Sediment Analysis of Biochemical Trace Evidence for West African Spiritual Activity in 19th Century Germantown

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Sediment Analysis of Biochemical Trace Evidence for West African Spiritual Activity in 19th Century Germantown

Senior Project Submitted to
The Division of Science, Math, and Computing
of Bard College

by
Liri Ronen

Annandale-on-Hudson, New York
May 2021
Acknowledgements

To my advisors, board members, and chemistry professors - thank you for being so kind, so welcoming, so patient, and so understanding of my inadvertently divided attention. Despite music being my main focus and interest, your enthusiasm, curiosity, discipline and mentorship inspired me to continue my path in chemistry for the duration of my time at Bard. It was not an easy journey, but you were always there, ready to listen and lend a hand at a moment's notice.

Chris (LaFratta), thank you for believing in me all these years, and guiding me through the labyrinth of equations and formulas that is a chemistry bachelor's degree. And Chris (Lindner), thank you for your patience, your scrupulousness, and your courage for betting on my help in a project so dear to your heart.

Thank you to my brother Goni for helping me get myself into the lab, and the rest of my family for supporting me from home. Thank you to Isaiah Brackman, for turning me on to the archeology department at Bard, and thank you to my wonderful roommates at 32 Broadway, for making our place a home to come back to at night.
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Abstract

In service of the archeological excavation site at the Parsonage in Germantown, NY, an exploration of analytical techniques could prove useful towards ethnohistoric interpretations of recently uncovered artifacts. Through the 18th and 19th century, the Parsonage housed the Calvinist minister of Germantown, as well as several families of African-American descent, both free and in bondage. An etching of a traditional Bakongo Cosmogram found on a wooden frame alongside the hearth in the basement of the Parsonage, which probably served as the slave quarters, had, along with other material evidence, raised interest in the strong possibility of the fireplace's use as an altar in veneration and healing rituals. Through extraction, microscopy, and spectroscopy of trace chemical and botanical evidence, I attempt to reveal more about the practices and habits of the Parsonage dwellers, and provide further proof of the spiritual activity that might have taken place there.

Front view of the hearth in the basement of the Parsonage, on Maple Avenue, Germantown, NY

(Lindner, SHA Newsletter, Spring 2016)
Introduction

My Path to Finding a Project

As a chemistry student, my interest has always been found in the more practical aspects of result analysis, in which data is directly applied to a larger context beyond characterization for synthesis or isolation. I was looking for a Senior Project involving archaeology because of my fascination with the way scientific methods and observational instruments are used to fill in details about the past that are otherwise irretrievable. I found out about Professor Christopher Linder’s work at Bard through my friend, who worked with Christoph on the civil summer excavation program at the site in Germantown. I immediately signed up to one of the archaeology classes Dr. Lindner offers at Bard, and after a semester of studying his work in the Parsonage site in Germantown I was confident in the idea of collaborating with him on the project. He was as excited as I was about the possibilities of incorporating spectral data to the ongoing hypotheses and narratives that he’s been working on at the site, and filled me in on previous cases in which he had used chemical analysis for his work, namely for the paint on the wall in the basement of the Parsonage. I began my search for a method of analysis that would be both practical to execute in the labs at Bard as well as useful towards Dr. Lindner’s research. I considered the various findings at the Germantown site and the possible interpretations they could offer when provided with spectro-analysis data. As such, I attempted to explore the archaeological and historical hypotheses that Dr. Lindner was already pursuing, which gave me a clearer framework for archaeological evidence that could be expounded on with the use of the analytical methods available to me.
After discussing the matter further with Dr. Lindner, we had a few leads that could potentially produce useful data for the ongoing research at the site, which mainly revolved around the spiritual significance attributed to the hearth located at the basement of the Parsonage. The most prominent of those leads would be the finding of residual plant materials from libations poured into the hearth, an activity that would fall within the spiritual context presented in Dr. Lindner's research. Such evidence would contribute directly to the distinguishing markers discussed in Dr. Lindner's former publications that indicate the use of the hearth as an altar.

The Parsonage Site

The Parsonage was excavated between 2009-2020 by Dr. Lindner, his students, and a group of local volunteers. The dig has had the amazing opportunity of community involvement and contribution, even by current Germantown residents who are direct descendents of the very people who had first settled along the estuary. Dr. Lindner has utilized the help of many lower and higher education students by offering classes and community projects, and through their help, the dig was able to take shape and further sections of the parsonage and the surrounding property were excavated. Several students from Bard College have made significant research developments through their own Sr. Projects, namely Cheyenne Cutter (2020), who utilized a vast lexicon of pottery sherds from the site to
look at the daily behaviours and affiliations of people living at the site, as well as Ethan Dickerman (2020), who's consolidation and categorization of the available historical data made invaluable contributions to the archeo-history of the Parsonage.

