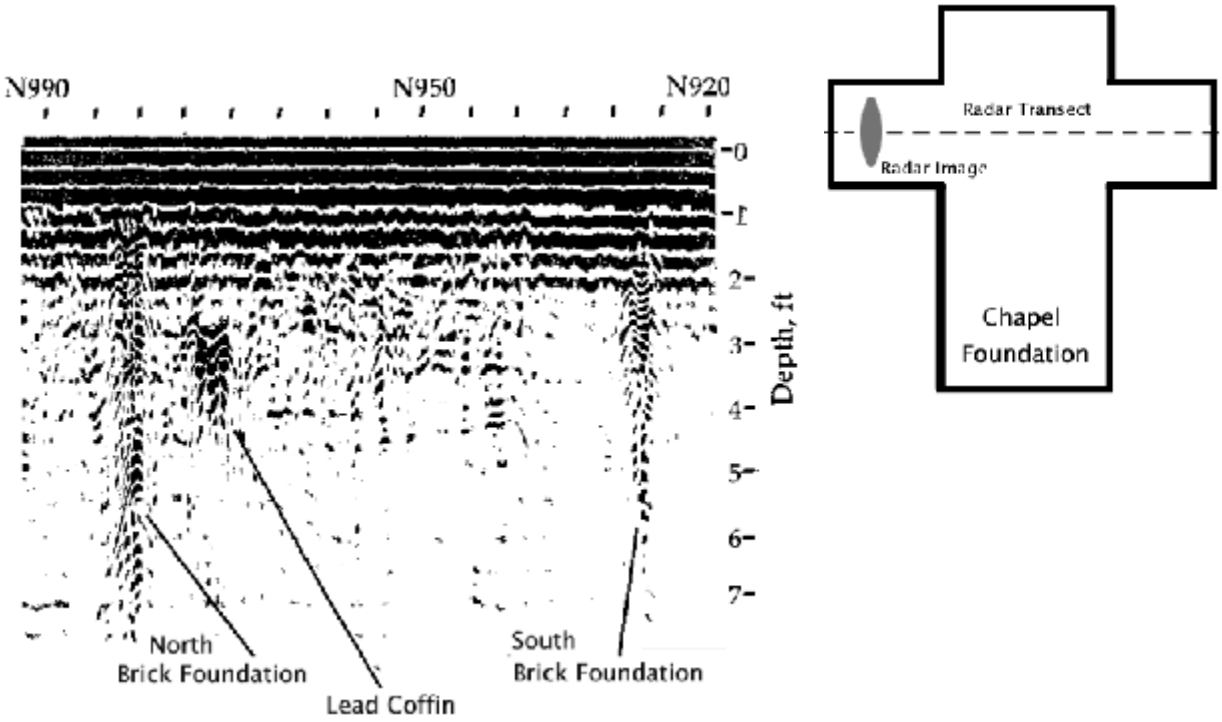
Project Lead Coffins

The Search for Maryland's Founders

An interdisciplinary inquiry

The Discovery

Early in the project, we used Ground Penetrating Radar (GPR) to investigate the site of the cross-shaped Brick Chapel built in the mid-1660s. Undertaken by Bruce Bevan, the GPR indicated a large, dense "target" in the north arm of the brick chapel. By 1990, excavation had proceeded to the point that we had the entire foundation of the brick church exposed. In the north arm, or transept of the cross we observed a soil disturbance which coincided with the location of the dense radar "target."



Excavation in the early winter of that year discovered three lead coffins in the north arm of the church. These were the first to be investigated by professional archaeologists in the New World. Rather than rush into investigating the coffins, it was decided to rebury them where they were until we could plan the best, most comprehensive investigation possible.

