Northeast Historical Archaeology

Volume 36 *The Historical Archaeology of Sylvester Manor* Article 7

2007

The Use of Soil Micromorphology at Sylvester Manor

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Soil micromorphology is a vibrant sub-discipline of archaeology that studies sediment fabric, color, composition, shape, layering, and sorting using intact soil cores and thin sections. This technique takes into account the dynamic relationship between people and the world in which they live, and has contributed useful archaeological data to the Sylvester Manor Project. This paper constructs a landscape history for portions of the South and West lawns using soil cores and thin sections. Results reveal how Sylvester Manor's lawn, Midden, and Brick and Mortar Layer were composed, as well as how they were changed over time by plant and animal activity. These results have been used to better excavate and interpret the archaeological record of Sylvester Manor. This article provides an excellent example of how soil micromorphology can be used by historical archaeologists to more fully understand the archaeology of the modern world.

La micromorphologie des sols est une sous-discipline vivante de l'archéologie qui se concentre sur l'étude de la trame sédimentaire, la couleur, la composition, la forme, la stratification et le triage granulométrique à partir de carottes intactes et de lames minces. Cette technique tient compte des relations dynamiques entre les gens et le monde dans lequel ils vivent et a contribué à produire des données archéologiques utiles au projet du Sylvester Manor. Cet article recrée l'histoire du paysage de certaines portions des pelouses sud et ouest à l'aide de carottes et de lames minces. Les résultats révèlent la façon dont la pelouse du Sylvester Manor, la fosse à déchets et les couches de brique et de mortier ont été composées, et démontre comment ces éléments ont été modifiés au fil du temps par les activités humaines et animales. Les résultats ont permis une meilleure fouille sur le site du Sylvester Manor et une interprétation plus juste des résultats. Cet article démontre l'excellent potentiel de la micromorphologie des sols pour permettre à l'archéologue de mieux comprendre l'archéologie du monde moderne.

"In microscopic dimensions the soil is not just a mass, but a whole world. We are able to get an idea of what we know of this world if we think of it in terms of our world translated down to microscopic dimensions."

Walter Kubiena, *Micropedology* (1938: 6)

"Micromorphological data…can provide interpretive material for the archaeologist…thereby adding a new breadth to the archaeological interpretation of a site."

Marie-Agnès Courty, Paul Goldberg and Richard Macphail, *Soils and Micromorphology in Archaeology* (1989: 5)

Introduction—History from the Ground Up

Walter L. Kubiena developed a new way to study the earth during the early decades of the 20th century. He likened past soil studies, which attempted to understand the soil *en masse* using chemical treatments and geologic sorting, to trying to understand New York City after it had been shaken for twenty-four hours. As he put it,

> "One would not be able to reconstruct Broadway, Fifth Avenue, or the Empire State Building, or to find out what kind of goods are found in the large warehouses on the New York harbor. The first thing to know, in order to get an idea of New York, is not so much the nature of its chemical composition as a whole, but how it looks in detail as a structural entity" (Kubiena 1938: 6).

He coined his new technique "micropedology," and the approach soon became accepted among earth scientists. At its heart was the principle that the very arrangement of soil had a story to tell. If a soil was to be investigated and researched according to its composition and historical creation, "intact" samples were needed for observation. Therefore, Kubiena refined several methods that were already in use in the earth sciences, which included, among other things, the use of soil thin sections. Thin sections were an important innovation for two reasons. Firstly, they allowed intact soils to be taken from the field and observed in the laboratory under various levels of magnification. Secondly, minerals and other materials that existed within the soils could be easily seen and identified under a microscope using optical techniques (Kubiena 1938: 6, 75).

Today "micropedology" is known as soil micromorphology. This sub-discipline of earth sciences encompasses the microscopic study of sediment fabric, color, composition, shape, layering, and sorting using intact soil cores and thin sections. The philosophy behind micromorphology is similar to that behind the discipline of archaeology. Both fields understand that intact soils have a wealth of historical information to tell. It is perhaps due to this similarity that micromorphology has been so useful in studying archaeological sites.

Soil micromorphology experienced a renaissance in archaeology in the last decades of the 20th century that continues to the present (see Courty, Goldberg, and Macphail 1989; Davidson, Carter, and Quine 1992; Goldberg 1983; Goldberg and Macphail 2006; Macphail, Courty, and Goldberg 1990; Macphail and Cruise 2001; Macphail and Goldberg 1995; Stoops 1993). In North America and around the world, this method has been employed by archaeologists at a variety of prehistoric sites, but has rarely been used to study sites that post-date AD 1500 (Currie 1994). Therefore, the present study not only contributes to the Sylvester Manor investigations, but also provides an example of how soil micromorphology may be used by historical archaeologists to study the archaeology of the modern world.

Site Formation at Sylvester Manor

All archaeological sites are created by a combination of both natural and human-made activities (Schiffer 1987). Human activities have provided the greatest contribution to the formation of Sylvester Manor in the form of constructing buildings, laying pavements, creating ornamental lawns, and disposing trash. The history of human activity at Sylvester Manor can be divided into five different periods (see also Mrozowski, Hayes, and Hancock, this volume).

