AN OUTLINE OF FORENSIC ARCHEOLOGY

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Archeology is the systematic study of human societies from the past using the items they left behind. Archeology is a subfield of **anthropology**, which is the study of humans in general, whether modern or ancient. Two fields that are commonly confused with archeology are **geology** (the study of rocks, minerals, and the physical history of the earth) and **paleontology** (the study of ancient creatures, such as dinosaurs). Archeologists frequently have training in geology and paleontology but differ significantly in that their central concern is humans and human remains.

Forensic archeology is the application of archeological methods to the resolution of medicolegal issues. Specifically, forensic archeologists perform the controlled recovery of human remains and other evidence at forensic scenes. Proper archeological procedures generally require significant time and attention to detail, and so the process may seem rather slow to investigators. However, the end result of this effort is the ability to exactly reconstruct the entire scene as it appeared before excavation. Why go to all this effort? With information provided by the forensic archeologist, the investigator may be able to:

- verify or exclude testimony from a witness or suspect;
- draw a connection between an assailant and the scene;
- reconstruct the circumstances of the decedent's death;
- establish how and when the human remains ended up at the recovery spot;
- understand the natural forces that may have disturbed the scene after it was created;
- be certain that evidence found at the scene is actually associated with the case;
- go to court with the assurance that the processing of the scene was done in a thorough and professional manner by scientific experts who knew what they were doing.

We use the term **evidence** broadly to include all items recovered at the scene, such as human remains, artifacts, insects, plants, soil samples, footprints, toolmarks, graveshafts, and fluid stains. **Remains** refers to human bones and soft tissues, including teeth, hair, and nails. **Artifacts** refers specifically to physical objects that have been used and/or manipulated by humans, including but not limited to jewelry, coins, clothing, weapons, projectiles, and trash.

FORENSIC ARCHEOLOGY: WHAT MAKES IT UNIQUE?

Anthropologists have been conducting archeological investigations around the world for over 100 years. Forensic archeology differs from regular archeology in a few critical ways:

- The scene is made more complex due to the presence of police, coroners, and news personnel. While ancient archeological sites may occasionally be this complex, forensic scenes nearly ALWAYS are.

- At ancient sites, relevant layers are generally completely buried. At forensic scenes, relevant layers almost always include the existing ground surface, i.e., the burial feature generally opens directly onto the present ground surface, and remains may be scattered widely across the surface. This means that

the ground that you walk on simply to get to the scene is a part of the site and your mere presence may alter or destroy evidence.

- Forensic evidence is much broader and potentially more subtle than the artifacts archeologists typically encounter. For example, the forensic archeologist must be sensitive to the presence of such evidence as cut roots, dry leaves and dead vegetation, toolmarks, shoeprints, and fingerprints.

- The artifacts encountered at forensic scenes are frequently perishable and rarely encountered at normal archeological sites. These items may include paper, cloth, tobacco products, insect evidence, hair, fingernails, and other soft tissues. The collection, packaging, cleaning, and preservation of such evidence requires special training and care.

- The possibility of encountering biohazardous or dangerous materials (such as loaded weapons) is greater at forensic scenes.

- Forensic archeologists must always maintain a proper legal chain of custody for all evidence, assuring that all items and samples can be accounted for and protected until they are officially released to the police or other experts. All methods, procedures, notes, and findings may eventually be questioned in a court of law, and so proper documentation and accountability becomes essential.

These unique characteristics suggest that medicolegal officials should employ archeologists who have specific training and experience in forensic investigations.

EMPLOYMENT & QUALIFICATIONS

Nearly all forensic archeologists teach at universities, work in museums, or are professional archeologists. Few are employed as full-time forensic scientists, and thus most consult only on a part-time basis. Caseloads vary widely depending on the geographic location. At the University of Indianapolis we currently see about 10 forensic cases a year that require archeological fieldwork.

