View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by TopSCHOLAR

Western Kentucky University
TopSCHOLAR®

Mammoth Cave Research Symposia | 10th Research Symposium 2013

Feb 14th, 8:30 AM

The History and Conservation of Saltpeter Works in Mammoth Cave, Kentucky

George M. Crothers
University of Kentucky

Christina A. Pappas
University of Kentucky

Christian D. Mittendorf
University of Kentucky

Follow this and additional works at: http://digitalcommons.wku.edu/mc_reserch_symp


Part of the Animal Sciences Commons, Forest Sciences Commons, Geology Commons, Hydrology Commons, Other Earth Sciences Commons, and the Plant Sciences Commons

Recommended Citation

George M. Crothers, Christina A. Pappas, and Christian D. Mittendorf, "The History and Conservation of Saltpeter Works in Mammoth Cave, Kentucky" (February 14, 2013). *Mammoth Cave Research Symposia.* Paper 2.
http://digitalcommons.wku.edu/mc_reserch_symp/10th_Research_Symposium_2013/Day_one/2

This is brought to you for free and open access by TopSCHOLAR®. It has been accepted for inclusion in Mammoth Cave Research Symposia by an authorized administrator of TopSCHOLAR®. For more information, please contact todd.seguin@wku.edu.

The History and Conservation of Saltpeter Works in Mammoth Cave, Kentucky

George M. Crothers[1], Christina A. Pappas[1], Christian D. Mittendorf[1]

[1] William S. Webb Museum of Anthropology, University of Kentucky

Abstract

Remains of the saltpeter mining operation in Mammoth Cave are a significant feature of several cave tours and figure prominently in the history of cave use. We undertook a comprehensive review of existing historical descriptions and recent archaeological investigations to construct the most reasonable account of how the saltpeter operation worked and assess its current conditions. At least three types of saltpeter vats were constructed in the cave reflecting an increase in the size of the operation and efficiency of processing sediments over time. Remains of three pump towers are also found in the cave in various states of preservation. The water pipe system was mostly dismantled, but archaeological evidence indicates its most probable route through the cave. We recommend more thorough documentation of existing remains, conservation efforts to preserve existing remains, better interpretative signage, and possibly repair or replication of damaged or missing components to further enhance public interpretation.

Introduction

The niter mining and saltpeter conversion process at Mammoth Cave was a sophisticated industrial engineering operation in its day during the War of 1812. While portions of the mining works are preserved in the cave's stable environment, significant portions have been dismantled, buried, or destroyed and on-going processes threaten to eventually destroy the remaining wooden works. On a visit to Mammoth Cave in the mid-1830s, Robert Bird (1837, 1838) describes his guide building a fire in the Rotunda using the wooden saltpeter remains to light the cave:

> *". . . he falls to work on certain old wooden ruins, to you yet invisible, and builds a brace or two of fires; by the aid of which you begin to have a better conception of the scene around you. You are in the Vestibule, or ante-chamber, . . ." (Bird 1838: 86).*

As much as we might cringe at this thought today, in 1837, with the War of 1812 only 22 years in the past, historical preservation was not a concern. Through the years, as Mammoth Cave has been developed to accommodate increasing numbers of visitors, preservation of the saltpeter works has been only an occasional concern. Even as late as the 1990s, it was reported that a collection of wooden pipes and other wooden debris was collected in the Rotunda in preparation to be carried from the cave for disposal as part of a cave clean-up project. Fortunately, this was discovered in time and halted. Less conspicuous, but still a serious threat, is the slow but steady disintegration of wooden remains by fungal action, condensation, and other natural cave processes, such as roof fall that significantly damaged saltpeter remains in the Rotunda in the early 1990s.

The University of Kentucky Museum of Anthropology with technical assistance from Pennsylvania State University and Texas A&M University's Conservation Research Laboratory has been engaged in a comprehensive survey of past research and recommendations for future conservation work of the saltpeter remains at Mammoth

Cave. In this report, we provide a summary and timeline of the development of the saltpeter mining operation in the early nineteenth century. We conclude with a discussion of future work to provide additional documentation of the remains and improve interpretive materials for the National Park Service.