The Team

Given the unique nature of the discovery, we needed to involve a number of experts with special knowledge to plan the best way of approaching this rare find Experts in atmospheric science, nuclear physics, geology, pollen analysis, archaeological conservation, non-destructive analysis, history, and forensic anthropology were invited to participate in the planning. In a series of meetings, research goals and a protocol for the investigation were established. Three major research questions were defined:

1. Identification of the occupants of each of the coffins
2. Investigations into 17th-century health issues and mortuary practice.
3. Study of the 17th-century environment and how it has changed.

Knowing the identities of the coffin occupants was the basic historic question that needed to be addressed. The potential for very well-preserved human remains in the lead coffins could allow medical science to begin investigating what it was like to live and die in early colonial Maryland. We knew that the death rate among early settlers was extremely high, but we did not know exactly what was killing them. Finally, if the coffins were air-tight, an unparalleled opportunity to extract a sample of antique air was present.

The oldest sample of atmospheric air which has been studied dates only to the mid-20th century. Only by knowing what gasses were present in the past can we begin to understand how modern pollution is affecting the air we breathe and the ozone layer which protects us from the sun's radiation. As sealed time-capsules, the coffins could provide a host of other environmental data in the form of pollen which would allow us to better recreate the environment as it was being changed by the colonists. Additionally, since different plants produce pollen at different times of the year, pollen analysis could help provide crucial data as to the time of death.

The next nearly two years were spent in designing and testing devices to make the investigations possible and arranging resources and donations to do the job right.

Logistics

To approach the major research questions we had outlined, numerous logistical concerns had to be addressed. How to provide a secure environment to excavate and analyze was a principal issue. This concern was addressed by the U.S. Army Reserve who took on the Project Lead Coffins as a training mission. The military provided security and a specialized hospital tent complete with an X-Ray lab.

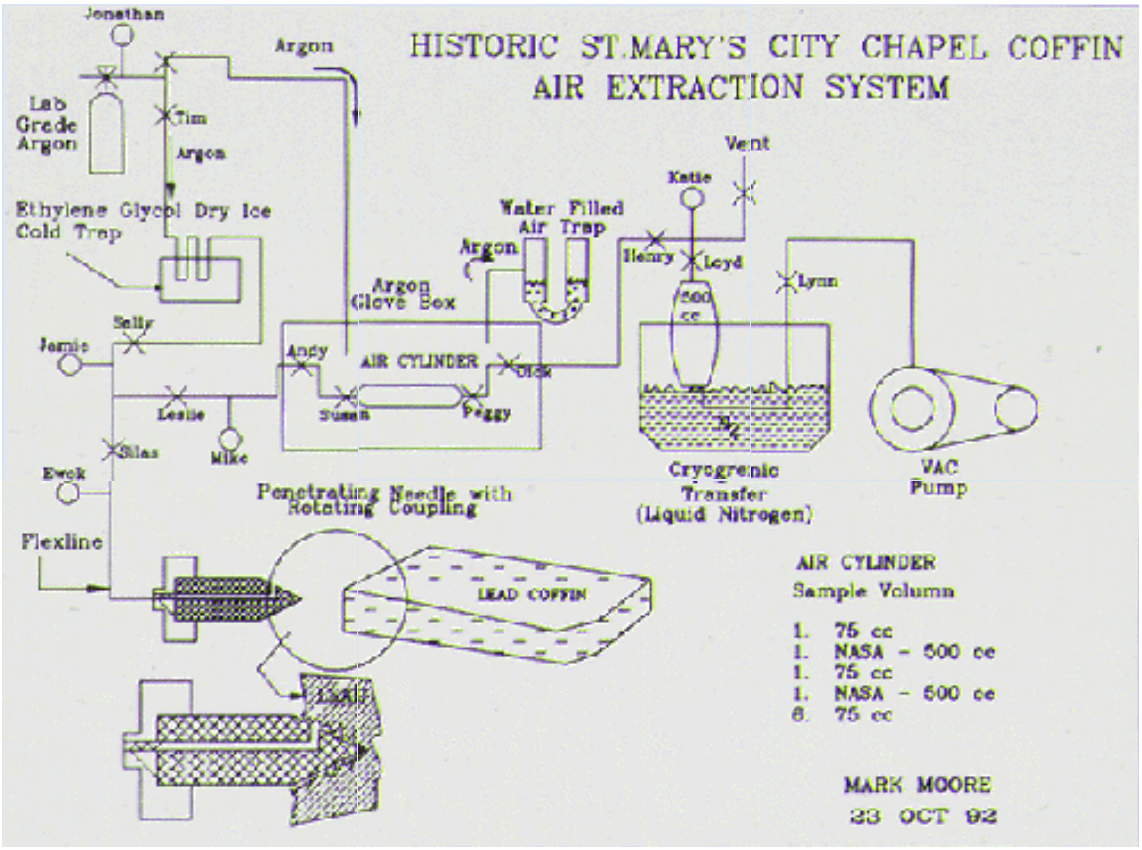
In order to proceed with the planned research it was necessary to find a way to image through thick lead so that we could have the best data on the condition of the remains and also not compromise the environmental data. Mark Moore, a nuclear physicist with the Armed