The vast majority of archeologists have not been trained to assist in death investigations. A qualified forensic archeologist should have the following training and experience:

- an M.A. or Ph.D. in anthropology, with formal graduate coursework in field archeology, laboratory analysis, and osteology under the supervision of qualified experts;
- fieldschools in archeological methods;
- experience directing the excavation of real archeological sites;
- experience in the excavation of archeological and forensic human burials;
- training in evidence collection and crime scene analysis;
- active membership in relevant professional organizations, such as the Society for American Archaeology, the Registry of Professional Archaeologists, and the American Academy of Forensic Sciences;
- a record of research, papers, and publications in the fields of both archeology and forensic archeology;
- trial experience.

While the forensic archeologist does not have to be a specialist in the analysis of the human skeleton, he or she should be able to identify all of the bones of the body and have a working

knowledge of human anatomy, or else confusion and misidentification of remains could occur in the field. Many forensic archeologists are also board-certified in forensic anthropology (see www.csuchico.edu/anth/ABFA).

WHY USE ARCHEOLOGISTS?

A forensic archeologist can provide expertise and assistance in four general areas:

- locating buried or otherwise hidden ("clandestine") remains;
- collecting remains and artifacts that are scattered over the ground surface;
- excavating buried remains and artifacts;
- recording important environmental data that is later used in the analysis of the remains or by entomologists, botanists, and other specialists.

LOCATING CLANDESTINE REMAINS

Searching for the remains of a missing person can be a difficult and frustrating task. Critical to the success of a search are:

- clear organization with pre-arranged search strategies and open lines of communication in the field;
- assembly of as many search personnel as possible, both trained and untrained;
- good weather and a careful choice of time of year for the search. In general, the early spring is best because foliage is low. If an initial search during a different season is unsuccessful, it may be wise to schedule another when conditions are most favorable;
- good maps of the area, including USGS survey maps and aerial photographs;
- a careful consideration of the quality and veracity of informant leads;
- coordination of efforts with cadaver dogs. Dogs should be brought to the area the day before the ground search is scheduled or immediately ahead of the archeologist. Spots that the dogs fix on should be flagged and left undisturbed until the experts can check them out in a controlled manner;
- access to remote sensing technology. This may include metal detectors, ground-penetrating radar, and/or infrared sensing devices. Experts in these methods can be brought in if the human and canine ground searches have not worked.

People advancing in a search line should be instructed to follow a few general guidelines:

- Slow, careful searching is a must. Rapidly racing through a scene is worse than no search at all because vital evidence may not only be missed but may actually be trampled and destroyed.

- Close spacing between people is desirable. Minimally, individuals' visual fields must overlap.

- Everyone should remain in the linear formation, resisting the tendency to break ranks by lagging too far behind or running ahead of the pack.

- The search area should be covered from multiple directions, if time and manpower permits.

- Keep in mind that evidence may be suspended above the ground in trees, towers, bridges, or buildings.

- Suspicious items should be flagged and left undisturbed for the experts (who will be following behind) to examine in place.

- It may be necessary to clear weeds and brush from large areas of the scene so that evidence can be spotted. However, a foot search should always be conducted prior to the use of mechanical clear-cutting.

- Human remains, whether initially buried or not, may be widely scattered by a number of forces including animals, humans, farming machinery, flowing water, and gravity. Therefore, one should not assume that the scene will be a small one!

During a ground search, a number of clues may indicate the presence of buried remains:

- disturbed soil, with a different texture, density, and/or color than the surrounding soil. The handiest tool in our arsenal is a metal tile (T) probe of about 3 to 4 feet in length with a small ball bearing soldered to the end. Changes in soil density and compaction can be detected quickly by probing carefully at regular intervals;
- depressions;
- mounds of soil, rocks, vegetation, or trash;
- areas of burning;
- cut trees or branches;
- discrete areas with unusual plant growth. Plants over a grave may range from completely absent to flush with new growth, higher and greener than the plants in the immediately surrounding area. Different species may have colonized the disturbed soil of the gravesite;
- partially buried clothing, tarps, or carpet;
- exposed bones or artifacts.

ARCHEOLOGICAL RECOVERY: BASIC CONCEPTS

Archeological recovery involves more than simply digging up remains with shovels. The controlled recovery of human remains is designed to maximize the acquisition of information and evidence that may be critical to the case. Because archeology is by nature a destructive process, careful documentation (observation, measurement, mapping, & photography) must be maintained at all times. A proper archeological recovery will:

(1) **clarify the stratigraphy of a site**. Soils are normally subdivided into naturally-occurring stratigraphic layers that are distinguished by their color, texture, grain size, and composition. The archeologist determines the original layering and reconstructs the sequence of events that disturbed it. Specific disturbances (such as a graveshaft, animal tunnel, drainage ditch, trash pit, or uprooted tree) are called features.