The dig and research done at the parsonage can serve to show the ubiquitous instability of historical narratives, as it reveals through its various findings of bone fragments, pottery sherds, nails, toys, minerals, personal items, and more, the stories and details excluded from the historical records - specifically, the suppressed and forgotten history of black communities.

Dr. Lindner’s research at the Parsonage and other sites in the Hudson Valley has contributed chapters in books such as *Environmental History of the Hudson River* (2011), and *The Archeology of Race in the Northeast* (2015). His extensive studies of the census records of Germantown revealed the lineage of ministers and medical practitioners that dwelled in the Parsonage between the time of its construction in the mid 18th century and its purchase by Harry Hyes in 1846, and possibly afterwards. Historical documentations of black individuals dwelling at the site during that time are few and far between, but they do show us that around those individuals, a small community of several black families arose in Germantown, lasting for 80 years (Dickerman 2020; Lindner and Dickerman, 2020).

By closely examining finds at the site for cultural markers and historical associations, Dr. Lindner is interested in finding more about the activity and relations of this community through the artifacts and emplacements found at the site, which could provide a glimpse into the previously unknown lives of people who had left behind scarce historical documentation. Particular interest falls on the hearth in the basement of the house, which exhibits many features and signs of what could potentially be determined to be spiritual activity. Through
study of West-African tradition, ethnohistory, creolization processes, and relevant archeological research methods, the analytical procedures devised for this project could have the potential of uncovering evidence and documentation beyond the current findings and census data, of what might very well be forgotten ritual aspects of the lives of the dwellers of the Parsonage.

Wedding party of Rutheford Robbinson down the street from the Parsonage, circa 1900 (Germantown History Department)
**Known History of Germantown and the Parsonage**

The original (Palatine) settlers of the area we now know as Germantown, NY arrived in 1710 after a long and arduous journey, which for some started in the Rhineland (modern day Germany, along the Rhine river) from a small region called the Palatinate (Modern English). They were refugees, coaxed to immigrate to England by propaganda and welcomed by the Crown with a political thumb aimed at the Catholic French, who were losing control of territory and resources across Europe. After being rejected by British citizens at the outskirts of London, they were shipped away for labor, some hundreds to Ireland and approximately 2,700 to the Hudson Valley in America, where they were required to harvest pine sap and process it into tar and pitch for navy ships. Due to lack of British support, and their true aspirations to become farmers on a frontier land of their own, the Palatines resisted; and although many of them left the original plot of 6,000 acres in Germantown, then called East Camp, in 1725 the remaining 63 families were given possession of the land and the freedom to farm it.

*(Becoming German, P. Otterness 2004)*

The Parsonage itself was built between 1763-69, for pastor Gerhard Daniel Cock, who married Christina Ten Broeck in 1769. Census shows 4 slaves in his ownership in the year 1790. The Parsonage was bought from the Church in 1805 by his widow’s sister, Maria Ten Broeck Delamater, who that same year had noted the birth of a daughter Zian to a slave she had owned. After her death, the next appearance of the property in the records is under the ownership of Christina’s relative Dr. Wessel Ten Broeck Van Orden, who sold it in 1846 to an African American, Harry Hyes, who did not reside at the house. In all likelihood, he had rented out the Parsonage to an African American farmer/cobbler named Henry Person and his family, who
purchased the house from him in 1852. Dr. Wessel Ten Broeck Van Orden was linked to the name Persen through digital genealogy databases - raising the possibility of Henry's relation to slaves dwelling with the Ten Broecks in their massive nearby estate. Henry's daughter Emma J. Person died in 1911, and the house was sold away that year, making her the last known African American resident of the Parsonage.

From the Federal census of 1860, free African American populations can be projected to show a neighborhood around the Parsonage, the largest dot in the map's center. Eight years after Henry Person had moved into the Parsonage, Germantown's black population stood at 29 people, only two of which did not live along Maple Avenue.

(Ethan Dickerman, 2019)
Evidence of the Hearth as an Altar

The archeological evidence which led professor Lindner to suspect the hearth of being an altar used for practices of veneration and offerings includes both findings from the hearth as well as its vicinity. Inside the hearth, caches of artifacts were found in three main clusters: one in the Southeast corner, one towards the center front, and another in the Northeast corner (see images taken from a conference poster by Lindner and Dickerman (2020) and accompanying data).