Late Woodland and Contact Period (ca. 1200–1652). Archaeological evidence is found on the manor's South Lawn and North Peninsula. Excavations have found native pottery, animal bones, charcoal, shells, and lithics.

Plantation Period (1652–1680). Sylvester Manor was established on Shelter Island as a provisioning plantation to supply barrel staves and foodstuffs to several sugar plantations in the Caribbean. Native Americans, Africans/African Americans, and Europeans lived and labored on Sylvester Manor during this period.

Tenant Farm Period (ca. 1692–1735). During this time, Native Americans, Africans/African Americans, and Europeans continued to work on the property, but the manor became less a provisioning plantation and more a localized farm.

Formal Manor Period (1735–Present). A series of landscape changes have taken place, which have included the creation and maintenance of the manor house, ornamental lawns, gardens, and related structures.

In addition to evidence of these human activities, Sylvester Manor includes windblown and waterborne sediments. Plants and animals have also contributed to soil forming processes and have actively reshaped the existing deposits at Sylvester Manor. Hundreds of worm and insect species live in the soils around Sylvester Manor (Shields 2002). These invertebrates produce channels that are lined by organic materials brought in by their daily activities. Such disturbances appear quickly, but can remain in the soil for hundreds of years (Courty, Goldberg, and Macphail 1989: 144).

Thus far, thin sections and float samples have confirmed the impact of earthworms, beetles, and plants on the archaeological record of Sylvester Manor. One of the consequences of earthworm activity is the blurring of natural and cultural boundaries in the soil, which can mean the movement of artifacts and ecofacts between sediment layers (see also Piechota, this volume). Another consequence is earthworm casings, which can form topsoil that may cover artifacts in several short years (Canti 2003; Wood and Johnson 1978: 327–328; Vogel 2004). Tree roots have also had a noticeable impact on the archaeological deposits of Sylvester Manor. This is particularly true of the South Lawn (FIG. 1), where they have mixed soil and archaeological layers through root growth and tree sway. Elsewhere on the manor, smaller roots have also loosened archaeological deposits and created voids that can be seen in thin section.

Methods

This study is based on seven samples from three areas taken in June 2001 (Proebsting 2002; FIG. 1). Two different techniques were used to take these samples. Cores from the West Lawn and the South Lawn midden deposit were taken by driving sections of aluminum

