

Forensic Anthropology and Bioarcheology at the Smithsonian Institution

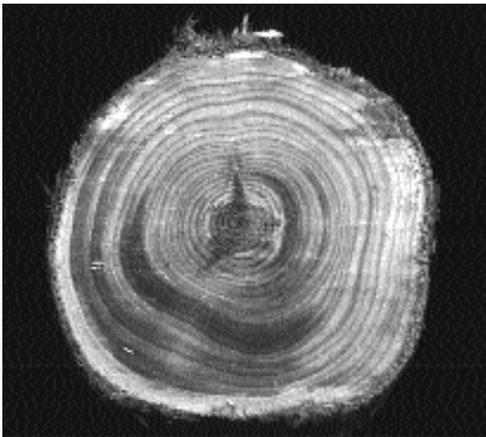
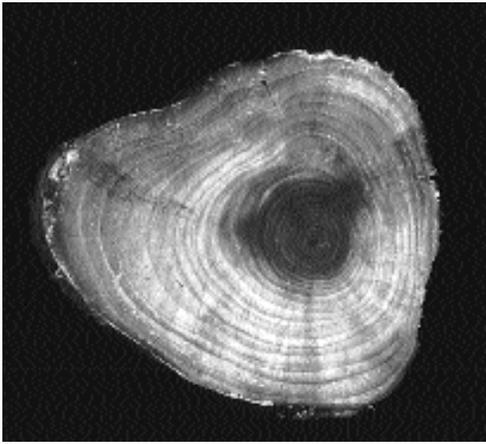
The Smithsonian's Division of Physical Anthropology has a long history of providing assistance to law enforcement agencies by completing examinations of human remains and providing expert witness testimony. Additional contributions include professional advice and training regarding technical procedures involved in the discovery, recovery, and analysis of human skeletons; Smithsonian staff also conduct forensic-related research.

Smithsonian forensic cases generally involve skeletonized or poorly preserved bodies that need identification and examination for trauma or other pathology that might explain the death of the individual. This work involves not only laboratory evaluation of the remains, but also frequently includes field research and excavation assistance. This expertise is currently provided by two forensic anthropologists, Douglas Ubelaker and Douglas Owsley, who are employed as research scientists and curators of the human skeletal collections at the National Museum of Natural History. In this capacity, their research deals with bioarcheology, particularly as it relates to prehistoric and early historic populations; topics dealing with demography, pathology, morphometric variation, and adaptation; as well as involvement with legal investigations as forensic scientists.

Affiliation with the Smithsonian and its extensive collections often proves to be of assistance in the resolution of specific human identification cases. The museum's anatomical collections are frequently consulted for comparative reference when specific questions arise during examinations of individual cases. Reference collections are essential for understanding individual and population variation in skeletal and dental morphology. The importance of this resource is often realized when attempting to establish personal identification of remains through comparison of antemortem and postmortem radiographs. The significance of an unusual feature for establishing an identification can be gauged by systematically surveying appropriate reference collections to determine its occurrence by age, sex, and population.

Identification of the cremated remains of two American journalists who disappeared in Guatemala in 1985 depended on this type of comparative information (Owsley 1993). A field search recovered the incomplete and fragmented remains from the location where they had been burned and then scattered. Three small, completely calcined, fragments of the frontal bone of one person could be pieced together, which collectively represented a portion of the forehead the size of a quarter. This segment contained a well-defined sulcus in the frontal crest that overlapped a centrally placed lobe of the right frontal sinus, a structural feature that was also visible in an antemortem radiograph taken four years before the disappearance when one of the journalists was involved in an automobile accident. To rule out the possibility of a coincidental match, 350 crania of African and European American males and females and a large series of radiographs were examined to determine patterns of variability with respect to internal frontal crest and sinus morphology. The comparative research demonstrated the uniqueness of the radiographic pattern observed in this small piece of frontal bone. Even in instances of extreme fragmentation and burning of bone, positive identification can be achieved, which in this instance was validated by comparative collections that provided population data (as well as a better understanding of cranial anatomy).

In another case, Ubelaker (1990) was asked to examine the skeleton of a homicide victim found in a shallow grave on the Pine Ridge Indian Reservation in South Dakota. His evaluation identified the male as Native American, and the osteological profile and the estimated time since death matched a missing member of the Sioux tribe. As dental records were not available, confirmation depended on thoracic radiographs obtained from the local Public Health Service hospital. These antemortem films revealed an unusual notch in the axillary border of the right scapula, a trait that was also evident in the skeleton. To determine the uniqueness of this feature as a basis for establishing personal identification required checking scapulae in the Smithsonian's collections including



Abnormal growth rings (top photo) in an eastern red cedar indicating that the tree was pushed over when a body was buried against the trunk. Smithsonian Institution photos, 1995.