Forces Radiobiology Research Institute developed a process to create images through the lead using gamma radiation. Mr. Moore also made arrangements with MQS Inspections of Allentown PA to provide the necessary Cobalt 60 radiation source and a mobile laboratory to develop the images.

Two other logistical issues to be resolved:

1. How to extract an air sample without negatively impacting either the coffins or their contents
2. How to gently lift the coffins out of the ground and transport them to the area for study.

Elements of the U.S. Armed Forces again came to our aid. The Naval Electronic System Evaluation Activity at Webster Field, St. Inigoes, Maryland, provided a specialist who helped fabricate, in conjunction with NASA atmospheric scientists, a glove box system which allowed us to extract the coffin gasses without introducing an exterior air, replacing it with clean argon gas.



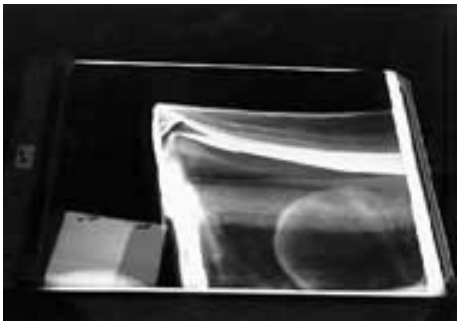
Technicians and craftsmen from the Patuxent Naval Air Station devised a special lifting cradle which was designed to cut under the coffins and a gantry system and bomb cart to lift each coffin out of the ground and transport it to the study tent. With these and other systems in place we were ready to begin the Field Phase of Project Lead Coffins - The Search for Maryland's Founders

Throughout the project various companies, groups and individuals gave freely of their time to make the research possible. Below is a list of just the government agencies and private companies that gave freely of materials, time, and expertise. The success of the project reflects the commitment of these groups to helping us better understand our shared past.

Agfa Division, Miles Inc.	**Federal Bureau of Investigation**	**Tracor Applied Sciences**
Armed Forced Institute of Pathology	**MQS Inspections, Inc.**	**University of Wyoming**
Armed Forces Radiobiology Research Institute	**National Aeronautics and Space Administration**	**U.S. Army Reserve Command**
Brinsfield Funeral Home	**Olympus Corporation**	**U.S. Navy**
College of William and Mary	**Pennsylvania State University**	**Carl Zeiss, Inc.**
Eastman Kodak Company	**Smithsonian Institution**	

Project

In October of 1992, the archaeologists began the process of uncovering the coffins. After the coffins were exposed to the same degree as they had been at the time of the original discovery, the next step in the process was the imaging of the contents so that an appropriate location for drilling the air-sampling holes could be determined. In order to use the radiation source that could generate enough gamma particles to produce images, it was necessary to erect a sandbag wall around the test site. Then, special x-ray film, donated by the Kodak Corporation, was placed in the correct location and the radiation source used to expose the film. The images were very clear and striking. Details such as the locations of the human remains and the overlap of the lead coffin construction were clearly visible. Each coffin in turn was imaged and this information fed directly into determining where the air sampling hole could be drilled.