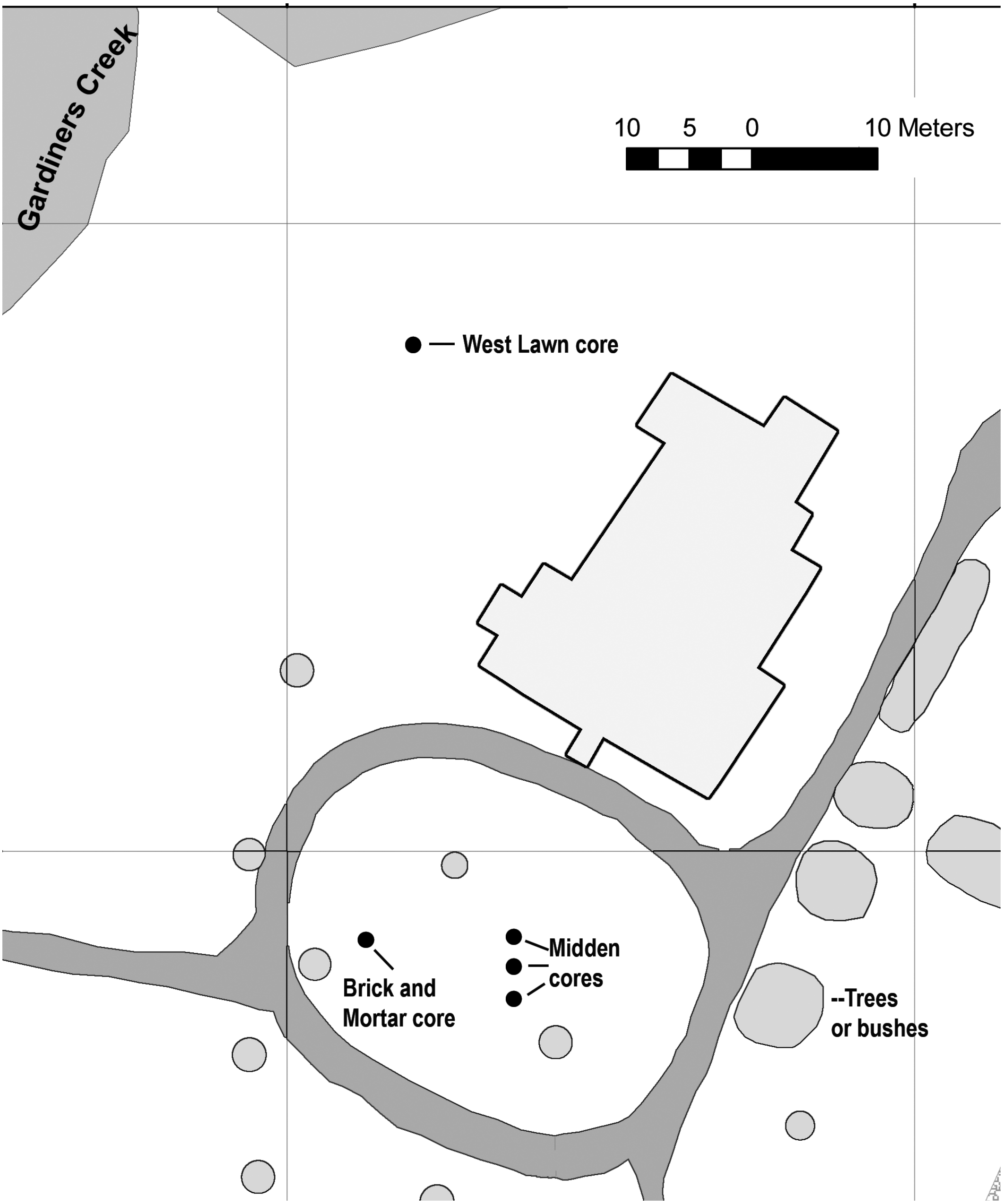


Figure 1. Map of Sylvester Manor showing the three areas sampled in June 2001.

drainpipe though the deposits. I used a different procedure to sample a Brick and Mortar Layer located on the South Lawn. Initially, a core was tried, which was unable to penetrate the Brick and Mortar Layer's coarse band of artifacts. To solve this problem, the profile was cleaned with a trowel and sampled using two open-faced boxes, which measured 10 × 50 cm and 10 × 20 cm respectively. These boxes were fashioned from aluminum drainpipe and were taken directly from the wall.

Once in the lab, these samples were filled with a mixture of polyester-styrene resin and dried under a fume hood until the samples were rock solid. Once dry, these samples were cut in two. One half was put through a stan-

Table 1. Resin impregnated cores and thin sections made from the soil samples.

Sample Areas (FIG. 1)	*Cores*	*Thin Sections*
West Lawn	Core 1, Core 2	1-A, 1-B, 2-A, 2-B, 2-C
Brick and Mortar Layer	Core 3, Core 4	4-A, 4-B
Midden	Core 5, Core 6, Core 7	

dardized series of grinding and polishing papers. This half was then scanned to create high-definition computer images of the soil's sediments. The other half was ground flat and cut into a series of 5 × 7.5 cm sections. Some of these sections were sent to Spectrum Petrographics (Vancouver, WA) where they were mounted onto glass slides and cut into thin sections. Once these thin sections returned, they were also polished and scanned to create high definition computer images of the soil's sediments (TAB. 1).

Most of my observations were centered on the slabbed and polished cores. These were supplemented by some thin section analysis. With guidance from Dr. Paul Goldberg, I separated the cores into multiple strata using the four characteristics of sediment composition, sediment sorting, sediment roundness, and sediment abundance using a standardized set of geologic charts and a binocular microscope. For the thin sections, Dr. Goldberg and I observed the slides under a petrographic microscope and characterized them using the criteria of sediment stratigraphy, sediment fabric, sediment color, and sediment composition. During the core and thin section observations, I recorded notes on printed color images of the samples. This data provided the basis for interpreting the samples.

Results

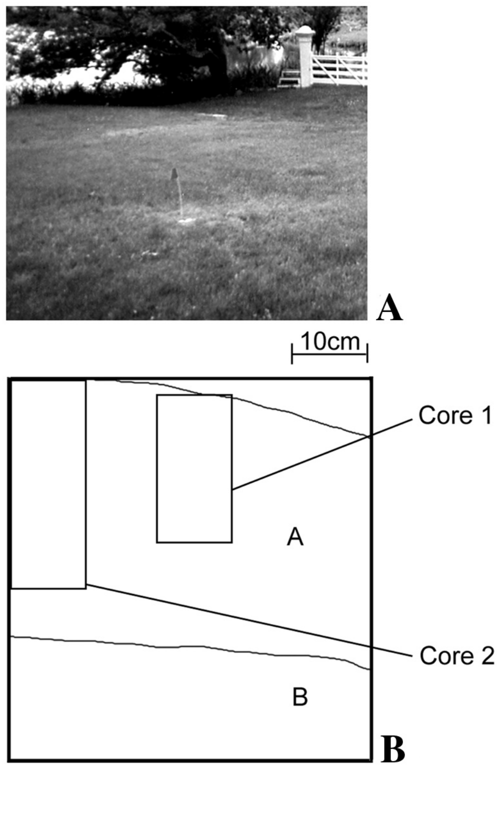
West Lawn

Two core samples were taken from the West Lawn. These samples were taken just west of Test Pit N490 E510 that was excavated in June 2001 and yielded a small amount of faunal remains, redware, nails, and brick fragments, which are typical types of artifact at Sylvester Manor. The test pit's profile had two soil layers. Layer A was dark brown sandy loam and Layer B was brown to dark brown sandy loam. Both of the samples were taken from Layer A and made into resin-impregnated cores and thin sections to serve as a geologic control for Layer A across the lawns of Sylvester Manor (FIGS. 2– 4).

