THE LAST WORD SOCIETY

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Surface Analysis of a Musket Shot Dated Between 1645 and 1655 Found in Historic St. Mary's City, Maryland

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ABSTRACT: A number of large lead musket shot have been found in the Pope's fort site at historic St. Mary's City in Maryland. These collected shot have been dated to the period from 1645 to 1655 by Dr. Henry Miller. One of these musket shot has an interesting flattened configuration and appears as if it hit a very solid object. The impact surface has been examined with scanning electron microscopy (SEM) and energy-dispersive spectrophotometry (EDS). The results of these examinations have been compared with examinations of bone and an oyster shell of the same age found at the site. The findings are consistent with the impact site containing sand and probably also bone.

KEYWORDS: forensic science, Last Word Society, archeology, historical background, muskets, scanning electron microscopy, energy dispersive X-ray spectrophotometry, Maryland, colonial St. Mary's City

Historical Background—"The Scene"

The first European colonists arrived at the site of St. Mary's City in 1634 [*1*]. Unfortunately, they did not escape the conflicts in Europe. The mid-seventeenth century was the time of the English civil war, with battles between Parliament and the Crown. Very little written evidence of the involvement of the Americas in the British civil war has

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been found. St. Mary's City, located near Chesapeake Bay on the St. Mary's River at the north side of the Potomac outlet, contains some of the only physical evidence. The only other European city present in the region at this time was Jamestown. St. Mary's served as the center of Maryland government until 1695, when Annapolis was made the capital. The area of St. Mary's City of interest in this study is a fort that surrounded the house of the first governor of Maryland, Leonard Calvert.

The first evidence that the remnants of a fort surrounded the Calvert house was unearthed when a septic tank of a nearby house failed and required excavation. During the process of digging around the tank, what was first thought to be a colonial garbage pit was discovered. Extensive archeological excavations and test holes were performed and a fort was identified [*1*]. Based on these excavations, the fort had an appearance, as is shown in Fig. 1.

The written history behind the fort is quite scant. In 1645, a Captain Richard Ingle, commander of the *Reformation*, a private man-of-war licensed by Parliament, sailed into St. Mary's City and seized the city in a brief raid. No attack was expected, and Governor Calvert was unable to raise troops from the scattered plantations along the St. Mary's River. Ingle and his well-armed troops proceeded to loot and plunder the area, especially the homes of Maryland's Catholic leaders. Ingle then returned to England, leaving several Protestants loyal to Parliament in charge.

One of these individuals was Nathaniel Pope, a successful planter and merchant. He is also the first American ancestor of George Washington. Pope occupied Governor Calvert's house and plantation and apparently fortified the house. There are a few direct references to a fort, but no details as to its nature or size. The discovery of the actual remains of the fort was unexpected. Shown in Fig. 2, the fort wall consisted of a moat, a wooden palisade, a protective embankment, and a firing step. This was reconstructed using information obtained by a layer-by-layer archeological excavation of the complex layered sandy soil that filled the moat. The fort fill was much like a time capsule of early colonial times. In this fill were ancient oyster shells, animal bones, fragments of 17th century pottery, religious medals, terracotta pipes, and other interesting artifacts. The most interesting artifact from a forensic science point of view is a deformed, apparently