**Southeast:** ‘Two fitting halves of an oyster shell, bone handled iron implement, fish scales, ceramic fragments of coggle edged slipware, spongeware, polychrome pearlware and plain white earthenware, carved shell bead, a gunflint, a clear quartz crystal, and a white clay smoking pipe shank. Two grey salt-glazed stoneware sherds and the neck and mouth of a jug with a handle attachment were found in the Southeast corner, but were not as clearly clustered with the rest of it.’

*Image of the Southeast corner, with emplacements superimposed*
Center Front: ‘A bone button, two smoking pipe shanks, a thick piece of olive glass, a peanut, a walnut, a nail, and two blue glass beads.’

Northeast Corner: ‘A leather strip, six iron pieces, another clear quartz crystal, a split purplish shale pebble inscribed with two X’s, and a small clinker-like object resembling the shape of an animal.’

Each of these items alone does not represent evidence of spiritual significance - however, found in clusters, these artifacts are interpreted as emplacements: symbolic objects intentionally placed as offerings in a ritualistic practice. This action of concealment is part of a known Bakongo tradition called Minkisi, a venerative offer to ancestral spirits that maintain influence on the physical world. An excerpt from James Denbow’s article ‘Heart and Soul: Glimpses of Ideology and Cosmology in the Iconography of Tombstones from the Loango Coast of Central Africa’ (1999), from *The Journal of American Folklore*, best describes the traditional beliefs behind these practices:
“According to Bakongo cosmology, a watery barrier, called kalunga, separated the world of the living from the spirit world of those who had died. This barrier formed part of a universe, created by the singular and supreme god, Nzambi, and was manifest in the cyclical movement of the sun. People most simply represented this by a cross within a circle, often with small “sun circles” at the four intersections of the cross and major circle. The sun’s rising and ascendance – seen as a counterclockwise movement in the southern hemisphere – represented birth and maturation; the setting represented old age and passage through death and a watery barrier to a white, spirit world, called mpemba. While the normal representation of this cycle was a circle, the more complete conception was that of a spiral. Soon after death ancestral spirits remained in close contact with the living and could be called upon and controlled by spiritualists, nganga, using minkisi charms for beneficent works and ndoki for malevolence. As ancestors became more remote through the spiral of time, they became less influenced by the living and morphed into spirits, basimbi, “associated with water, the ocean, rivers and springs, and even the smooth, white, waterworn stones found in such places.”

According to West African traditions and historical accounts, the Minkisi emplacements carry symbolic connections to the spirit world through their associations with features such as the watery barrier, or its white color. Archeological research by Patricia Samford in Virginia plantation slave quarters revealed use of iron implements and tobacco pipe pieces for emplacements as well. On the left is a diagram of one
of Samford’s designated altars - concealed inside were seven complete fossil scallop shells, three large cow bones, two kaolin tobacco pipe bowls and a pipe stem. The extensive ethnohistorical research done by Samford and her team directly compares this cache to traditional Igbo and Mande altars, in which similar items were assembled in similar ways. The parallels between the contents of altars uncovered by Samford and the items found in the hearth at the Parsonage are striking, and further physical evidence from the hearth's surroundings makes for an extremely convincing case for its use as an altar.

**The Cosmogram**

To the right of the hearth, on the wooden frame that connect the fireplace to the wall, three etchings were found: One appears to be a sailing ship, another shows a smoking pipe with West African decorations on its bowl, and a third etching portrays a Cosmogram, garnished with a ‘deep punctation set into its eastern quadrant, representing the moment of birth in the life cycle’. (Conference poster by Lindner and Dickerman, 2020)

The figure of the cosmogram is an essential illustration of the beliefs of West African traditions, and its appearance on the frame of the hearth along with the X’s inscribed into the shale pebble are extremely significant pieces of evidence. The presence of the cosmogram completes the narrative of the possibility of the hearth being used for spiritual practice.
From left to right: the Cosmogram, smoking pipe and sail ship etchings found adjacent to the hearth.