Brick and Mortar Layer

Two overlapping samples were taken just east of Test Pit N443 E506 that was first excavated in June 1999, which contained delftware and nails as well as a heavy concentration of brick and mortar artifacts. The profile of this wall had four layers. Layer A was silty clay, Layer A_2 was silty clay dominated by brick and mortar artifacts, Layer S was sand, and Layer B was silty clay. In June 2000 remote sensing found a geophysical signature in this area that matched a signature for a buried cobbled sur-

Figure 2. Soil samples from the West Lawn. A) Photograph of a pin flag, which marks the sample area. B) Profile of Test Pit N490, E510 showing the locations of cores 1 and 2. This profile was sketched during the 2001 season.



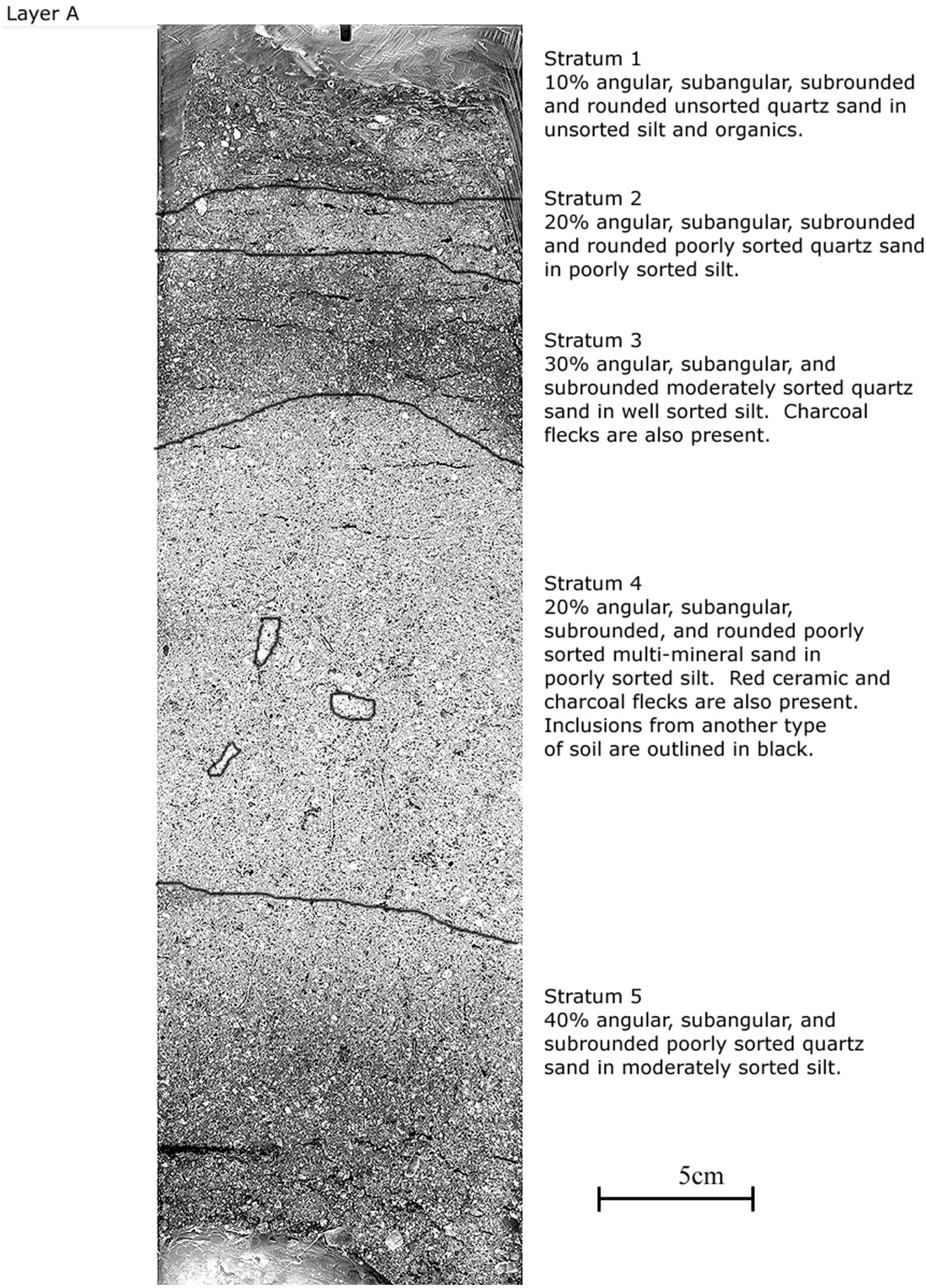


Figure 3. Scanned image of Core 1. Labeled on the left is Layer A, which was recorded as a single layer of soil during excavations. Labeled on the right are descriptions of the five soil strata that were discovered in the lab.

