Dogs find things. We all know that. We also know that dogs like to be helpful and please their owners (Gell 1988, p. 7, describing dogs as “biddable”). In 1998, members of a sheriff’s office came to the Laboratory for Human Osteology at the University of Alabama with bone gathered from the grounds surrounding a house that had caught on fire in a rural area of the county and subsequently burned to the ground. I identified the bone as human, and the police asked if I could accompany them to the site of the house fire. As we drove to the site, the investigators indicated that they did not think that I would find any bones, because the fire was too hot and the structure had collapsed and burned pretty completely. I told them that the bones they had brought to me were smoked and burnt but in relatively good shape.

At the site, two pet dogs were playing in the yard. I grabbed one of the vertebrae out of the bag of bones the police had brought me and got out of the car. The two dogs ran up to me. I scratched the smallest dog on the head and held the vertebra to his nose. The dog with stubby legs took off into the brush surrounding the house. In no time, it came back with a human rib. We played the game a few times, with the dog bringing back more bone. The hard part was getting the bone from the mouth of the dog. After a period of this “play,” the dog lost interest, and a policeman went to search the brambles for more skeletal material. None was found. The bone the dog brought was heat altered. So, a deceased human was in the house.

The firemen and the police took me into the house, which had no walls or roof, and into the “living room,” where another rib had been found by investigators. The person must have fallen asleep on the sofa and burned in the fire, the police and fire investigator said. I looked around and pointed to an area of the destroyed house off to the left of the living room. “What was that room?” “That was the kitchen,” a fire investigator said. Now I recognized a stove amid the burnt debris. “Your body will be in the kitchen,” I said. “The bone was out here,” the fire investigator said. “Dogs find things, but the flies are in there,” I replied.

HISTORY BEHIND FORENSIC ANTHROPOLOGY AND CADAVER DOGS

The origins of forensic anthropology come out of the scientific endeavors of individuals who studied and practiced anatomy, chemistry, and medicine. Some of those individuals were on the fringes of archeology, assisting in the analysis of skeletal remains of prehistoric Native Americans. For example, Joseph Jones, a doctor, analyzed skeletal remains from stone box graves in Tennessee, providing data on cranial measurements, cultural modifications to the cranium, and pathological diagnoses on the skeletons (Jones 1876). He even did thin sections to analyze the microstructure of bone. George Dorsey (1868–1931) was probably the first forensic anthropologist. Being a curator of physical anthropology at the Field Museum in Chicago, a professor of comparative anatomy at
Northwestern University, and a professor of anthropology at the University of Chicago, his career was marked by a dissertation on mummies from Peru. His claim to fame was being the first anthropologist ever to testify in an American criminal trial, and it happened to have been in the famous murder trial of Adolph Luettgert, a Chicago sausage factory owner who was thought to have killed his wife in 1897 and made her into sausage. Dorsey was an expert witness for the prosecution, and his testimony was controversial but resulted in Luettgert being convicted. It also resulted in a backlash toward Dorsey, primarily from experts for the defense, that ended in his resignation from the museum and universities he was associated with and resulted in his pursuing other interests besides osteology and anthropology (Kleping 2006, pp. 9–11).

During the early part of the twentieth century, an anatomist, T. Wingate Todd, continuing the work of Carl August Hamann, helped create a collection of human skeletons derived from modern cadavers that were documented with sex, age, stature, and ethnicity, as well as data on birth, occupation in life, and cause of death (Byers 2011). Early development of forensic anthropology during the 1930s and 1940s involved physical anthropologists attached to museums or working for salvage projects associated with the New Deal programs set up by Franklin D. Roosevelt. Physical anthropologists analyzed the skeletons salvaged from excavation of archeological sites that were endangered, practicing their skills at skeletal analysis, but for the most part, they did not involve themselves in criminal cases. In 1939, Wilton M. Krogman again put physical anthropologists on the radar for criminal investigation. Krogman had an article published in the FBI Law Enforcement Bulletin (Krogman 1939) that alerted law enforcement to the skills of physical anthropologists. Krogman eventually wrote the first textbook for forensic anthropology (Krogman 1962).