(images taken from a conference poster by Lindner and Dickerman, 2020)

**Pouring of Libations**

The pouring of Libations is a well known West African traditional practice, brought over to colonial West through the trans-atlantic slave trade (Samford, 2007). Similar to Minkisi, it is an act of reverence, paying honor and tribute to the ancestors and communicating with them. Pouring of libations is also used to refresh an altar, in preparation for a separate offering. (Levada Nahon, interview 2020)

The drinks used for libations are oftentimes alcoholic beverages, such as whiskey, rum and palm wine. In the West, grape wine has been used instead. The practice of the pouring of libations goes hand in hand with Minkisi, as they are both used for communication, offering, and sometimes a request in return. The central goal of this Senior Project is to identify the presence of such practices through sediment analysis of the samples taken from the hearth itself. Evidence for the practice of libations will establish the hearth as a well credentialed altar, with all the historical, artifactual and chemical identification markers in place.
Merging of Disciplines

Archeology has always been a unique branch of science in that it involves both figures and numbers, as well as inferred and deduced interpretations. In the right hands, archeological finds can be very informative about their origin and environment, but it is necessary to acknowledge the inevitable fragility of the narratives they produce. The faint traces of history that archeologists often work with leave gaps in the narratives that can only be filled with contextual educated guesses, until a new piece of evidence can provide an explanation or a bridge to the missing data. Over the past century spectroscopy methods such as carbon dating, elemental analysis, pollen analysis, saponification, and more, have opened up new possibilities in how narrative interpretations are formed around an archeological site/research, and can provide concrete data to go alongside the more subjective interpretive part of the work. Before deciding on an approach, I studied the literature for commonly used methods of archeo-chemistry in order to determine the analysis possibilities that are available to me in the Bard laboratories.

Common Methodologies of Archeological Chemistry

Radiocarbon Dating

Radiocarbon dating is perhaps the most notorious, and in many cases the most useful analytic technique applied to archeology. When excavating a site, the ability to date organic materials can be invaluable, and as such the method has single handedly revolutionized our capacity to study and understand ancient life on earth since its refinement in the mid 20th century. The technique relies on the known half-life measurement of the decay of radioactive carbon $^{14}$C,
which stands at approximately 5,730 years. Because of this half-life, samples older than 50,000 years aren’t likely to yield reliable results, even with extraneous preparations. Radioactive carbon is produced in the stratosphere and troposphere by galactic and solar cosmic rays, which strike \(^{14}\text{N}\) nitrogen atoms with a neutron to produce \(^{14}\text{C}\). Combining with abundant atmospheric oxygen into \(\text{CO}_2\), these isotopic carbon atoms invade the biosphere through photosynthesis. Ongoing measurements of atmospheric \(^{14}\text{C}\) ratios provide a calibration curve, which along with environmental and organism specific information, help estimate the value of \(N_0\) - the isotopic carbon ratio found in the organism at the time of its death: the point at which it stopped sustaining this ratio. \(t\), representing time elapsed, can be solved for using the following formula:

\[
t = \ln\left(\frac{N_0}{N}\right) \cdot 8,267 \text{ years}
\]

With \(N\) representing the sample isotopic measurement, and 8,267 years being the mean-life value: the average decay time of an individual \(^{14}\text{C}\) atom. The isotopic ratio in the sample is measured today using accelerator mass spectroscopy, an improvement over the older beta counting method, which uses proportional counters.

**Saponification and Lipid Analysis**

The porous texture of ceramic vessels can lead to the entrapment of organic residues from cooking and processing of foods that can survive within the pores for hundreds to thousands of years. Through the process of saponification, fats and oils trapped in ancient ceramics can be extracted and characterized using a combination of modern spectral techniques such as High Temperature Gas Chromatography (HTGC), Gas Chromatography Mass Spectrometry (GC/MS) and GC combustion isotope ratio MS (GC-C-IRMS). Extensive knowledge of degradation
processes of natural products can be used to identify the origin of the extracted lipids from animal products, vegetables and plant oils.

**Sediment Analysis**

Under the right circumstances, sediments analysis of organic particles and molecules can be very useful to an archeological dig, but there isn't a right way to do it - each study warrant its own set of parameters and controls, and the preservative ability of sediment varies vastly according to environment, composition and the targeted analyte. In the case of the Parsonage, sediment analysis has the most potential in providing additional evidence and data that could support current research at the site.

**Previous Chemical Analysis of the Site**

'The red-brown paint covering the Cosmogram and most of the wooden frame around the hearth was analyzed by Christine Puza, Conservator of Furniture and Wooden Objects at the Williamson Art Conservation Center, Clark Art Museum, in Williamstown MA. She had tentatively identified ceresine as a constituent in the paint, stating the probability of ceresine presence at 80%. Having come into commercial production in the 1870’s, it is possible that the paint was applied during the African American occupation of the Parsonage'.