Native Americans from the Northern Plains. No other examples were found during this survey, which reinforced the uniqueness of this anomaly as basis for identification. With the return of Native American human remains to appropriate tribal governments as a result of the Native American Graves Protection and Repatriation Act (NAG-PRA), future identifications based on comparative evidence will prove more difficult to the disadvantage of law enforcement agencies and the families of missing persons.

The collections of the Department of Vertebrate Zoology have also proven invaluable to forensic

investigations. Each year, incomplete or fragmentary bones that have been burned, sawed, or scavenged by animals are submitted for identification as potentially human. Two calvaria (i.e., the superior portions of the cranial vault) with human proportions but atypical morphology were identified as hydrocephalic calves through comparison with documented museum specimens (Ubelaker, Berryman, Sutton, and Ray 1991).

Besides immediate access to collections, forensic anthropologists at the Smithsonian have the benefit of ready consultation with other museum specialists. Scientists representing a variety of specialties including botany, entomology, zooarcheology, and geology have advised on specific cases. Determining time since death, for instance, has been aided by evaluations of insects found with the remains, as well as by the size and complexity of plant roots growing in and around the bones. When a partially buried skeleton of a stabbing victim was found against the trunk of a small cedar, the tree's growth rings were analyzed to see if there was a noticeable "fertilization effect" due to the availability of nutrients from the decaying body. Recovery of skeletal remains and clothing indicated that the body had been placed there several years ago. Cross-sections of two trees of the same species, but from a short distance away, were used as controls. Analysis did not demon-

strate an obvious nutritional effect; however, the vertical orientation of the tree trunk was apparently altered at the time of burial. Unlike the circular growth rings of the control trees, the cross-section of the test tree showed eccentric rings and the formation of compression wood. This atypical feature was used to estimate the number of years since death for the murder victim, because it clearly indicated a growth-related response to a disturbance of the tree's normal developmental pattern.

Zooarcheologists have helped with many cases requiring the identification of nonhuman bones. For instance, the search of Jeffrey Dahmer's boyhood home in Bath Township, Ohio, recovered the fragmentary skeleton of his first victim along with the bones of several animals (Owsley, *et al.*, 1993). The identifiable nonhuman bones and bone fragments found at this semirural site represented a variety of species: cow, sheep, pig, dog, cat, rabbit, woodchuck, opossum, and other animals and birds. Although many of the bone fragments represented typical cuts of meat found at a market, the skeletons of at least three dogs were represented. The most unusual piece was the femur of a large dog with a metal spike driven into the shaft. There was no evidence of healing, indicating that the modification was made at about the time of the dog's death or soon thereafter.

In 1996, a case required help from the Division of Sedimentology to resolve questions about provenance. Specifically, the investigating agency requested assistance in determining the original location from which the human remains actually came. Soil from the suspected burial site was compared to soil extracted from the medullary cavity of one of the bones to determine whether the bones came from the location where they were reported to have been found.

Multiple analytical procedures were used, including visual examination for color and classification using Munsell soil color charts, texture analysis using a laser particle size analyzer, and X-ray diffraction to determine the mineral composition of the two samples. The samples matched in color and had identical mineralogical diffraction patterns indicating that the same minerals were present in the same relative proportions. The distributions of particle size diameters also agreed, the only difference being the inclusion of larger sized particles in the soil sample. Infill material removed from the medullary cavity consisted of a finer filtrate that had migrated into the bone, a sorting process that had selectively limited particle size. Without question, the samples originated from the same soil series as the location where they were said to have been discovered.

Dog femur with an embedded metal spike recovered from forensic investigations at Jeffrey Dahmer's boyhood home in Bath Township, Ohio. Photo by Robert Mann.