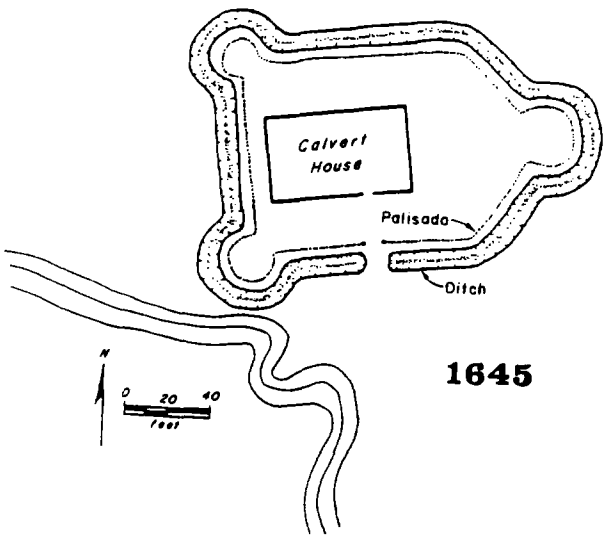

FIG. 1—*Plan of fort.*

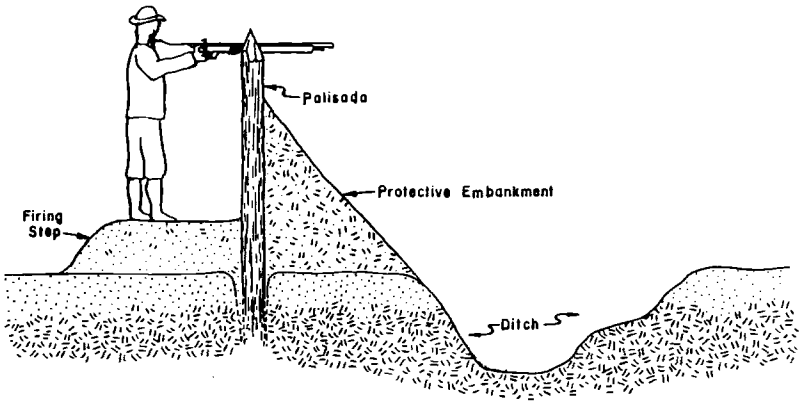

FIG. 2—*Fort wall.*

fired, musket shot (Fig. 3*a*). It has a convex surface (Fig. 3*b*) that contains little imbedded material and a flattened surface (Fig. 3*c*) that contains imbedded material. Scanning electron microscopy (SEM) with energy-dispersive X-ray spectrophotometry (EDS) was used to examine the impact surface in order to deduce an impact site. SEM has been used in the evaluation of more recent bullets [*2,3*]; combined with EDS, SEM has been used in the analysis of art objects [*4*]. Archeologists hypothesize that the deformed shot may have struck the protective embankment of the fort.

Experimental Procedure

Instrumentation

EDS, also known as electron-probe X-ray analysis, is based on the property of elements to emit X-rays of characteristic energy patterns when struck by high-energy electrons. It is well combined with SEM because the high-energy electrons can be used both to image and analyze the surface. The SEM used in this study was a Hitachi™ S570. A GW™ solid state back-scatter detector was used to help locate different elements and a Kevex Quantum™ detector was used to obtain the EDS spectrums.

Sample Preparations

For SEM and EDS to function properly, the specimen must conduct an electrical current. The musket shot had previously been processed in the archeology lab. This involved brushing to remove surface debris, conservation with a solvent to remove corrosion, and coating with micro-crystalline wax to protect the surface. The wax was removed with an organic solvent. The shot itself was conductive and did not require coating with a conductive material. The bone and shell required coating with gold and palladium for SEM and carbon coating for EDS. Coating was accomplished using a plasma etch coater.

Control

As a control, an unfired, undamaged shot from the same time period was first examined. In spite of poor purification procedures 350 years ago, no particulate matter was identified in the surface either by close examination or SEM (Fig. 4). The surface appeared microscopically deformed, possibly due to the archeologic preservation method of brushing