With the results of the imaging in hand, each coffin was carefully tapped with a self-sealing bit connected to the air sampling device to attempt to extract air. It was clear even before we began this step of the process that the small coffin and the middle sized coffin were not air tight. However, we stuck to our protocol and went through the process of extracting air samples from each of the coffins to test procedures. Only the large coffin held out any possibility. When the sample was extracted from the large coffin, the system actually held a vacuum suggesting we had an air-tight container.

The sample was rushed to the lab where it was found to contain a very complex mixture of gasses. Only later, after months of analysis, did we determine that there had been infiltration of outside air in the sample. While we had failed to recover the antique air we sought, the system we had developed to extract the samples had worked flawlessly, and NASA considers the system a model for future attempts to recover the crucial samples needed to understand how our environment is changing.

Following the air sampling, we began pumping chilled argon gas into each of the coffins to maintain the integrity of the human remains inside. The next step in the project involved taking the first peek inside each of the coffins using a fiber optics borescope provided by the Olympus Corporation. This step allowed us to begin to evaluate the condition of the coffin contents. The borescope showed very well-preserved human remains and intact wood in both the small and middle sized coffins. It was not possible, because of where the hole had been drilled, to see fully into the largest coffin. All we could see was a perfectly preserved inner coffin of wood.

Borescope Examination

Image of skull taken via fiber optics borescope

We continued to pump chilled argon gas into the coffins as we carefully excavated the remaining soil from above each of the coffins. The layers of soil were recorded, and photographed with film donated by the Agfa Corporation, providing us with crucial information about the relative sequence of the burials. After all the soils above and around the coffins had been removed, we were ready for the next team of specialists to begin their job.

Preparing the small coffin for lifting

A team from NASA who specializes in Non-Destructive Evaluation (NDE) began the job of searching for hidden cracks and other weakness which would make it impossible to lift the coffins out of the ground. Utilizing a range of techniques including ultrasound, eddy current, and infrared diffusivity, the specialists determined that there were a few areas which showed some weakness in the coffins but that they were generally stable enough for lifting. This team was also able to estimate the weight of the coffins based on lead thickness measurements so that the next step - lifting the coffins - could begin.

The system which was developed to remove the coffins from the ground involved a cradle which held a steel plate which could be propelled under each coffin by means of hydraulic jacks. The coffin was then gently pulled back and on to the cradle which was then lifted out of the pit using a chain hoist and gantry. The small coffin was lifted without difficulty and transported to the medical tent where it was very carefully opened. It held the remains of a 6 month old baby girl who had severe medical problems including obvious skull lesions and a flaring at the end of the ribs characteristic of dietary problems.

The middle coffin was extracted without incident and the lead lid of the coffin carefully removed. Under this we discovered very well-preserved wood from the inner coffin and the extremely well-preserved remains of an older woman.

Preservation was excellent with silk ribbons intact and preserved herbaceous material which turned out to be rosemary the herb of Remembrance. Examination of the skeletal remains showed that this woman had suffered a severely broken leg, but had survived the injury. Her bones showed evidence of osteoporosis and her teeth were severely decayed.

The final challenge facing us in the field was the removal and opening of the largest coffin. Based on estimates of lead thickness and consideration of how much soil we needed to remove, we estimated the lift weight for the large coffin to be approximately 1,500 lbs. Good engineering practice told us to design for a lift of twice that much, or 1.5 tons. The coffin was successfully lifted and transported into the medical tent. We carefully removed the lead

outer shell and were presented with a perfectly preserved inner wooden coffin. We carefully removed the wooded lid and were amazed at what we found.