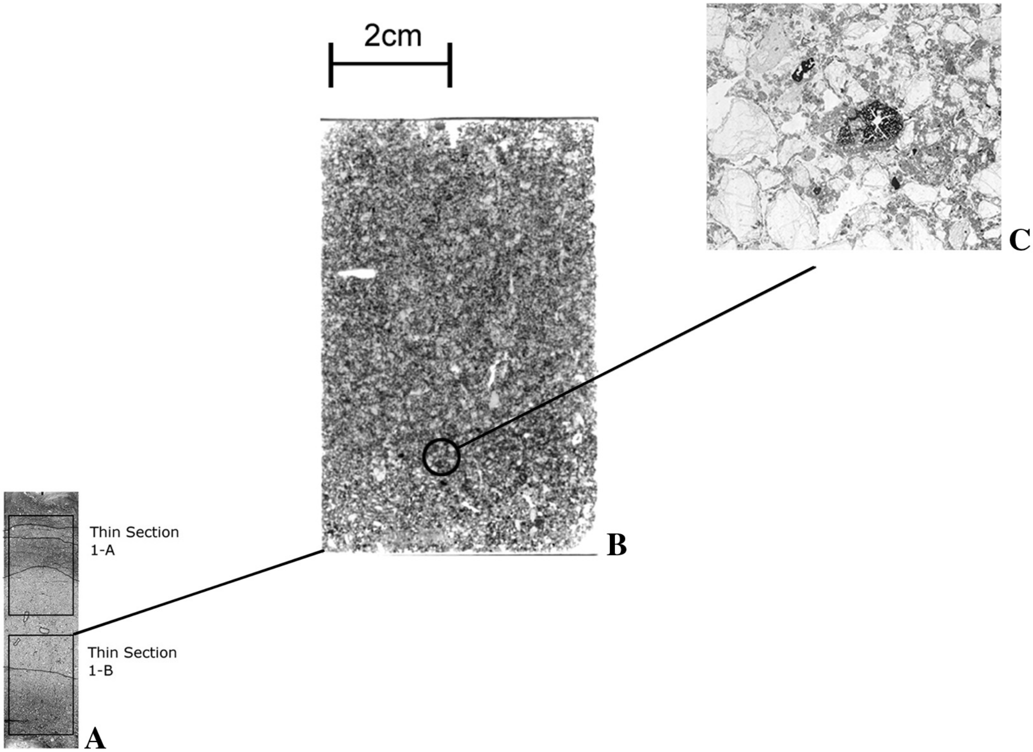


Figure 4. A) Scanned image of Core 1 showing the location of Thin Section 1-B. B) Scanned image of Thin Section 1-B. This thin section had equal proportions of sand and silt with a mineral composition of quartz and feldspar that was identified using a petrographic microscope. C) Micrograph showing evidence of plant and animal activities, which include root channels and insect remains. Image taken under plane polarized light.

face found elsewhere on the site (Kvamme 2001: 35–37). Because of these findings, this test pit was reopened in June 2001. No cobbled surface was found, but soil samples were taken from layers A and A_2 and made into resin impregnated soil cores and thin sections (FIGS. 5–7).

Midden

Three cores were taken from a portion of the Midden, which is a historic refuse deposit that contains Sylvester Manor's highest concentration of artifacts from the Early Plantation and Tenant Farm periods, denoted in excavation records as Layer A_2. These artifacts include animal remains, coral, shell, ceramics, brick, mortar, charcoal, coins, nails, and glass. Block A was a 6 × 6 m portion of the Midden excavated during the summer of 1999 (see FIG. 6 in Hayes, this volume). The east wall had four layers. Layer A and Layer A_1 were silt loam, Layer A_2 was silt loam dominated by artifacts from the Early Plantation and Tenant Farm periods, and Layer A/B was silty-clay loam. Samples were taken at two-meter increments and processed into resin-impregnated cores to examine layers A, A_1, and A_2 of the Midden (FIG. 8, 9).

Discussion

Living Among the Artifacts

The results show that Sylvester Manor's archaeological deposits display the effects of plant and animal activity. For example, thin sections from the Brick and Mortar Layer show earthworm activity, which appears to be localized in areas where the pH of Shelter Island's naturally acidic soils have been buffered by lime-based artifacts, such as coral, shell, bone, mortar, and plaster. Given that earthworms cannot tolerate acidic soils, earthworm channels suggest that the artifact-buffered soils are what have created a suitable habitat for these animals (Limbrey 1975: 29). Earthworms can

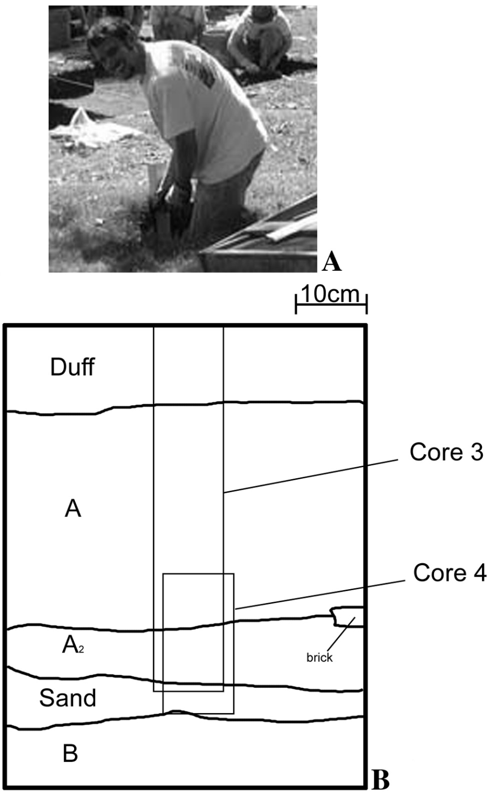


Figure 5. Soil samples from the Brick and Mortar Layer. A) Photograph of author taking core samples from the east wall of Test Pit N443, E506. B) Profile showing the locations of cores 3 and 4. This profile was sketched during the 2001 season.