(2) **recover all evidence**. Small bones and teeth are easily missed by the untrained eye even when clean, and adhering dirt and debris makes their recovery and recognition even more difficult. Therefore, soil and debris is generally screened through 1/4" wire mesh.

(3) **document the provenience of all evidence**. Provenience refers to the coordinate location of an item in 3-dimensional space, reflecting its latitude (north-south location), longitude (east-west location), and vertical position (depth or elevation), as measured in meters (m) and centimeters (cm).

(4) **determine whether evidence is "in situ."** An item that is still in the position in which it was originally deposited is said to be in situ. The forces that move items out of position (e.g., humans, animals, water) must be explained and understood.

(5) **limit postmortem damage to the remains**. Uncontrolled excavation with shovels can damage fragile bones. In the laboratory, the anthropologist's identification of perimortem trauma is made less difficult if the excavation was conducted carefully with small tools, such as trowels, spoons, and wooden picks.

THE STAGES OF RECOVERY & EXCAVATION

The recovery of buried or scattered evidence generally proceeds in 5 stages:

(1) **establish a datum and construct a reference grid**. The datum is a fixed point near the scene (such as a large tree or the corner of a building) that can be found again if needed. The subdatum is a stake placed close to the remains at a known distance from the datum. Lines running east-west or north-south through the sub-datum are known as baselines. A reference grid is constructed out from the subdatum or baseline and over the site, using stakes, surveyor's chaining pins, and string. This grid serves to organize all subsequent collection and excavation activities. It is subdivided into square units measuring one meter to a side and numbered in an orderly fashion. While not all units are necessarily strung at each scene, any point on the landscape can be given a precise provenience as long as the proper measurements are taken from the subdatum or baselines.

(2) **expose the surface of the grid**. Using rakes and trowels, all loose debris (leaves, sticks, trash) is removed from the surface in order to recover scattered evidence and to define the exact boundaries of any features. The uppermost centimeter of soil is removed with the debris during this stage and screened. Some evidence (particularly small or loose items) may be collected now so that it is not lost or trampled later.

(3) **excavate the remains**. Disturbed soil covering the remains is systematically removed and screened. Excavation is usually done with trowels, spoons, and wooden picks, although flat-edged shovels may be used in some contexts. Bones and artifacts are usually left in place until everything has been exposed.

(4) **collect the remains**. Bones and artifacts are collected in a controlled fashion and bagged. Provenience information is recorded directly on the sack as well as in a master log listing all evidence as it is encountered.

(5) **final cleanup**. After the primary evidence has been removed, the soil beneath the remains is scraped down with trowels and flat-edged shovels and screened to recover any remaining items. A metal detector may be used to sweep for buried metallic objects.

Obviously, the specific characteristics of a case may require departures from these basic steps. Experienced forensic archeologists know when to modify their techniques to suit the circumstances.

GRIDS AND MAPPING SYSTEMS

The reference grid serves at least 3 important functions:

(1) It helps to make sure that all ground is examined systematically. In addition, the grid helps to keep people from trampling the remains;

(2) It helps with mapping. You can use the straight string lines of the grid to take measurements to evidence without having to refer to the baseline or subdatums each time.

(3) When the scene is photographed with the grid in place, it will help other experts, the court, and especially the jury to understand the scene and to appreciate the care you took to recover the evidence.

The grid is an example of a **cartesian coordinate system**. Each unit is numbered based on the location of one of its corners. For example, (2S,2W) designates the unit whose southwest corner is located exactly 2 meters south and 2 meters west of the subdatum point (0S,0W). The coordinate (2S,2W) therefore refers simultaneously to a 1 square meter unit and also to the specific point on the ground surface at the unit's SW corner. The coordinate (2.74S,2.31W) would be a point that falls within unit (3S,3W), at a point that is exactly 2.74 m S and 2.31 m W of datum. This measurement system is based on right-angles and is identical to the graphing system that students learn in school.