We discovered the highly deteriorated remains of an adult male. The human remains had undergone some sort of transformation which had reduced the upper third of the skeleton into a white crystal compound known as brushite. Later, we were to create a hypothesis of what had caused this chemical reaction.

This completed the field phase of the project, but the real work had just begun. Months of painstaking analysis were to follow. The true secrets of the coffins were to emerge as a result of this careful study.

Laboratory Analysis

Work after the excavation took many different directions. Some of the analyses undertaken were not even imagined during the planning phase because we did not know what we going to find. The work all centered on answering the three big research questions which we had laid out in the original planning meetings:

1. Identification of the occupants of each of the coffins.
2. Investigations into 17th-century health issues and mortuary practice.
3. Study of the 17th-century environment and how it has changed.

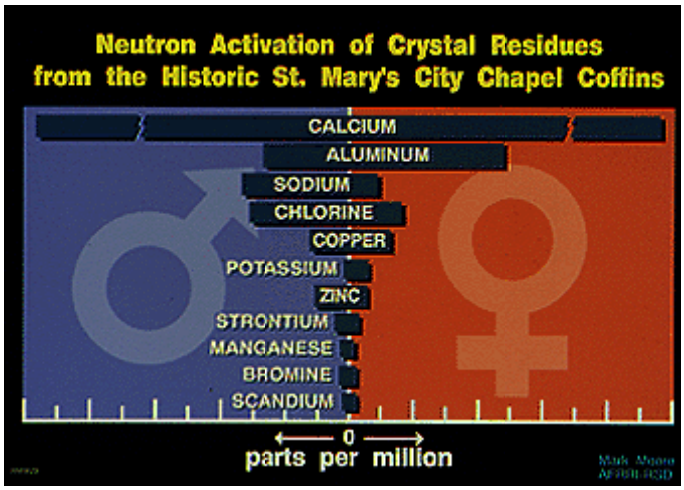
Scientists at the Smithsonian Institution and the Armed Forces Institute of Pathology took the lead on the investigation of the human remains. Careful examination of the bones by physical anthropologists determined more precisely the age of death and general health conditions of each of the burials.

The child had been approximately six months of age and suffered from serious nutritional problems including severe anemia and vitamin deficiency. Specifically, a vitamin D deficiency leading to rickets was indicated. Additionally, she had a cranial infection which had caused the lesions in her skull.

The man had been in his early fifties at the time of death, stood about five and a half feet tall, was right handed and rather corpulent. Muscle attachments suggested a relatively sedentary lifestyle The woman had probably been in her early sixties when she had died. In addition to the broken leg and osteoporosis, she appears to have had injured her back and had advanced arthritis Her dental condition suggested a diet rich in sugars, seeming to indicate wealth.

Other types of analysis of the human remains included investigation into the relative amount of the isotopic forms of carbon. When compared with other samples, the remains from the Chapel suggest individuals who had consumed both New World and Old World grains. These individuals would appear to have been born and raised in Europe, but had lived for a long time in Maryland.

Other analyses with the human remains involved looking at the chemical constituents of the brushite that represented much of the remains of the man. Neutron Activation Analysis by scientists at Penn State identified large quantities of aluminum in the brushite. Aluminum is a relatively rare material in the 17th century. The only ready source would have been in the form of alum. Alum has astringent and drying characteristics which would have made it a logical choice to use in an embalming process. It would appear that the man had been embalmed and seems likely that the embalming may have actually led to the more rapid decay of his remains.



A second application of Neutron Activation Analysis by scientists at Penn State investigated chemical content of the preserved hair and other samples from the coffins. The most striking finding of this study was the presence of large quantities of arsenic in the woman's remains. The sampling of the hair showed what appeared to be increasing doses of arsenic before the death of the female. The working hypothesis is that arsenic was being administered as a medication to the woman before her death. Such was the state of medical knowledge in the 17th century.