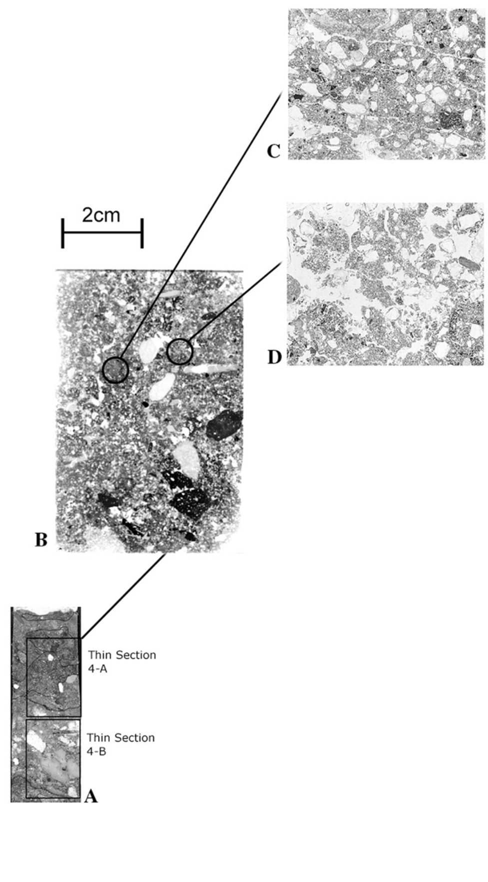
impact archaeological sites by moving and burying archaeological materials; these previously unseen activities are significant and can now be accounted for when excavating and interpreting the archaeological deposits of Sylvester Manor (Canti 2003; Wood and Johnson 1978: 327–328; Vogel 2004; Piechota, this volume).

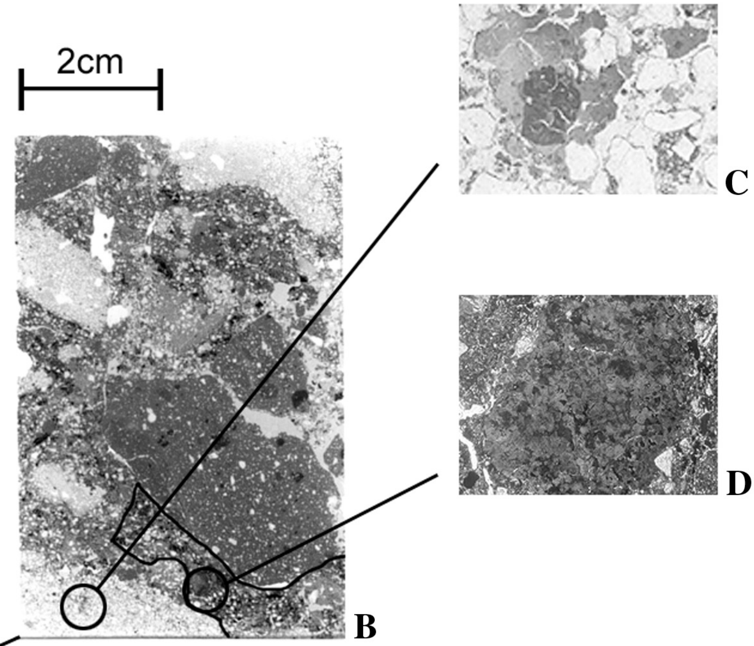
The Lawns of Sylvester Manor

Results also show human activities that have taken place at Sylvester Manor. For example, soil cores and thin sections show that Layer A of the South and West Lawns is divided into several different strata. These strata were deposited over one another quickly, because there was not enough time for a layer of dark organic material to form between each layer of soil. Therefore, I propose that Layer A represents a single large-scale landscaping event that happened when the ornamental lawns were created soon after the start of the Formal Manor Period.

This landscaping event explains why the archaeology of the Early Plantation and Tenant Farm Period were so well preserved beneath the West and South Lawns of Sylvester Manor. It also speaks to the larger social and economic changes that were taking place in the cultural and physical landscape of Sylvester Manor. These occurred as Sylvester Manor's core was transformed from a working farm and plantation to a Georgian-style manor that was created more for the sake of appearance than the day-to-day needs of a large agricultural operation.

Figure 6. A) Scanned image of Core 4 showing the location of Thin Section 4-A. B) Scanned image of Thin Section 4-A. The porosity of the silt and clay in this thin section is very open, which is at least in part the result of plant and animal activity. C) Micrograph showing burned architectural materials in unburned soil. Image taken under plane polarized light. D) Micrograph showing evidence of earthworm activity. Image taken under plane polarized light.