World War II, the Korean War, and the Vietnam War promoted the use of physical anthropologists and thus furthered the amassing of knowledge that would later be used in the developed field of forensic anthropology (Nafte 2000). Dr. Charles Snow and Dr. Mildred Trotter worked at identifying war dead and developing better ways to analyze human remains at the U.S. Army’s Central Identification Laboratory established in 1947 in Hawaii. Korean War dead were identified by physical anthropologists such as T. Dale Stewart, Thomas McKern, Ellis Kerley, and Charles Warren. The work by McKern and Stewart resulted in the publications of Skeletal Age Changes in Young American Males (1957) and Personal Identification in Mass Disasters (Stewart 1970), which became standard works that have paved the way for further developments in research on and determination of sex, age, and ethnicity in the skeleton (Pickering and Bachman 1997).

In 1979, forensic anthropology became defined as “the applied branch of physical anthropology that deals with the identification of more or less skeletonized human remains for legal purposes” (Stewart 1979, p. 169). The phrase “mass disaster” in the title of Stewart’s 1970 publication would develop a wider definition in the latter half of the twentieth century and the beginnings of the twenty-first century, and forensic anthropologists began assisting with plane crashes, space shuttle explosions, terrorist activities, and war and genocide atrocities with accompanying mass graves. Forensic anthropologists, since 1993, have been active participants in the Disaster Mortuary Operational Response Team (D-MORT) in the U.S. Department of Health and Human Services (Kennedy 2010).

Those individuals practicing forensic anthropology today apply standard physical anthropological methods and techniques to identify human remains in order to aid the legal process and to verify human rights violations. In Italy, there is a recent appeal for “a geo-archaeological protocol” for handling a crime scene (Barone et al. 2015). This standardization of protocol, while not always regimented in its procedural order in the United States, approaches a crime scene and the identification of human remains with a multiplicity of disciplines that involve not only forensic anthropologists but also the expertise of geophysical scientists, forensic pathologists, forensic odontologists, entomologists, and homicide investigators. All have the goal of understanding the evidence presented by human remains and the crime scene in order to determine the manner of death, whether by foul play, accident, or natural causes. Concomitant with this combined effort of detection comes the increased involvement by the forensic anthropologist in the recovery of not only skeletonized remains but also various states of decomposing human remains (Komar and Buikstra 2008).
This interest in the decomposition of human remains by forensic anthropologists has had a long evolutionary history and involves paleoanthropologists, paleontologists, and archaeologists (Vass 2001). Archeologists, when confronted with a human skeleton in a burial pit, invariably want to know if all of the remains are present. So do paleontologists when they find animal fossils and paleoanthropologists when they find early hominid remains. In some cases, the remains are not all present, and the question is why they are not. The study that pertains to the laws of burial is called taphonomy. What forces move and alter the original position of the body where it was originally deposited at death? Early studies examined movement of bone by water, wind, animals, man, plants, gravity, freezing, heat, and even seismic activity (Chapman and Anderson 1955; Wood and Johnson 1982, Figure 31, for seismic effect).

Seminal studies of taphonomy and fossil death assemblages (Behrensmeyer and Hill 1980; Binford 1981; Brain 1981; Shipman 1981) paved the way for studies on human forensic taphonomy that continue to this day (Haglund and Sorg 1997, 2002a; Pokines and Symes 2014). These more modern studies of taphonomy involve soil effects, plant and animal movement, and alteration of bone (e.g., Alexander et al. 2015; Pokines 2014; Pokines and Baker 2014); movement by water (e.g., Brooks and Brooks 1997; Evans 2014; Haglund and Sorg 2002b; Nawrocki et al. 1997); effects of heating, cooling, freezing, and thawing (e.g., Junod and Pokines 2014; Symes et al. 2014); and cultural alterations to bone and movement by man (e.g., Congram 2014; Paolello and Klales 2014).

Many forensic anthropologists have training in archeology and are versed in the recovery and documentation of items (skeletal remains) deposited on the ground surface or buried subsurface. It is at this juncture that the forensic anthropologist meets the cadaver dog.

SEARCH FOR REMAINS AND RELIABILITY OF CADAVER DOGS

Early search methods for human cadavers (as suggested by Boyd 1979; Morse et al. 1981; Skinner and Lazenby 1983) included the use of infrared aerial photography, the visual search of an area by investigators, and the use of a probe along with a methane gas detector (Killam 1990, p. 235). Killam (1990) suggested that three other methods be added to the search methods for detection of human remains: air-scenting dogs, ground-penetrating radar (GPR), and “electromagnetic (sling-ray) profiling.” With the onset of decomposition of a cadaver, Killam recommended the use of air-scenting dogs and suggested that the use of a dog-and-handler team, as opposed to human searchers alone, would lead to faster recovery of the remains. The dog–handler team also would do the least amount of damage to the crime scene and were an option “certainly more economical and manageable than a host of pedestrian searchers.” Today, GPR and cadaver dogs are commonly used in concert, with the cadaver dogs being a “minimally invasive search technique” (Ruffell et al. 2014, p. 144). Ruffell notes that in one recent case, dogs helped provide “additional evidence that satisfied the police,” which led to the removal of the concrete in a basement floor, which yielded, after excavation, the remains of a missing person.