Cardinal Hickey performing disinterment rites

Important clues concerning the time of year when the individuals died was provided by analysis of the pollen found within each of the coffins

The child had been buried in the spring, the woman, based on the ragweed pollen, was buried in the fall, and the man's coffin showed a lack of pollen indicating a winter burial. The pollen analysis also indicated that both the man's and the woman's internal wooded coffins had either been fabricated or stored in a setting with lots of European small grains such as a barn or granary. Very few individuals grew the European grains in early Maryland. Only the wealthiest could afford this luxury.

Study

Well before we began the excavations, historians were hard at work creating a list of candidates for the occupants of the lead coffins. Certain characteristics such as high status, wealth and adherence to Roman Catholicism, were given traits since burial in a Roman Catholic Church in a lead coffin indicated that the individuals had to fit these profiles.

Death dates had to occur after 1667 when the Brick Chapel was built, and before 1705 when the doors to the Chapel were locked by order of the Royal Governor. The individual had to live near enough to St. Mary's City for it to be practical to have been buried there. Given this collection of evidence, the historians were able to create a short list of individuals who could have been buried in the lead coffins.

Identification

By process of elimination, the list of possibilities of who was buried in the large coffin was pared down. Some individuals were either too old or too young at the time of death. Some individuals had died in seasons other than winter. Some individuals had other historic data that suggested that they could not be the occupant of the lead coffins. When all was said and done, only one individual was left who could possibly have been buried in the lead coffin - Philip Calvert, Chancellor of the Colony and youngest son of the first Lord Baltimore. By association, the woman buried next to him was his first wife, Anne Wolsey Calvert. This left the child buried beside Anne to be identified. We cannot say with surety who this child was. As mentioned above, careful recording of the soil layering helped us to create a relative sequence of burial. The archaeology clearly demonstrated that the child had been buried after both of the adults.

Possible Identities of the Adult Male		
All wealthy, Catholic and high social status		
John Pile	age 50-60	d.1676
Thomas Brooke	age 44	d. 1677
Thomas Notley	age 45-55	d.1679
William Calvert	age 41	d.1682
John Darnell		d.1685
Richard Gardner	age 40	d. 1689
Joseph Pile	age 48	d.1692
Edward Pye		d.1697
Henry Brent		d. 1694
Philip Calvert	age 52	d. 1682

Hence, the child could not be the daughter of Anne since she was buried before the child had died. A likely surmise is that these are the remains of a posthumous child of Philip by his second wife, Jane Sewell. After the death of Anne Wolsey, his first wife, Philip married his

17-year-old step-niece. Philip was dead within a year. When Charles Calvert, the third Lord Baltimore returned to England in 1684, Jane went with him. It seems likely to us that Philip's last hope of posterity, an infant female, may have been interred with the rest of the family group.

Philip Calvert was a man who was closely linked to the development of the Maryland Colony and St. Mary's City. Lois Greene Carr, historian for Historic St. Mary's City, and Edward Papenfuse, Maryland State Archivist have undertaken an extensive study of Philip whom they describe as "Consummate Public Servant."

Preservation of the woman's skull was excellent, so that it was possible to create a facial reconstruction. A specialist in art and forensic analysis began with a perfect cast of the woman's skull and began to build up the face based on standard tissue thickness and hair color based on samples from the coffin along with a best guess as to eye color. Now this person can look back to us from across the centuries.





Further Study

While most of the principal research goals of Project Lead Coffins have been met, there is still more study and research to be undertaken. Much has already been done that has not been mentioned in this brief overview. We have not discussed at all the conservation and stabilization of the coffins and their contents. However, space is limited and through time even new discoveries not yet contemplated await. The study of these extremely wealthy, high status individuals has given us a peek at how the luckiest people in the Maryland Colony lived and died.

They provide a standard of how rough and tumble life was in the early colony and point out how even the wealthiest individuals suffered great medical problems which the science of the day could not begin to remedy. They also say a great deal about what the life of the common individual must have been when Maryland was young.