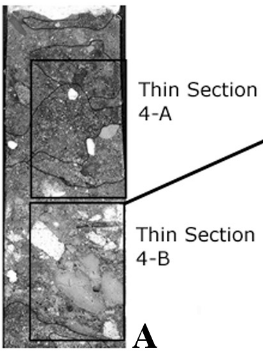


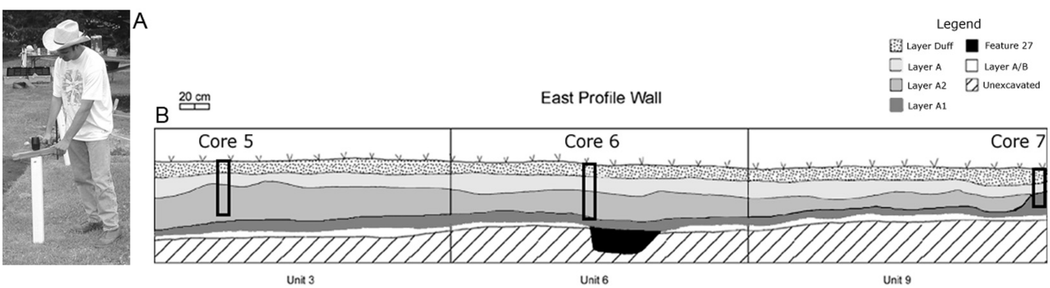
Figure 7. A) Scanned image of Core 4 showing the location of Thin Section 4-B. B) Scanned image of Thin Section 4-B. This material is compact and has a very low porosity due to intense concentration of clay, brick, and mortar. Ash and charcoal appear to be worked into the unburned clay. Other burned (calcined) architectural materials include brick, limestone, mortar, and plaster. C) Micrograph showing a piece of calcined plaster. Image taken under plane polarized light. D) Micrograph showing a piece of burned coral, which was once part of the calcined mortar. Image taken under plane polarized light.

The Midden

The Midden is the largest archaeological feature excavated at Sylvester Manor. It was recorded as a single soil layer in the field, but my results show that the Midden was in fact composed of many small deposits of soil and artifacts. This finding has led to the creation of more refined excavation techniques that have uncovered other valuable details about the archaeology of Sylvester Manor (see Piechota, this volume).

I argue that the Midden was being used for trash disposal for a number of years. This interpretation is supported by the results of Hancock (2002: 63) who found mean ceramic manufacture dates of AD 1707 for the lower and AD 1716 for the upper portions of Midden Block A. Most of the artifacts within the many

Figure 8. Soil samples from the Midden. A) Photograph of the author demonstrating the technique used to take soil core from the Midden. B) Profile of the east wall of Block A showing the locations of cores 5, 6, and 7. This profile was sketched during the 2000 season (adapted from Hancock 2002).