In the late 1990s, I was called out on a case that involved heavy-equipment grading of the top of a hill at a suspected neo-Nazi camp in the woods. A body was believed to be buried on this hill. Search dogs had been brought out previously and had shown some interest in areas on the hill. So, a full search by authorities was undertaken, and my anthropology graduate students and I came along to offer assistance if human remains were found and to help locate the limits of a possible burial pit. Dogs were brought out again before the bulldozer went to work. The dogs indicated on one specific area. The area did look disturbed and irregular, with stained soil on the ground surface. We methodically started to excavate. What we uncovered was a burnt tree stump. The dogs had indicated on a buried burnt decomposing tree. And after excavation, there was no possibility of a body being at that location. The bulldozer took over, taking soil off the top of the hill in small measured increments in order to provide a clean surface for us to examine for evidence of a pit that would yield a body. There was no pit or body found that day. The police started to bad-mouth the dogs and the handler. This had happened at two other searches that I had attended prior to this particular search.
I knew the dogs could find things but questioned how reliable dogs could be at finding human remains and how reliable the handlers were at recognizing the indications made by the dogs. I had queried a few handlers at the time and asked them about the materials that they used to train their dogs. I was told they used anything from cast-off teeth from dentists and toenail clippings to blood-soaked cloth provided to them by medical examiners.

Enter an inquisitive undergraduate student named Alanna Lasseter, who wanted to do a forensic anthropology project with me. I asked her if she wanted to test the reliability of cadaver dog-and-handler teams, and that is what we set out to do. I searched and found, 20 mi. from the University of Alabama, a trainer of cadaver, search-and-rescue, and drug and explosive detection dogs. The trainer runs the Alabama Canine Law Enforcement Officer's Training Center (ACLEOTC). The facility includes over 150 ac. of land, about 68 ac. of which is used for training. The trainer, Rick Farley, was amenable to the idea of testing the reliability of dogs and handlers because he knew that the dogs could in fact detect cadaver scent. Any problem was most likely in the training of the dog to detect the correct scent and in the training of the handler to understand when the dog was indicating on the scent. We all felt that dogs and their handlers working in the humid southeast would face wholly different problems in detection from dogs and handlers based in other regions of the United States.

At the time, there was one other forensic anthropologist I knew of who had actually tested cadaver dog abilities, and that was Debra Komar (Komar 1999). A chapter by France et al. (1997) entitled “NecroSearch Revisited: Further Multidisciplinary Approaches to the Detection of Clandestine Graves” in an important book on forensic taphonomy by Haglund and Sorg (1997), alludes to the fact that a decomposition dog’s success is tied to weather conditions. With temperatures in excess of 85°F (30°C), a dog will be in discomfort and less able to detect a scent and will generally need to be within a meter of a buried source to locate it (France et al. 1997, p. 506). Conversely, lower temperatures also make it difficult for a dog to locate a scent at a distance, “especially if the source is buried” (France et al. 1997, p. 506). It was Komar (1999) who first tried to test the detection of cadaver scent by dogs in colder temperatures, finding that dogs could indeed locate human bone on the ground surface in colder temperatures.

In 2001, fresh human and animal remains, along with animal and human skeletal samples, were buried in May by Lasseter et al. (2003). With support from the medical examiner at the Alabama Department of Forensic Sciences, fresh human remains in the form of gauze that had been soaked by placement inside a cadaver’s open autopsy, and fresh animal remains from a meat department of a local grocery store, were obtained. Skeletal remains consisted of forensic material donated for the purpose of scientific study. Both the fresh and skeletal materials were buried in five field areas, each measuring some 50 × 100 yd. One field was an open grassy area ringed by woods, a second field was on the edge of some woods, and the other three “fields” were areas that were deep in the woods. Each field was separated by close to a quarter mile. The fresh and skeletal portions were buried approximately 1–2 ft. deep. Out of 20 dog-and-handler teams contacted, four teams agreed to search the areas, and the search took place during the months of July and August. Various dog breeds were used (two German shepherds, a rottweiler, and a Labrador), aged from 1 year 8 months to 10 years, not all certified, trained on pseudo and real materials, with years of training ranging from “sporadic” to 8 weeks to 7 years. One team had no case experience in the field, while another team had 100 cases of field experience. Three of the teams had worked with the state police and the Federal Bureau of Investigation (FBI). Temperatures for the search ranged from the low 80s to the low 90s (°F), and the humidity ranged from 50% to close to 75%. During the search, the teams were videotaped to document handler-and-dog interaction.