(SHA Newsletter, Spring 2016)
Samford, Subfloor Pits, Palynology and Wine Acids

One of the prominent links between evidence found in the hearth at the parsonage and existing relevant research of West-African spiritual life is Patricia M. Samford's work on the subfloor pits found in the living quarters of Virginia plantations. In her book *Subfloor Pits and the Archaeology of Slavery in Colonial Virginia*, Samford describes the excavation, findings and analysis of the slave living quarters of three heavily interconnected plantations: Carter's Grove, Kingsmill, and Utopia. The subfloor pits commonly found within the footprints or confines of the living structures, were a large source of intrigue in regards to their usage and functionality. The number of subfloor pits found was large enough to tabulate statistical characteristics that aided in the interpretation of their functionality. The pits were categorized according to location, size, depth, level, repair and of course, the artifacts found inside. This organizational compartmentalization helped in Samford's assignment of their use, which was delineated to three main categories: root cellars, personal storage areas, and what Samford refer to as shrines. These “Shrines” were designated according to the artifacts and emplacements found in the pits, by comparing their caches to known traditions and findings from ethnohistorical research of West-African cultures, particularly Igbo. These shrines could be more accurately described as altars, since Shrines are typically entire structures devoted for spiritual activity, whereas altars are domestic and are found within living spaces. Such altars served for veneration of the ancestors, through practices such as concealment (minkisi) and the pouring of libations. Such known practices allowed Samford to inquire into each subfloor pit cache in great detail, including analysis of the remnants and residues found in the soil through chemical extraction. Samford's strongest case of a subfloor pit altar, marked “Feature 44”, included findings of personal items/emplacements
governing strong signs of traditional symbolism, and the trace evidence of the pouring of libations through large grape pollen concentrations, suggesting the presence of wine. Samford considers the pollen findings her most compelling evidence, making note to include sources documenting the creolization and migration of the practice of pouring libations from West Africa to the colonial west. That is, within the context of the large scale deposits also found in the pit: seven fossil scallop shells, three large cow bones, two kaolin tobacco pipe bowls, and a pipe stem. The pipes, association with water, apparent arrangement of the artifacts, and even their color, all correspond to the symbolism found in such rituals, in reference to the spirit world and its inhibitors. As such, all evidence points towards the cache being a garnered altar. Along with the high frequency of grape pollen found in the soil filling the pit, Samford considers Feature 44 her most credentialed of the subfloor pits. The similarities of artifacts and symbolism between Feature 44 and the hearth at the basement of the parsonage evoke irrefutable parallels that make for an exciting foundation of historical evidence of links between them. The in depth comparison of the hearth and Feature 44 can be found in section “Evidence of the Hearth as an Altar”. With many of the ethnohistoric and archeological markers already in place, finding concentrated evidence of grape pollen in the hearth at the basement of the parsonage would further cement the hypothesis of its usage in a spiritual context. What is more encouraging, is that since the hearth is found indoors and only the soil at the base of the hearth will be tested for pollen, only a measure of the Relative Pollen Frequency (RPF) is needed to establish a dominant presence of Vitis/Ceanothus pollen under an optical microscope. If the samples were to be taken from outside, variables such as natural herbology, as well as exact dating of the sediment strata
would have to be considered, and Absolute Pollen Frequency (APF) would have to be measured, requiring much more extensive data.

One of the issues with pollen analysis is distinguishing and characterizing the pollen extracted from the soil as Vitis (grape), since the physical characteristics and morphology of the species is identical to the one of Ceanothus. Samford’s interpretation of the Vitis/Ceanothus type pollen as belonging to grapes relies on geographical and contextual factors, which are not ideal for presenting scientific data. Therefore, an improvement of the analytical method is required to confidently show the presence of wine residues in the hearth at the Parsonage. In a meeting with Cornell professor Bruce Reisch, who offered his expertise on grape cultivation and archeological research, a second approach was devised for identifying wine residues in the soil, following the procedures and techniques described in Patrick McGovern’s research of neolithic wine making in his publication *Early Neolithic Wine of Georgia in the South Caucasus*. Using both pollen analysis as well as conventional spectroscopy methods such as FT-IR and GC/MS, Patrick McGovern and his team tested soil samples from clay vessels for the presence of four acids that together make up the chemical residue of wine, the most important of which is Tartaric acid.

Despite little historical relevance to the Parsonage in Germantown, the methods used in Patrick McGovern’s research can be readily applied to the intended analysis of the hearth sediments from Germantown, in that it provides the necessary improvement on Samford’s methods, which relied heavily on geographical and ethnohistoric context to interpret the grape pollen findings. If found in the hearth sediments, the major presence of grape pollen along with tartaric acid would provide a well established residue signature of wine, on a scale too large and too frequent to be interpreted as accidental spillage from cooking/dining.
Methods

Soil Samples

When looking for evidence of the practice of the pouring of libations, in the form of pollen and tartaric acid, we want to analyze sediment found in and around the area of the Minkisi emplacements themselves. Considering evidence that the hearth was used as an active fireplace (such as tar spills and char), there's a good possibility that most organic evidence within the top level was destroyed, so the samples were taken from deeper parts of the hearth, into which liquid would still seep down.