Ties to Bioarcheology

Frequently, remains from archeological contexts become the subject of legal investigations. Several cases each year prove to be historic burials that are exposed by construction activities, vandalism, or land subsidence and erosion. Identification of these remains depends on an evaluation of historical records, associated materials and provenance, and osteological analysis. Cases that involve accidental disturbance or exposure by natural processes generally require no further police investigation, although efforts to establish personal identification can assist legal processes necessary for determining the final disposition of the remains. Intentionally disturbed remains require further investigative action by law enforcement agencies, as unauthorized disturbances or disinterments are violations of sepulcher. In some cases, we have conducted field investigations of broached graves to obtain evidence and ascertain whether human remains were removed. Experience in bioarcheology is invaluable in being able to recognize and evaluate these situations. Bioarcheology and forensic anthropology are closely linked disciplines with shared techniques, methodology, and occasionally similar objectives. Most forensic anthropologists have educational backgrounds that include archeological field experience; indeed, expertise with archeological survey methods, field mapping, and the documentation of ancient burials develops one's technical capabilities and an appreciation for the importance of context, provenance, and proper recordation. These basics directly apply to medicolegal investigations. In the laboratory, the analysis of archeological samples provides greater understanding of intra- and inter-group variability and an appreciation of taphonomic variables that can effect the preservation of skeletal remains. The ability to accurately distinguish postmortem fractures that occurred long after death from those

incurred at the time of death can be gained only through working with samples that show changes or damage as a result of burial or recovery processes. *Smithsonian's Bioarcheological Database*

Bioarcheology at the Smithsonian is directed toward the analysis of human skeletons using a comprehensive osteological database approach. The application of modern biological and anthropological techniques to samples from archeological contexts provides data effective for studying biocultural adaptations,

trends in demography, trends in health and the history of disease, and cultural and historical relationships. Information about archeological provenance and dating, bone inventories for each skeleton, demographics (including determinations of age, sex, and race), skeletal and dental pathology, nutrition, cranial and postcranial measurements, dental and skeletal growth and development, and taphonomic observations are incorporated into the Smithsonian's computerized databases as a basis for comparative research using a temporal and geographical framework.

Historic populations are an important focus of this research. Smithsonian researchers are currently involved in the analysis of archeologically-recovered remains from important colonial sites such as Jamestown, Virginia and St. Mary's City, the first colonial settlement in Maryland. Additional research is focused on 18th- and 19th-century groups, including more than 300 skeletons of inmates of the former Richmond (Virginia) Penitentiary. A rather unusual sample consists of a large series of commingled bones that were found in a 19th-century well on the grounds of the Medical College of Virginia. The skeletal remains appear to represent bodies that were disinterred soon after death for use in medical school instruction at a time when it was illegal to use human remains to teach anatomy. The well simply provided a convenient and secure place of disposal after dissection and student practice with surgical procedures such as amputation.

Smithsonian investigations have also involved remains recovered from battlefields and military cemeteries. Osteological analysis can help to establish the identities of individual soldiers as well as obtain information about overall health and nutritional status and causes of death. Such analysis can also yield information about the medical treatment, primarily surgical intervention, provided to soldiers that subsequently died. Military

burials recovered from several Civil War battlefields including Antietam, Gettysburg, the siege of Port Hudson, Brandy Station, and Glorieta Pass have been examined. A skeletal series from a battlefield, which is somewhat rare in bioarcheological research, presents an opportunity to study the effects of field conditions and physical stress in a special subset of the general population in which physical characteristics are relatively consistent and controlled as a result of military induction criteria. The objectives of these investigations are to record data on age, sex, race, and other physical characteristics; antemortem bone and dental pathology; and perimortem trauma and possible

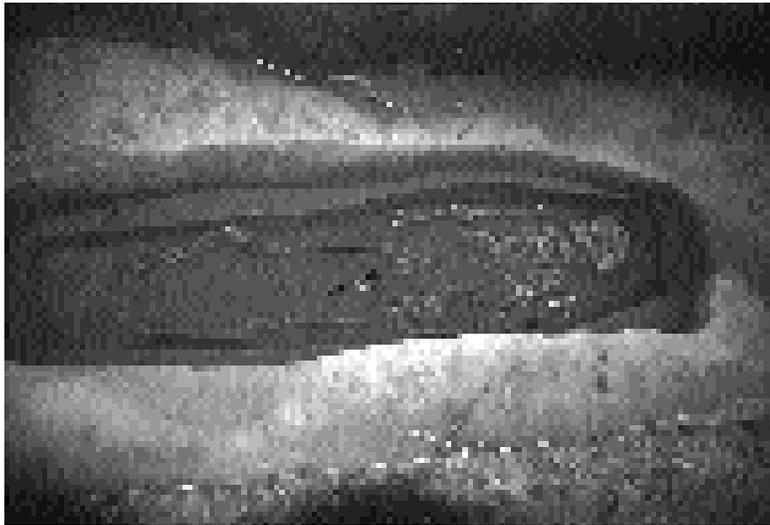
that the land had been the scene of Civil War battles and that the locale probably contained military interments, requested that a survey be conducted of the approximately two acres still owned by the descendent congregation of St. James Church. Physical evidence supporting the historic accounts was viewed as essential data for nominating the battlefield site to the National Register of Historic Places. It was at this point that bioarcheologists from the Smithsonian Institution were asked to contribute to the history and archeology of Brandy Station.