One important finding of the Lasseter et al. (2003) study was the fact that the “dogs were consistent in finding dry human bone.” All of the dogs were able to narrow the search or give an alert, but one dog provided an alert that went unrecognized by the handler (which some would call a “miss”), for the areas that contained skeletal remains at some point throughout the trials. The dogs were more readily able to discover buried skeletal remains as opposed to buried fresh remains (15% versus 10% of tests respectively). One dog team found a small skeletonized human cervical vertebra
that was buried 2 ft. deep in a heavily wooded search area. This was 2 months after burial. In addition, the study found, through the examination of the videotapes, that dog handlers sometimes failed to understand what the dog was telling them. Thus, alerts sometimes went unrecognized by the handler. A dog might give an indication but not the indication it was taught to give. A dog might be pulled away from a search area when the dog had not finished searching. One dog lay down on the exact spot where something was buried, and the handler took it as a sign that the dog wanted water when in fact, the dog appeared to have been indicating that it had found something. The 2003 study indicated that standardized training was needed for all dog-and-handler teams and that skeletonized bone could be found and needed to be added to the training materials for the cadaver dog (Lasseter et al. 2003). Recently, Riezzo et al. (2014) examined cadaver dogs’ ability to detect low concentrations of human cadaveric blood among confounding substance odors. Dogs that were well trained were able to discriminate between the confounding odors (e.g., food remnants, dog menstrual blood, synthetic detergent, swine blood, urine contaminated by blood) and the human cadaver blood even in low concentrations, which indicates “high levels of olfactory sensitivity.” The well-trained dog can “identify traces of blood that cannot be perceived by the human eye” (Riezzo et al. 2014).

LOCATING ANTIQUATED BURIED HUMAN BONE

One of the problems that bioarchaeologists face when they are actually trying to locate prehistoric and historic graves with their included skeletal remains is the fact that they are dealing with the extreme end-stage decomposition of the human body, the presence of primarily bone. Even in modern forensic cases where police are trying to locate buried human remains that have been subsurface, or on the ground surface, those fresh remains can become bone at a very fast rate. This depends on geographical, environmental, and taphonomic conditions. A carcass in the southeastern United States can become skeletonized extremely fast. In one unscientific test case using two newly dead goats (not sacrificed for this study) placed on the ground surface in Moundville, Alabama (near Tuscaloosa), during the summer (July: average high temperature 93°F, average low temperature 72°F; average precipitation in inches 5.12, per U.S. Climate Data 2015), the goats had fully decomposed to bone within 2 weeks. Temperatures were high, and maggot masses were extremely large and very active on these remains, as could be expected. Of course, a buried body decomposes at a different rate from an exposed body, and that also is dictated by geographical, environmental, and taphonomic conditions (Galloway 1997; Manheim 1997; Micozzi 1997; Pokines and Baker 2014; Rodriguez 1997; Vass 2001, 2012). It is the skeletonized buried body that some bioarchaeologists have become interested in finding with cadaver dogs.

Martin et al. (2012) tested the ability of cadaver dogs to locate historic human burials that have been buried for over 70 years. The burials were located in a family cemetery in Tuckasegee, North Carolina. The graves included modern marked graves and unmarked graves with limited documentation as to their actual location. Some of these graves were upward of 200 years old. First, GPR, a proven technique for locating historic graves (Conyers 2006; Dupras et al. 2006), was used, and this helped locate the coffins and grave shafts. Then six cadaver dogs and four handlers were deployed to search the same area. It was found that GPR was most successful with detecting more modern graves, where remnants of the coffins and the actual burial pits could be discerned. GPR was not as reliable for the older, more historic burials. Conversely, the cadaver dogs had success with detecting the older historic burials “where remains were likely in advanced states of decomposition due to minimal embalming and coffining” (Martin et al. 2012). The authors indicate that both GPR and cadaver dogs should be used together to maximize detection of graves, just as Killam (1990) had previously done.