Control

Ordinary ubiquitous soil - samples taken from outside Vineyard sample - taken at Millbrook Vineyards from under the grape vines Southwest corner of the hearth, 5-6 inches below surface, March 4th 2016

Minkisi

Center right, 7-9 inches below surface, March 29th 2015
North Corner, 7.5-9 inches below surface, April 21st 2019

Diagram map of the hearth and relative locations from which sediment samples were drawn. (Sketch by Dr. Lindner, 2021)
Pollen Analysis

Control Methods

In order to ensure that my methods are indeed effective to the degree of accuracy that would be needed for the soil samples from the parsonage, I had to first perform the procedures on known samples. Through the generous help of Cornell professor Bruce Resich, I was able to obtain known grape pollen samples collected from multiple species. Using these samples I spiked regular soil with a few stamen of pollen and performed the extraction procedure I had adapted from methods such as Erdtman's acetolysis and the analysis procedures used by Scott Cummings and Thomas E. Moutoux, the researchers who analyzed Samford's samples from the plantation quarters. Unfortunately, many pollen isolation methods require the use of Hydrofluoric acid to dissolve silicates in the soil, vastly improving microscope visibility. The hazards of using HF in the lab prevented me from being able to follow any of the procedural steps involving the dangerous acid.

Once I was able to see grape pollen through the microscope in the spiked control samples, I moved on to the second control step: performing the pollen extraction on soil taken from the Millbrook Vineyard grounds, a sample in which I would anticipate finding a major concentration of grape pollen. Finding grape pollen in the vineyard samples will provide a basis for the efficacy of the extraction sample, and will show that a more naturally formed abundance of grape pollen is detectable through my method.
**Acetolysis** (My Variation on the Erdtman method)

A 0.5-1 g sample of soil is oven-dried at 105°C, ground using mortar and pestle and sieved twice, once through 1 mm mesh and then again through 150 μm mesh. The sieved particles then go into a 15% NaOH solution, for removal of humic aggregates. The solution is boiled for 3-5 minutes while being stirred with a magnetic stir bar. The compacted sample is then washed and centrifuged (2,000 RPM for 5 minutes) 3-4 times with water, until the base is removed. The sample is shaken up and transferred to a glass silicate vial, where 10 mL of Erdtman acetolysis mixture (9:1 parts Acetic Anhydride and Sulfuric Acid) is added drop by drop, and a black-brownish color is observed. After a few minutes, the solution is once again washed and centrifuged with water 4-5 times, until the acid is removed. Using a spatula, a scoop of the top layer containing the smallest particles is transferred to another vial, to which 3 mL of 1:1 solution of water and glycerol is added. The vial with the remaining sediment receives 5 mL of the water + glycerol solution, and a few drops of safranin-o stain are added to each vial, to make the pollen instantly visible under the microscope.

The samples are shaken up, and a 0.01 mL drop of each vial is placed on a microscope slide using a micropipette, and a slipcover is placed on top of each drop.
Using a powerful light microscope (up to 100 times magnification) the soil samples were analyzed and any pollen found was characterized using literature diagrams and pollen morphology guides.

**Cummings and Montoux's Reference Procedure**

To remove carbonates present in the soil, 10% HCl is added to the soil sample, and the resulting solution is screened through a 150 micron mesh. To neutralize the sample, water is added to the solution and after letting stand for two hours the supernatant is decanted. A small amount of sodium hexametaphosphate is added, and then water again to neutralize. Let stand for two more hours. The sample is then dried and pulverized, mixed with the flotation solution (water, sodium polytungstate) and centrifuged at 2000 rpm for 5 minutes. The organic supernatant containing the pollen is decanted, while more floatation solution is added to the inorganic fraction and the separation process is repeated. After all the organic solvent is extracted, it is centrifuged at 2000 rpm for 5 minutes, and then decanted into a 50 ml conical tube and diluted with water. This tube goes through the centrifuge at 3000 rpm for 5 minutes and after a rinse, it is acetylated for 3 minutes.
Acid Analysis