After surveying the environs of St. James Church, subsurface probing identified nearly 50 unmarked burials of which six were selected for further examination. The coffins were described and measured, and in order to hopefully identify these individuals, were opened to expose the skeletal remains and associated artifacts. The burial artifacts were described and inventoried and the skeletal remains were examined osteologically. Of the six burials, five were civilian and one was military. The five civilians were buried at a standard depth in wood coffins with identifiable hardware. In contrast, Burial Number 21 was laid to rest in a

shallow grave surrounded by a frame made of reused yellow pine planks. This improvised coffin lacked both a top and bottom, as well as side handles. The skeletal remains were those of an adult white male judged to be about 30-35 years. Coat fragments and buttons, a kaolin pipe, and remnants of his boots were analyzed. The burial context closely matched the mournful scene described by William Miller Owen (1885:106), historian of the Washington Battalion, when he observed that "At night a burial detail performed the sad rites to bury our dead comrades by the flickering light of a blazing fire of logs and rails, having made rude coffins of the pews of St. James Church which, meaning no sacrilege, were appropriated for that purpose."

Comparison of the osteological data from Burial Number 21 with Confederate Army records provided statistics that helped narrow the identity of the soldier to two possible candidates of similar age. Both were Irish born with former occupations as laborers before the war. One of the major accomplishments of this investigation was to demonstrate that, both archeologically and historically, the site of St. James Church meets the criteria for listing on the National Register of Historic

Archeological investigation (work-in-progress) of Jamestown's first colonists at St. James Fort, Virginia. Photo by Parvene Hamzavi.



cause of death. Through comparison of such data with military records and descriptive information from diaries and other archival sources, it is sometimes possible to identify specific individuals. Of 31 Confederate soldiers found in a mass grave and one adjacent burial site on the 1862 Battlefield of Glorieta Pass, some 20 miles east of Sante Fe, three positive identifications were achieved and seven more were probable (Owsley 1994).

Further, where there are disputes about land and its possible development, bioarcheological research can help establish the historical significance of the property, as was demonstrated at Brandy Station, Virginia (Owsley, *et al.*, 1992). This area of Culpeper County was the site of two military engagements: the artillery duel of the Battle of the Rappahannock on August 23, 1862, and the cavalry battle of June 9, 1863. During the earlier battle, the Washington Artillery, a crack Confederate unit, was positioned on the Culpeper side of the Rappahannock River and in a crossfire lost eight soldiers. Reports following the incident stated that the dead were buried at nearby St. James Church. A real estate developer had purchased the land that surrounds the ruins of St. James Church. Civic and church groups, aware

Places. Excavation of the Brandy Station graves also yielded data on late 19th-century burial practices that, with the results of other bioarcheological studies, can enhance understanding of American social history of the past century.

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Forensic Anthropology and the FBI



Cadaver dog trained to detect decomposing human remains. Photo by the author.

The inclusion of forensic anthropology in criminal investigations involving the Federal Bureau of Investigation can be traced back to the early development of American physical anthropology. Czech-born Aleš Hrdlička (1869-1943) is widely recognized as the founder of American physical anthropology. Hrdlička spent most of his career at the Smithsonian Institution, located near the FBI headquarters in Washington, DC. Although Hrdlička is not known for his work on the forensic applications of physical anthropology, he gradually assembled the comparative collections and established the methodology that made this endeavor possible (Stewart 1982). Smithsonian records show that Hrdlička had some contact with FBI officials, advising them on cases within his expertise.

In 1939, the *FBI Law Enforcement Bulletin* published Wilton Krogman's article on human identification, a publication that raised awareness in the law enforcement community of the potential contribution of forensic anthropology to medico-legal investigation.

The relationship between the FBI and the Smithsonian Institution with regard to forensic anthropology solidified when Hrdlička's student, and his Smithsonian replacement, T.D. Stewart, began consulting for the FBI in 1942. Stewart not only analyzed skeletons for the FBI and others for the next 20 years, but added to the national collections and, even more importantly, published regularly on forensic anthropology topics (Stewart 1979). During this period, the involvement of physical anthropologists in forensic science grew steadily.