Other coordinate systems can be used in different circumstances. A **triangular coordinate system** uses direct measurements taken from the two endstakes of a single baseline. Measuring tapes attached to each stake are drawn straight to the evidence and the distances on both tapes are recorded. In the laboratory, these triangular measurements can be converted into cartesian coordinates by using trigonometry. A reference grid is not required.

A **polar coordinate system** uses a **surveyor's transit** or **electronic total station** to shoot a distance and bearing (angle) from a single datum point to each piece of evidence. No baseline or grid is required, and the data can be converted into cartesian coordinates with trigonometry.

A cartesian system is good for small scatters of evidence but is very time consuming to construct over large scenes. The triangular system is good for large scenes but requires an open setting with little tree cover so that the tapes can be stretched tight. The polar system is effective over very large scenes but is cumbersome in tight quarters and less accurate on small scatters.

A note on GPS ….

Most police officers now carry global position survey (GPS) instruments, small handheld devices that record the longitude, latitude, and elevation of any point on the landscape. These devices **appear** to be very accurate. However, the military deliberately muddies the satellite readouts for national defense purposes, so the instrument will be accurate only to within 5 or 10 yards at best. This level of precision is ok for locating the scene broadly on a USGS map but is NOT ACCURATE ENOUGH to plot the positions of individual pieces of evidence within a scene. The data you get will be largely meaningless and if a defense attorney took the time to plot the evidence on a real map from your data, he or she could make you look like a fool!

THE LAWS OF STRATIGRAPHY

The formation of soil layers in nature occurs in a very organized fashion, resulting in a few basic 'laws' of stratigraphy. These laws are sometimes referred to as "Steno's Principles" (after the 16th Century Italian scientist, a.k.a. Niels Stensen):

(1) Strata are originally formed flat, due to the effects of gravity. Therefore, the boundary between two different strata will be roughly horizontal.

(2) Objects within the same stratum are of the same relative age, unless some force has mixed two different strata together to form a new layer.

(3) In undisturbed contexts, deeper strata (and the objects they contain) are older than higher (more shallow) strata. This is known as the **law of superposition**.

(4) The age of a feature (such as a burial) that **intrudes** into one or more strata is determined by observing the highest stratum that it intersects. In other words, the body at the bottom of a grave may be absolutely deeper than the surrounding layers, but since the graveshaft was dug down into older strata, its age must be judged by where it "opens" at the top.

The uppermost layer (**topsoil**) is generally dark because it contains large amounts of organic material from decomposed vegetation. The deeper layers (**subsoil**) are generally lighter in color, contain less organic matter, but have more clay and gravels. The process of digging a hole disturbs this natural stratigraphy, resulting in a mixing of soils from different strata.

The archeologist generally removes a single stratigraphic layer or feature at a time before proceeding to the next deeper one. This will ensure that evidence from different layers or features will not be accidentally mixed. The archeologist may further subdivide a particular layer into **levels** of arbitrary but standardized thickness (usually 5 or 10 cm).

It should be noted that the laws of stratigraphy do not apply only to soil. Leaves on a forest floor, trash in a dump, and junk in a storage shed also tend to accumulate according to the same principles. The archeologist may be able to apply the laws of stratigraphy in these situations to provide an interpretation of the events that occurred at the scene.

DOCUMENTATION

Documentation of information is a critical facet of archeological control. If possible, it is a good idea to assign one person to the task of recording all data at the scene as the other individuals excavate. This same person can be making maps, taking photographs, and logging evidence as it is recovered. In general, the following forms of documentation are standard at any archeological project:

- Basic written notes on site conditions, the general environs of the scene, and the people assisting in the excavation are taken. However, the archeologist should not assume the responsibility of maintaining the crime scene log of all individuals entering and exiting the premises; this is the job of the police.

- **Plan view** (top-down) and (for burials) **profile view** (cross-sectional) **diagrams** of the remains are drawn to scale on graph paper. A scale, a north arrow, the position of the datum, the outlines of relevant features, and the position of the remains should be included in each view, although it is not necessary (nor desirable) for the diagrams to be intricately detailed. For example, stick figures are clear, unambiguous, and easy to draw. Additional information on the positions and depths of important evidence or other items can also be included;

- A list of all features and stratigraphic layers encountered should be made. Each feature and layer should be given its own unique number or letter (e.g., Feature 1, or Layer A).