Samples prepared for GC/MS are boiled for 30 minutes in 70 mL of 1:1 chloroform/methanol solution, and stirred vigorously for the duration using a magnetic stir bar. The soluble portion is decanted by pipette into a centrifuge tube, and the particles still suspended in solution are compacted via centrifuge (2,000 RPM, 5 minutes). A 1 mL sample of the soluble portion is taken up and filtered using a 0.2 \( \mu \)m mesh syringe filter, then transferred onto a watch glass and evaporated down to form a whitish solid residue. The residue is scratched off and placed in a GC/MS vial, filled halfway with the 1:1 chloroform/methanol solvent. In McGovern's procedure, a one step derivatization agent was used for transesterification of carboxylic acids before inserting the sample into the GC/MS, to yield an ester derivative of Tartaric acid that is much more clearly distinguished on a GC/MS spectrum. However, the agent in question - m-(trifluoromethyl)phenyltrimethylammonium hydroxide is quite hazardous and upon inhalation can be acutely toxic to the point of fatality. As such, the samples were analyzed without the derivatization step, in hope that tartaric acid could still be distinguished if present.
Results and Discussion

GC/MS

Results from the GC/MS, as can be seen below, were not very clean but showed a lack of tartaric acid with quite severe clarity. Despite the absence of the wine marker, this result does not nullify the possibility of the practice of libations, nor does it mean that wine was never used in the parsonage. Having only sampled from three small areas, the coverage of the hearth is far from definitive, so we can't say for sure that there isn't any acid yet to be found. Furthermore, usage of the hearth as a fireplace may have caused the destruction of organic compounds such as tartaric acid. The samples were taken deep enough from within the soil (5-9 inches below surface) to ensure they were not treated to the flames, but the intense heat may have still degraded chemical residues trapped in the dirt.

Sample weights used for organic extraction and GC/MS analysis:

<table>
<thead>
<tr>
<th>Sample Description</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Sample (Southwest corner)</td>
<td>1.006 g</td>
</tr>
<tr>
<td>Minkisi Sample (North Corner)</td>
<td>1.035 g</td>
</tr>
<tr>
<td>Minkisi Sample (Center Front)</td>
<td>1.012 g</td>
</tr>
</tbody>
</table>
GC/MS spectra comparison of solvent alone (1:1 chloroform/methanol) and 5 mM tartaric acid standard dissolved in the same solvent.
Selected-ion chromatogram (150 m/z, approx. molecular weight of tartaric acid) showing the fragments of tartaric acid, as it separates at approx. 9 minutes.
Control Sample taken from the back South corner of the hearth, a location where we would not expect to see tartaric acid. At 9 minutes, there was no constituent with 150 m/z (see selected-ion chromatogram on the next page)
Minkisi sample taken from the North Corner of the hearth, where a grouping of emplacements was uncovered. No tartaric acid here either, although it’s not as clear. At approx. 4 minutes, a constituent of 149 m/z is separated, but does not exhibit the fragmentation that appeared on the 5 mM tartaric acid standard. (See selected-ion chromatogram on the next page)
Minkisi sample taken from the Center Front of the hearth, where another grouping of emplacements was uncovered. Again, no sign of tartaric acid. The same constituent of 149 m/z is separated at around 4 minutes, but its appearance in the spectra of the solvent alone determines it is not a chemical presence indication, but a part of the solvent data. (See selected-ion chromatogram on the next page)
MS Data Review All Plots - 5/4/2021 9:59 PM

File: c:\varian\data\lin\minkisi sample nos.sms
Sample: Minkisi Snake NoS
Scan Range: 1 - 2270 Time Range: 0.00 - 35.98 min.

Operator: LR
Date: 5/4/2021 1:19 AM

Spectrum 1A
Sample: Minkisi sample nos.sms
4.357 min, Scan: 266, 60, 350, Ion: 9042 us, RIC: 33192, BC

Counts
Counts

100% 75% 50% 25% 0%
149.1 109.55 179.0 8563
119.0 150.0 150.0 1923
169.0 1492 133.0 1923
702 702 702 702

Minutes
Minutes

Print Date: 04 May 2021 21:59:25
**Microscopy**

A pollen cluster found in the vineyard samples appeared to be quite large in size (approx. 60 μm long) when compared to literature values of average grape pollen size (approximately 36 μm from pole to pole, 35 μm across). However, being the only pollen found in the sample, which was taken from right under a grape vine, it is unlikely to be of a different plant. Confidence in the vineyard pollen originating in grape flowers stems from the correct morphological features of the pollen; In addition, research of grape pollen micromorphology showed the possibility of variance in pollen size measurements in samples from different cultivars of *Vitis Vinifera* grape species.