While there is no single source that describes the engineering aspects of the saltpeter operation in its entirety, there are a number of general descriptions of the works at the time it was in operation and descriptions of the remains by various visitors to the cave after the operation ceased. We have compiled a reference list of more than 200 sources (written descriptions, photographs or drawings, and maps) that refer to the Mammoth Cave saltpeter operation, technical discussions of saltpeter manufacturing that would apply to Mammoth Cave in the early 1800s, or results of research on the operation. Among the early descriptions of the cave, one of the best sources is an account written by Robert Bird (already quoted above), published originally in the *American Monthly Magazine* in 1837 and reprinted in 1838. The so-called Eye-Draught Map of Mammoth Cave of 1811 drawn by Frederick Ridgely (see George 2001) and the 1835 Lee Map are also extremely useful for information on the saltpeter works. Numerous other published letters and descriptions refer to the saltpeter works and some contain unique information; however, these tend to be redundant, often based on previously published descriptions.

Interest in the saltpeter works as a historical resource began in the 1940s. Thor Borresen (1941), an Assistant Historical Technician with the NPS, produced a report on the remains in 1941 that made several recommendations for preservation of the remaining works. He also made the first detailed technical drawings of the extant remains. (His original drawings were later redrawn and adapted as part of a Historic American Engineering Record project [Mullin 1986].) The classic study of saltpeter mining in Mammoth Cave is by Burton Faust (1967), originally published in the *Filson Club History Quarterly* and later reprinted. In the 1970s and early 1980s, Duane De Paepe re-examined the saltpeter remains and did extensive historical research on the operations. This work culminated in a well illustrated book for the general public (De Paepe 1985). More recently, Angelo George has published several well researched books and articles on various aspects of saltpeter mining at Mammoth Cave and elsewhere (e.g., George 2001, 2005). Beginning in the mid-1990s, various archaeological projects related to the Historic Entrance Ecotone Restoration Project, new lighting and walkway construction projects, and the NPS-Earthwatch cultural resources inventory have documented other aspects of the mining works through excavation and survey (e.g., Crothers 1996; Mickelson 2008). Examination of all of these resources – early descriptions, historical research, and archaeological work – has allowed us to construct a fairly detailed outline of the saltpeter operation and subsequent development impacts.

Niter Production at Mammoth Cave

At the peak of production, sometime between 1810 and 1814, the Mammoth Cave operation was extensive. In the cave, it consisted of three hand pump towers, at least 3400 feet of wooden pipeline for bringing water into the cave and nitrate in solution out of the cave, ten leaching vats to extract nitrate from the cave sediments, an 1800 foot long hard-packed ox-cart trail to move large loads of sediment in the cave, up to two miles of mined cave passageway, and a work force of up to 70 men, mostly composed of slave labor. Immediately outside of the entrance, additional processing of the calcium nitrate solution was done to convert it to potassium nitrate, purify, and evaporate the water in a

large boiling furnace to produce saltpeter crystals. In addition, on the ridge above the cave entrance there were living quarters for the laborers and managers. The operation had to be supplied by a steady stream of firewood and potash from the surrounding area. Lastly, the final product was packaged and shipped, primarily by overland routes, to eastern gunpowder mills. Although the wooden remains – hoppers, pipes, and pump towers – are the most conspicuous elements of the operation, remains of or archaeological evidence of nearly all of the components of the operation may still be found in the cave. We discuss the elements of the mining operation in the following order: sediment extraction, leaching vats, ox-cart trail, pumps and pipeline, and boiling furnace.

Sediment Extraction

The best sources in the cave for nitrates are clay deposits where water no longer drips or percolates. Sandy sediments, which can be found underlying the clay for an undetermined depth, were not found to be nitrate rich (notes on the Eye-Draught map). The clay, which could be found in the upper few feet of sediment strata, was distributed throughout the cave but often lay beneath cave breakdown. This required removal of large amounts of breakdown and in several places stacked rock walls can be found that were removed to get at the underlying clay. This handy work is well preserved in Cyclops Gateway and Gothic Ave. or Haunted Chambers. An extremely good example of a mining pit can be seen opposite of the Church just behind the in situ water pipes and stone piers.