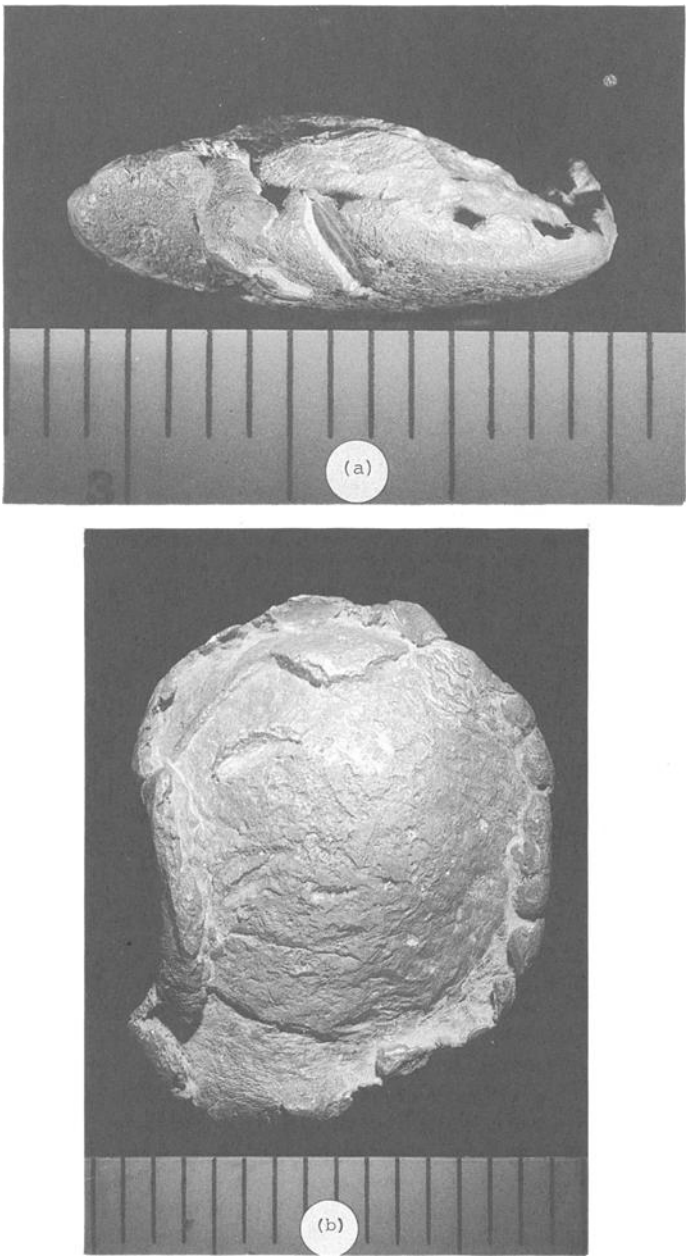

FIG. 3—*Deformed musket shot recovered from St. Mary's City (scale in inches):* (a) *edge view,* (b) *convex surface,* (c) *flat surface.*

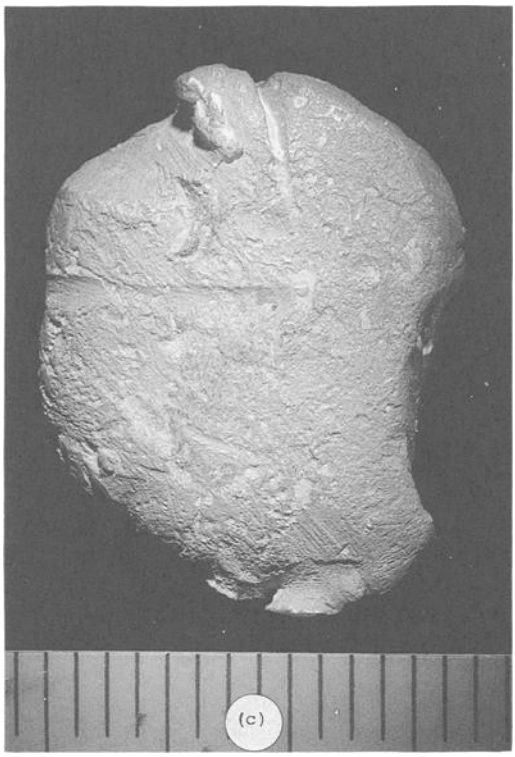

FIG. 3—*Continued.*

the shot to remove any loosely adherent soil and corrosion. When EDS analysis of this control was performed, only lead and a very small amount of silicon were identified.

Results

When the convex surface of the deformed shot was examined, no significant particulate matter was identified and the spectrum was quite similar to that of the unfired shot. SEM showed that there were two types of imbedded material in the flattened surface, crystals and partly dissolved material (Fig. 5). The routine conservation methods did not remove these materials; therefore, they were deeply imbedded in the surface. Also present were small amounts of adherent material that were not identified and most likely represented residual adherent conservation wax. The crystalline material had a spectrum of silicon and oxygen consistent with quartz sand (silicon dioxide) (Fig. 6). The detector was less sensitive in the area of the oxygen peak; therefore, it artifactually appears to be less. This would be expected if the shot hit a firm, flat-packed sand soil surface or a surface covered with sand. In the irregular, partly dissolved areas found on the impact surface of the shot, lead, calcium, phosphorus, and lesser quantities of silicon, oxygen, and aluminum were identified (Fig. 7).

A fragment of animal bone, likely deer, from the fill that was of the same age as the shot was examined to determine the spectrum that animal bone that had been exposed to the same environmental conditions over the last 350 years would show. EDS identified a very similar pattern (Fig. 8). The silicon, oxygen, aluminum found in both the bone

FIG. 4—*Surface of non-deformed shot (original magnification, ×30).*

and the material on the shot is likely consistent with mineral replacement. This similarity between the partially dissolved imbedded material in the impact surface of the shot and this bone appear to indicate that the shot impacted bone. To rule out the oyster shells that were mixed in the original fill deposit as the origin of the material, one of the shells was analyzed; a pattern similar to that seen in bone, but with much less phosphorus, was found (Fig. 9). Iron was present in small quantities in the bone and oyster shell and may have originated in the soil, which has a high iron content. This has yet to be investigated.

Conclusion

A reliable conclusion is that the deformed shot was fired and struck packed sandy soil. The shot most likely hit a fragment of bone that was thrown away earlier and was present in the soil that made up part of the fort wall. This is what might be expected if shots were fired at the fort during its recapture by Leonard Calvert in 1647. There is the additional possibility that it hit another sandy surface containing bone.