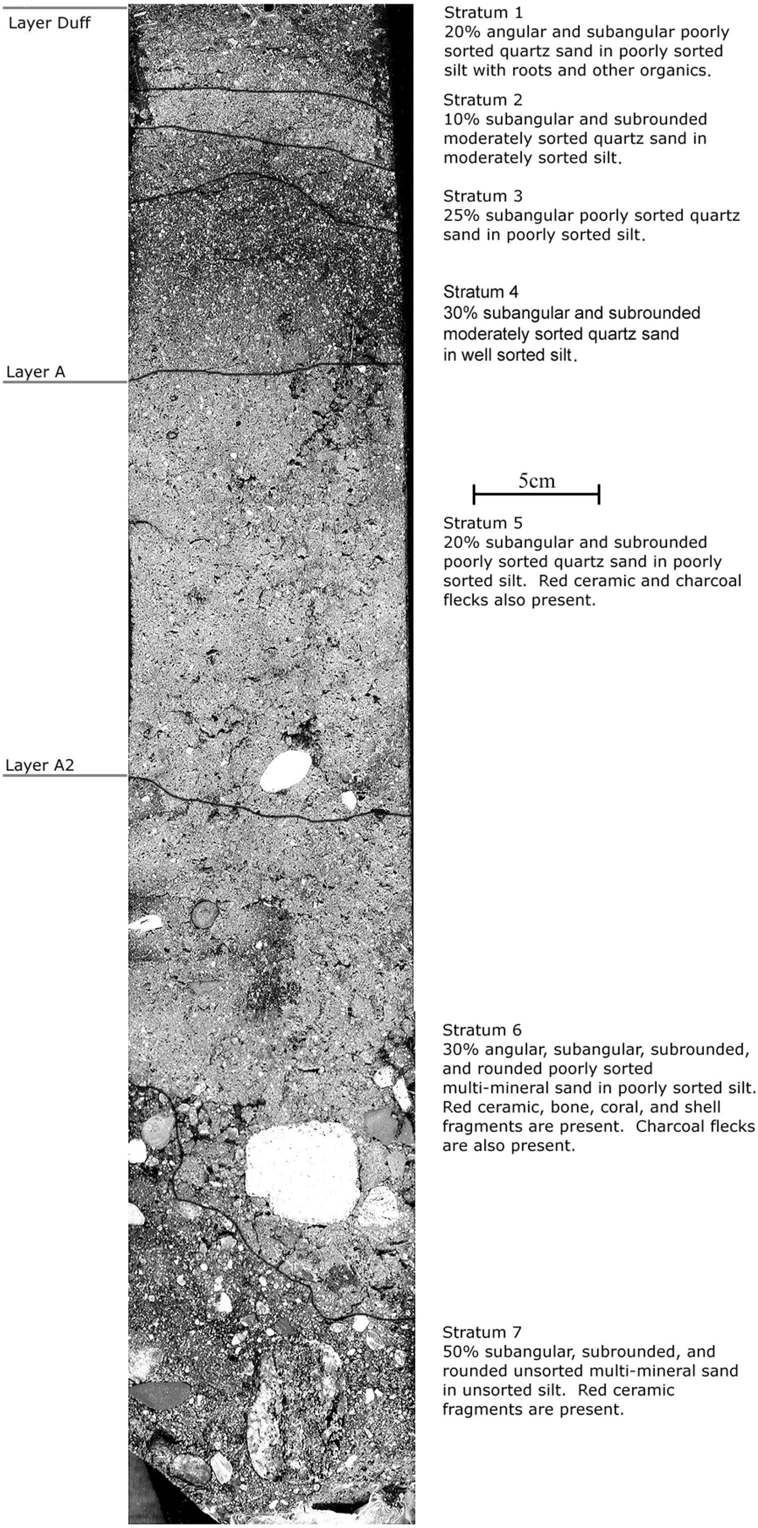


Figure 9. Scanned image of Core 5. Labeled on the left are layers Duff, A, and A2, which were recorded as separate layers of soil during excavations. Labeled on the right are descriptions of the seven soil strata that were discovered in the lab.

smaller deposits that make-up the Midden are not *in situ*. Instead, they were exposed to the elements of wind, water, and weather, and the activities of animals like earthworms and insects for more than a decade. In fact, the results of additional artifact analysis by Gary (this volume) suggest that the Midden was open until the middle portions of the 18th century before being covered over by ornamental lawns.

The Brick and Mortar Layer

The Brick and Mortar Layer is composed of building materials that are burned, while the soil is not. Therefore, these artifacts of the Brick and Mortar Layer were not burned in the same place where they were found. This deposit also includes a much higher concentration of clay than is normally found beneath the South Lawn of Sylvester Manor (Warner et al. 1975). It is possible that after a building burned on the property, its remains were used along with clay to fill in a low area in the topography of Sylvester Manor.

Thin sections also revealed a small piece of burned coral included within the Brick and

Mortar Layer. Coral was transported from the Caribbean as ship ballast and is connected to the production of lime mortar and plaster that was taking place during the late-17th and early-18th century. This mortar was different from earlier types found on Sylvester Manor, which were made using local quahog shell (Gary, this volume). Therefore, this piece of burned coral found in the micromorphology offers a diagnostic artifact that links the Brick and Mortar Layer to the late-Plantation and Tenant Farm Periods of Sylvester Manor history. This suggests that the Brick and Mortar Layer represents a building that was burned—either by accident or on purpose—during the intense period of construction that took place at the outset of the Formal Manor Period.

Conclusion—In Small Things Forgotten

On the most basic level, these results give us a better understanding of how the archaeological deposits of Sylvester Manor were formed. Using soil micromorphology, I have found that the archaeology beneath the South Lawn of Sylvester Manor was remarkably intact and offers an excellent opportunity to understand the Early Plantation and Tenant Farm Periods. Soil micromorphology has also given insights into Sylvester Manor's cultural landscape during the 17th and 18th centuries, which evolved according to the direction of its owners and the daily activities and decisions of the workers who lived and labored on the property. While the Midden represents the day-to-day activities of trash disposal that took place over many years, the ornamental lawn and Brick and Mortar Layer represent dramatic moments in time when the core of Sylvester Manor transitioned from a working farm and plantation to a Georgian-era symbol of status.

Soil micromorphology has shown the interconnectedness of humans and nature at Sylvester Manor. This fact is important for realizing that there are no clear divisions between the cultural and natural world (see Balée 1998; Crumley 1994; Mrozowski 1996a, 1996b, 1999, 2006). Just as layers of artifacts, sediments, and soil have been blurred by plant and animal activity—not to mention effects of wind, weather, and water—the day-to-day routines of the people who lived in Sylvester Manor were woven with the fabric of the natural world in which they lived. One example is the abrupt change from the use of local shells to Caribbean coral for mortar production (Gary, this volume). This change, seen under the microscope at the smallest scale, suggests much larger changes in the 17th-century ecology of Shelter Island that were the result of the exploitation of native animal species at Sylvester Manor.

Samples taken from the field provide a visual archive of the site's stratigraphy that can be analyzed in the lab long after excavations are finished. Although micromorphological analysis can be time consuming and the results not always unequivocal, when used by historical archaeologists during excavation—along with complementary techniques like archaeobotany, artifact conservation, geophysics, material culture studies, and zooarchaeology—soil micromorphology can contribute a rich source of archaeological data that takes into account the effects of human activity on the cultural environment and the natural world.

Acknowledgements

I want to thank Drs. David Landon, Paul Goldberg, and Stephen Mrozowski. They were outstanding committee members, generous with their personal time and lab space, and a blessing during my time in Boston. I also would like to thank Kat Hayes for her work on this volume as well as Paul Goldberg and two anonymous reviewers for giving excellent advice regarding this article. This research is the result of my Masters thesis, which was supported in part by a graduate assistantship and Spayne Research Grant from the University of Massachusetts Boston.

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