- A detailed log of all artifacts, bones, and samples collected should be made. Each item should be given a unique number, and the master log should give a basic description, general location (e.g., "surface of Feature 1"), and exact provenience for each. Our laboratory uses special forms to make data recording quick and efficient.

- Both wide-angle and close-up photographs should be taken. Scales and north arrows should be used whenever feasible but not to the extent that they obscure important evidence or severely compromise the composition of the photograph. The archeologist can focus on documenting the remains and associated evidence only to the extent necessary for writing the final field report; the crime scene technicians should be left to produce the full legal photodocumentation of the death scene.

The amount of raw data that is included in the final submitted report will vary according to the nature and complexity of the case and the needs of the local authorities and prosecution team. It should be noted that in our experience, line diagrams and site maps are nearly always admissible in court without objection by the opposing team; however, graphic scene photographs that show human remains may be objectionable due to their potential biasing impact on jurors. Therefore, drawings, maps, and tables should always be the first line of data presentation in the final report, with photographs used in a discretionary fashion.

SAMPLE COLLECTION & PACKAGING

The following types of evidence and data should be systematically obtained from a scene because of their potential for assisting in the determination of time since death:

- insects and climatic data (such as temperatures, degree of exposure to sun, & proximity to water);
- soil, taken from beneath the body as well as from an uncontaminated area nearby. Decomposition fluids and pollen can be extracted from the sample, and the soil may be matched to traces found on the shoes or vehicle of a suspect. In addition, insect remains can be sifted from the dirt;
- botanical evidence, including roots that penetrate the burial and plants that have grown above it. Plants in the surrounding area may be matched with seeds or leaves found in association with a suspect.

Packaging guidelines for completely skeletonized remains and associated evidence are simple: everything should go in paper. Both buried and surface remains will inevitably be slightly moist, and packaging in plastic bags or aluminum foil does not allow the moisture to evaporate properly. If drying is not allowed to proceed naturally, the bones may develop mold and fungus. In addition, the water actually accelerates the molecular breakdown of bone. Paper bags can be stapled shut to keep bones from falling out during transport. Small bags can be placed in larger bags, which in turn can be

sealed in large cardboard boxes or placed in a Rubbermaid container. Each bag should be clearly labeled with all pertinent information, including the case number, the item number, the date, and the excavator's initials. This information should be written in waterproof ink on the lower half of the bag, to allow the top half to be folded down and stapled.

Incompletely decayed remains that still include significant amounts of wet soft tissues should of course be packaged so that fluids do not leak on their way to the lab. The most efficient procedure is to lay the body parts on a sheet, fold, and place the bundle within a zippered disaster bag. Smaller portions can be placed in a paper bag which in turn is placed in a plastic bag. However, do not seal the plastic bag unless the odor is extreme.

REFERENCES FOR FURTHER READING

Dirkmaat D & Adovasio J (1997). The Role of archaeology in the recovery and interpretation of human remains from an outdoor forensic setting. In Forensic Taphonomy, ed. by W. Haglund & M. Sorg, pp. 39-64. CRC Press.

Dupras T, Schultz J, Wheeler S, & Williams L (2006). Forensic Recovery of Human Remains. CRC Press.

Hunter J, Roberts C, & Martin A (1996). Studies in Crime: An Introduction to Forensic Archaeology. Routledge.

Killam E (1990). The Detection of Human Remains. Thomas.

Morse D, Crusoe D, & Smith H (1976). Forensic archaeology. Journal of Forensic Sciences 21:323-32.

Morse D, Duncan J, & Stoutamire J (1983). Handbook of Forensic Archaeology and Anthropology. Rose Printing.

Skinner M & Lazenby R (1983). Found! Human Remains: A Field Manual for the Recovery of the Recent Human Skeleton. Archaeology Press, Simon Fraser University.

Wolf D (1986). Forensic anthropology scene investigations. In Forensic Osteology, ed. by K. Reichs, pp. 3-23. Thomas.

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