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FIG. 5—*Representative area of flattened surface of deformed shot (original magnification, ×25):* (1) *crystalline material,* (2) *partly dissolved material, and* (3) *adherent material.*

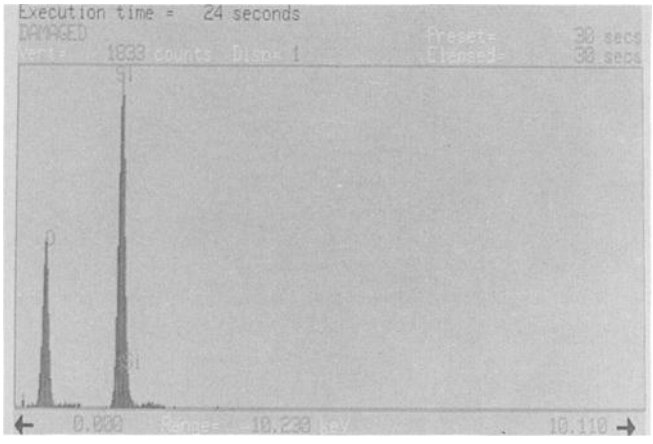

FIG. 6—*EDS of crystalline material.*

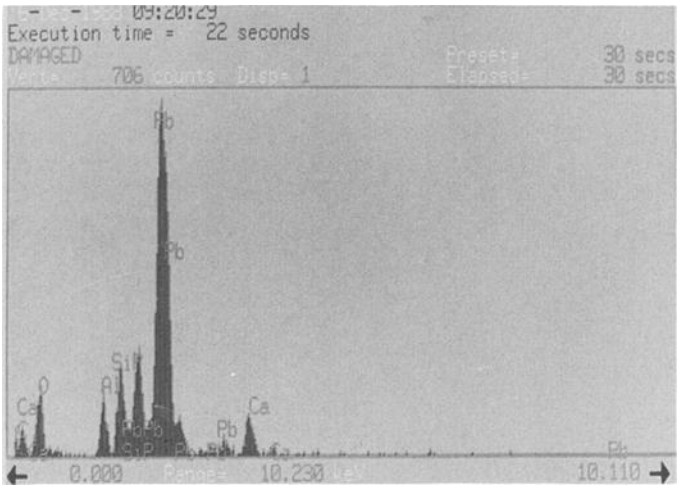

FIG. 7—*EDS of partly dissolved material.*

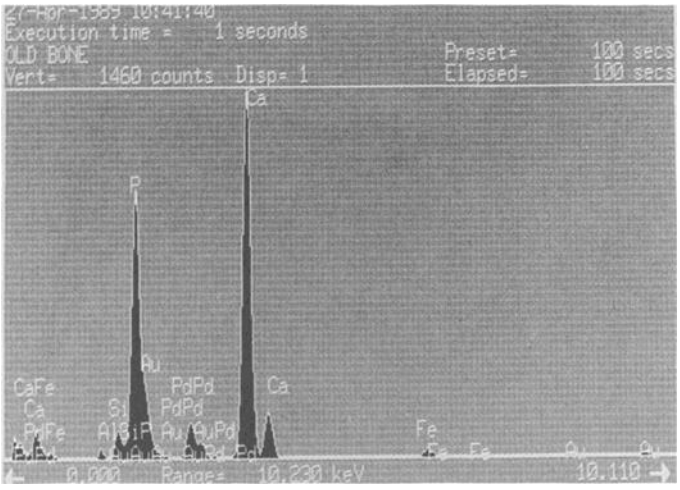

FIG. 8—*EDS of animal bone from site. (Note gold and paladium—this scan was obtained after coating for SEM.)*

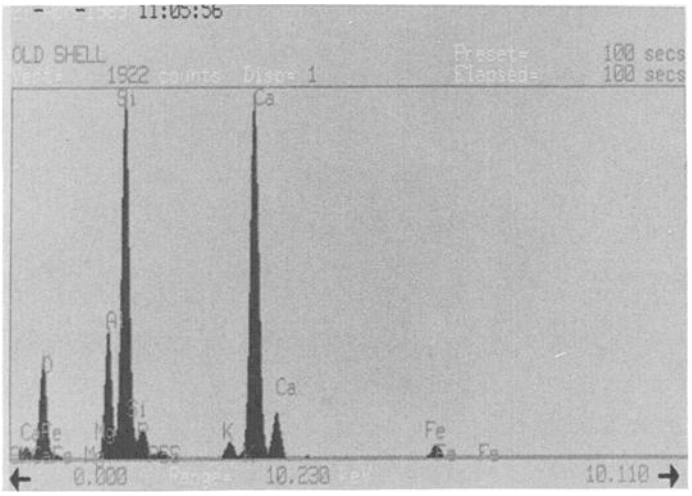

FIG. 9—*EDS of shell from site.*

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