Leaching Vats

Leaching or lixiviation of the cave sediment was done in wooden vats. Large square vats are generally considered characteristic of large scale operations and V-vats of smaller operations. Square vats were constructed in two areas of Mammoth Cave: the Rotunda or Big Room and at Booth's Amphitheater or the Grand Gallery. These vats are in various states of disrepair, some still containing their last load of sediment. They represent the end stage of the mining operation in 1814 or 1815. It is not clear when saltpeter mining began at Mammoth Cave, but it may have been as early as the late 1790s. However, this would have been a much smaller operation. It appears that the first vats were constructed at the entrance of Mammoth Cave and sediment was hauled from inside the cave to be processed near the spring. The Eye-Draught map of 1811 appears to show leaching vats in the entrance, but no vats in the Big Room or the Grand Gallery. Perhaps the Eye-Draught map was drawn earlier and later sent to various parties. At least two versions of the map survive with different handwritten notes (George 2001:14-15). These early vats in the entrance may have been V-vats. A drawing of the entrance on the Lee map appears to show the bottom member of a V-vat remnant. Portions of wood debris now stashed in the Rotunda appear to be parts of V-vats, perhaps salvaged and later carried into the cave.

It is not clear when the first square vats were constructed in the cave, but it would seem to be sometime after 1810. An extract of an undated letter by John Farnham (1820), describes square vats in the cave for leaching nitrate that was then conveyed by pipes "as near as possible to the entrance of the Cave, whence it is taken by buckets to some convenient place above ground, and put into boilers, . . ." (Farnham 1820: 357). Presumably this refers to the Rotunda or first hoppers. It is interesting that no pump tower appears to be at the entrance at this time. Farnham (1820: 358) later describes ascending a "plank bridge" into the haunted chambers, but mentions no vats or pipes at this location. Farnham would appear to have visited the cave sometime between 1810 and 1812 when the first hoppers and pipeline were built in the

Rotunda, but before the second hoppers or the entrance pump tower were constructed.

Ox-Cart Trail

The ox-cart trail may have been the first major modification to the cave for the purpose of mining. Eventually, the trail extended all the way from the entrance to just beyond the second hoppers. Here the oxen were tethered and fed. It is not clear how much farther the trail went into the cave because the modern tourist trail is built on top of any previous ox-cart trail. The first portion of the trail, however, was built through the Narrows. The passage was originally a low stoop way strewn with breakdown (Crothers 1996). A narrow path was made through the breakdown by stacking rock to the sides until a layer of thickly bedded sand was encountered and it was wide enough to admit an ox-cart. It is possible that the ox-cart trail was first constructed through the Narrows to bring sediment out of the cave for processing at the entrance, and only later a pipeline added when leaching was moved into the Rotunda. Excavations in the Narrows indicated two layers of trail construction: an older trail-bed under laying the wood pipe line and upper trail-bed incorporating the pipeline (Crothers 1996:4). Eventually, the ox-cart trail was extended through Main Cave, mainly hugging the left wall of the cave going in. The trail is still well preserved through this section of the cave until it merges with the modern trail at Kentucky Cliffs; however, rock has been placed on the trail to hide its presence.

Pumps and Pipeline

The pump and pipe system was an engineering feat. One set of tulip poplar pipes transported fresh water from the entrance spring to the first and second hoppers for leaching. A second set of pipes with the help of pumping stations carried the dissolved nitrate solution back to the entrance by a gravity feed. The towers in Booth's Amphitheater and the Rotunda raised the solution by a suction/lift pump to a height that would allow it to flow by gravity to a reservoir at the next pump station (Mickelson 2008). At the entrance, a third pump tower lifted the solution over the lip and by pipe to the boiling furnace. The pump tower at the second hoppers is the most complete, but it has been dismantled and incorporated into an old hand railing (no longer used). The pump tower at the first hoppers is mostly destroyed, but three of the legs are still partially intact in their original footing and the main body of the pump, recently damaged by rock fall, has survived. The tower at the entrance is now gone, but two long hand hewn square timbers in the Rotunda appear to be tower supports, possibly from the entrance pump frame (De Paepe 1975: 68). The drawing on the Lee map (1835) shows cross-member supports for this framing system still in place across the entrance.

