm) shell found in excavations on the river side of the mound (47%) far exceeded those values for midden at the top of the mound (8%). A hypothesis was proposed suggesting initially that the river had systematically winnowed away the fine-grained matrix as the midden was being deposited. If this were the case, then a ratio of shell to rock fragments should be the same in both parts of the mound, only matrix percentages should differ. Angular rock fragments (possibly fire-cracked) were not significantly more numerous on the river side of the midden (15% versus 11% on the top of the mound). Matrix was 18% on the western edge and 51% on the top. The ratio of shell to rock on the riverside is 3:1 (shell: rock), on the upper midden 1:1.4. This observation led to the suggestion that shell was being deposited preferentially near the river, and matrix near the center of the midden. Most of the shell seems to have been deposited in the area closest to the river. Matrix, on the other hand, was transported to the site from the surrounding lake and river sources and deposited preferentially at the top of the mound. The quantification of the shell, rock, and matrix as well as the knowledge of the volume (provided by coring) enabled this comparison to be made.

CONCLUSIONS

As was the case in 1935, coring and augering can help archaeologists to examine deposits located well below the surface. From 1935 to 1955 augering was being used primarily in the Mississippi River Delta by investigators (primarily James A. Ford) interested in correlating archaeological deposits with Mississippi River features. The correlation was for purposes of dating. Once radiometric dating was available, the correlations were less important and archaeologists continued to examine artifacts for purposes of constructing chronologies. As archaeological questions began to develop a more ecological tone, coring and augering were again used to reconstruct paleogeomorphic landscapes and to collect samples for biological and chemical analysis.

Systematic coring and augering of a site can provide a variety of data not otherwise available. This technique facilitates the definition of subsurface units, provides a clear view of the buried surfaces on which occupations took place, enables the estimation of volumes of site components, and determines the areal extent of the site. The technique is inexpensive, is adaptable to any site with distinct soil-color or texture variations, and is minimally destructive. Most importantly, coring and augering can expand the number of detailed and significant hypotheses that can be addressed concerning site stratigraphy and depositional processes.

This technique of examining the subsurface provides the archaeologist with vital stratigraphic information and with samples of buried site material. Because other methods of testing deeply buried sites (e.g., back hoes) destroy large portions of the archaeological record, coring and augering are suggested here as a means of identifying and sampling subsurface deposits in a non-destructive, labor-conservative way.

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