(Zeliha Gökbayrak and Hakan Engin, 2016)

<table>
<thead>
<tr>
<th>Vineyard Sample 1</th>
<th>1.004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vineyard Sample 2</td>
<td>1.057</td>
</tr>
</tbody>
</table>
Sample weights used for pollen extraction and microscope analysis:

<table>
<thead>
<tr>
<th>Sample Description</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Sample (Southwest corner)</td>
<td>0.503</td>
</tr>
<tr>
<td>Minkisi Sample (North Corner)</td>
<td>0.520</td>
</tr>
<tr>
<td>Minkisi Sample (Center Front)</td>
<td>0.562</td>
</tr>
</tbody>
</table>

No pollen was identified in the control sample taken from the Southwest corner of the hearth, despite detailed scan of the entire slipcover surface area.

The sample taken from the Center Front area of the hearth contained a total of 7 grains, 5 of which were too small to be pollen (<15 μm), and therefore had to be fungi spores. The other two were difficult to identify, because of their asymmetric shape and non conclusive morphology. However, one of the grains (below on the right) was close in morphology to that of grape pollen, in addition to fitting the correct expected size range.

50 x 36 μm  36 x 40 μm
The sample taken from the North corner of the hearth showed the most promising result yet. It contained only two grains in total, both within the size range of grape pollen. Both exhibited the three signature longitudinal culpi furrows that grape pollen carries. Grain 1 (measured 27 x 26 μm), seen below, featured fusion of the furrows at the poles, which, along with its size measurement would make it of the genus *ellicium*, which includes Anise and Florida Anise plants.

20x magnification

50x magnification
Grain 2 exhibited all the features belonging to grape pollen - down to the exact literature sizes of wild grape pollen grains. Measured at 36 x 35 μm, marked by three longitudinal culpi furrows, this grain (seen on the next page) most likely belongs to the *vitis* genus.

20 x magnification

50 x magnification
Discussion

As of right now the results are quite inconclusive - tartaric acid was not observed in any of the samples, while pollen grains were scarce and hard to identify.

However, I believe there is lots to improve in my methods, which were limited due to the very dangerous substances that they required. Hydrofluoric acid could have improved microscopic visibility by dissolving silicate particles obscuring the glass, while the trans-esterification derivatization agents could have been used to more clearly distinguish constituents in the GC/MS. The pollen extraction method proved to be effective when large quantities of pollen were present - such as in soil taken from the vineyard lot. Pollen grains were detected in the samples taken from the hearth itself, but were difficult to characterize. However, even without definite characterization, there are some conclusions to be made:

1. Unless the pollen had arrived into the soil before it was used for construction of the hearth in the Parsonage, which is quite unlikely, the pollen had arrived into the hearth through human activity - whether it was through cooking, eating, curing, or part of a ritual practice.

2. The possibility of contamination had arisen, since lab procedures were performed during springtime, and naturally spread pollen could permeate into the sample by sticking to our clothes, skin and hair. But since the procedures were performed simultaneously (with vigilant cleaning and labeled separation of tools, vessels and work area in between samples), an outside contamination event would likely affect all three samples, and consign the same pollen types into each sample. Such a commonality was not observed; the control sample, taken from the back of the hearth did not contain a
single grain, while the samples taken from more accessible and heavily used ends of the hearth both contained a variety of grains from different species.

3. Unidentified Fungi spores found in the sample collected from the Center Front of the hearth most likely indicate the presence of edible mushrooms used for cooking. Being the most exposed and easily accessible section of the hearth, it is reasonable to surmise the spores would settle in the general area in which the fungi would have been cut, prepared, or cooked.

4. Due to the modest pool of data, we cannot establish a pollen frequency count for any of the areas from which the samples were collected. However, if future extractions yield similar results, the presence of grape pollen and anise pollen tentatively identified in the North Corner sample could have large interpretive implications on Dr. Lindner’s current available data on the lives of the residents of the Parsonage. An established presence of grape pollen, even without evidence of tartaric acid, would still correlate to a stronger possibility of the use of the hearth for ritualistic practice, as it does in other academic publications such as Samford’s. The possibility of grape pollen arriving through the flowers or fruit of the plant could lend itself to an interpretation of a ritual offering distinct from libations - regarding the use and symbolic value of the plant itself in the spiritual lives and practices of African American Germantown residents.
Special thanks to Chris Lindner, Chris LaFratta, Bruce Reisch, Lavada Nahon, John Graziano, Emily McLaughlin, Simeen Sattar, Maureen O’Callaghan-School, my parents, my brothers, Isaiah Brackman, Cheyenne Cutter, and Ethan Dickerman.

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