Three portions of the pipeline remain intact, and dismantled pipes are strewn through the cave. The first and longest intact section is a dual pipeline through the Narrows, which commences just inside the entrance, hugs the right wall, where it is now protected behind a hand railing and is incorporated into the old ox-cart trail, but eventually merges with and lies under the modern trail into the Rotunda. The second intact section is a short section of dual pipes built on piers at the edge of the Church. This section of pipe is severely compromised by fungal growth from the old lighting system and is in need of immediate conservation. The third intact section of pipe is a single water pipe on a stone pier that is buried in the modern trail below Kentucky Cliffs. Discovered during an archaeological testing project for the boardwalk construction, it was apparently intentionally buried when the CCC trail was built in the 1930s (Crothers 1996). Bases of two stone piers along the ox-cart

trail between the first and second hoppers suggests that the demolished section of pipeline followed the oxcart trail and was dismantled when the trail was covered with rock by CCC workers in the 1930s (De Paepe 1975: 68).

Boiling Furnace

Very little is known about the construction of the boiling furnace, although the furnace chimneys stood for many years and piles of ash were noted by early visitors. An undated map of the furnace foundation in possession of the Park Service shows its location relative to the entrance, but no systematic attempt has been made to document the foundation more thoroughly. The modern road has probably compromised part of this feature, but additional archaeological work will be necessary to assess its integrity.

Future Work and Conservation Efforts

A comprehensive list of recommendations for additional documentation, both archival and by archaeological means, is being prepared for the NPS. This will include additional documentation of the remains found in the cave that will allow a virtual reconstruction of the operation at its peak phase of production. This will build on the earlier work by Borresen (1941) and the HAER project (Mullin 1986). Those portions of the remains that were dismantled and repurposed in the cave as hand rails, trail borders, and other uses should be removed, conserved if necessary, and placed in a location safe from the reach of tour groups. The rock which was placed on the ox-cart trail should be removed and this feature interpreted as a historical feature of the cave. We do not recommend reconstructing portions of the works in the cave that have deteriorated or been demolished, but replicas showing early nineteenth century craftsmanship and engineering of the vats, pipes, or pumps could be erected at the visitor center as interpretive displays. Some remains will be recommended for removal and conservation in laboratory conditions and then returned to the cave. This could include the lone remaining pump body and other unique pieces of the works. Environmentally friendly conservation treatment will be recommended for in situ remains to kill fungal growth, but the advance stage of dry rot on many pieces may be beyond salvage at this point. That is why thorough documentation of the remaining pieces is necessary now before even more information is lost.

References Cited

Bird, R. M. 1837 The Mammoth Cave of Kentucky. American Monthly Magazine 9:417-438; 525-546.

Bird, R. M. 1838 Peter Pilgrim: or A Rambler's Recollections 2. 2 vols. Lea & Blanchard, Philadelphia.

Borresen, T. 1941 Report on the Remains of the Old Saltpeter Works, Within Mammoth Cave, Kentucky. Submitted to Mammoth Cave National Park; National Park Service, Southeast Regional Office.

Crothers, G. 1996 Archaeological Testing of Houchins' Narrows, Rotunda, Broadway, and Audubon Ave. in Mammoth Cave, Kentucky. Draft Report submitted to Mammoth Cave National Park. Department of Anthropology, Washington University, St. Louis.

De Paepe, D. 1975 Economic Geography of the Mammoth Cave Regional Saltpetre Industry. In Cave Reserch Foundation 1975 Annual Report, pp. 67-69. Cave Research Foundation, Yellow Springs, Ohio.

De Paepe, D. 1985 Gunpowder from Mammoth Cave: The Saga of Saltpetre Mining Before and During the War of 1812. Paragon for Cave Pearl Press, Hays, Kan.

Farnham, J. H. 1820 Extract of a Letter Describing the Mammoth Cave in Kentucky. Transactions and Collections of

the American Antiquarian Society 1:355-361.

Faust, B. 1967 The History of Saltpetre Mining in Mammoth Cave, KY. Reprinted ed. Filson Club, Louisville.

George, A. I. 2001 The Saltpeter Empires of Great Saltpetre Cave and Mammoth Cave. H.M.I. Press, Louisville, KY.

George, A. I. 2005 Mammoth Cave Saltpeter Works. H.M.I. Press, Louisville, KY.

Lee, E. F. 1835 Map of the Mammoth Cave, accompanied with notes. Doolittle & Munson, Cincinnati.

Mickelson, A. M. 2008 Mammoth Cave's Nineteenth-Century Saltpeter Works: Analysis of the Hydraulic System. In Cave Archaeology of the Eastern Woodlands, edited by D. Dye. University of Tennessee Press.

Mullin, M. A. 1986 Mammoth Cave Saltpeter Works. United States Department of the Interior, National Park Service.