In a similar examination of a historic home and accompanying cemetery, the Office of Archaeological Research at the University of Alabama was contacted to do a remote sensing analysis of the Weissinger home site. The main impetus behind the project was to locate possible cultural deposits and to attempt to detect the presence of a cemetery. Archeological investigations of certain areas were undertaken by members of the 36th Expedition run by the Alabama Museum of Natural History. GPR was employed to “determine the horizontal and vertical extent of cultural bearing
deposits with primary focus on identifying the location of the cemetery, any structural remains and associated features of the house structure (e.g., foundation piers, wells, possible privies, refuse deposits, and other aspects of the landscape at the time of the original occupation)” (Thompson and Gordon 2014). In January of 1822, George Weissinger had purchased land in Perry County, Alabama, to develop into a plantation. He would die in 1837 and be buried on the property, and other family members would be buried in the family cemetery as well. The plantation home would have different owners and burn in a fire in 1918. Grave markers were recognizable into the 1930s. Then, gravestones that marked the place of six individuals were removed, which, according to Charles Weissinger, a descendant, was done to facilitate plowing (Thompson and Gordon 2014, p. 3). A gradiometer investigation of the property by Haley (2011) uncovered a scatter of debris and brick located subsurface that was associated with the house, but he did not succeed in locating a cemetery. A GPR survey (Jones 2010) offered potential areas for location of a cemetery. In 2012, four human remains detection (HRD)-certified dogs and handlers from the Institute for Canine Forensics were brought in to conduct a search of the area for a cemetery and its human remains. The dogs had previously been successful in locating many buried human remains: one instance included discovery of remains from the Donner party (from the mid-nineteenth century) located in the California mountains (Grebenkemper et al. 2012; Thompson and Gordon 2014). The dog-and-handler teams searched areas of the plantation labeled A through H and an associated ravine. The dogs did alert in various of the lettered areas, and those alerts varied in quality from 1 through 3 (1, scent alert = undecided on exact location, possibly disturbed/scattered; 2, committed = holds alert, took time to locate main source of scent; and 3, strongly committed = committed to a specific location, will repeat alert on same location; terms of the Institute for Canine Forensics, 2012, http://www.hhrrd.org/). Numerous red ant hills were alerted on. It is known that ants can feed on corpses and are more likely, as predators, to feed on the other insect species that are helping to decompose the corpse (Anderson 2001; Goff and Catts 1990; Wells and Greenberg 1994). In addition, ants move all sorts of things, bone and tissue included.

The dogs and handlers found that one area, area E, had a high probability of including human remains subsurface, and E was noted as an “area of interest.” Jones (2011) followed up by examining the area of interest and other areas with further GPR surveys, which yielded negative results. A backhoe was brought in, area E was dug to 6 ft. below ground surface, and no evidence of burial pits or human remains was located. Archeological investigations of the noted subsurface features thought to be associated with the house found through GPR and gradiometer did uncover those structural elements that were part of the house. Test trench excavations in areas other than area E failed to uncover evidence of the Weissinger cemetery.

One aspect of current research that could help with the detection of older graves and end-stage decomposition of a set of human remains is further training of dogs. When a dog searches an area with known buried skeletal remains and fails to detect the remains, then further training of the dog to detect a fainter and fainter scent of the skeletal remains might prove beneficial. In 2005, fresh and decayed human parts (donated) and animal materials were buried in a field belonging to Rick Farley at the Alabama Canine Law Enforcement Officer’s Training Center facility near Samanatha, Alabama. The location (coordinates) of these remains was documented. Our intent was to bring out dog-and-handler teams to the field after an extended period of time to determine the reliability of those teams in the detection of decomposed human and animal cadaver material. Originally, we planned to have teams search the field close to a year after the material had been buried. That did not happen. It is now 2015, some 10 years after the burial of the items, and dog-and-handler teams are being invited to search the field. While search of the field by teams is in its introductory phases, it is expected that while there may be success from some dog-and-handler teams, there will also be failure by some teams to detect the material. That is where proper training of the dogs to detect smaller and smaller amounts of the tail end of the process of decomposition (which includes primarily skeletal remains) may in fact help create future successful outcomes in detection by cadaver dogs, especially with buried remains.
Because the remains have been buried at the Alabama Canine Law Enforcement Officer’s Training Center for 10 years (since 2005), the ability of dogs to detect residual human cadaver scent off of the buried skeletal remains is problematic with the current training by dog-and-handler teams that uses synthetic canine training aids. Odors emitted through decomposition change, as indicated by insect studies showing that cadaver odor becomes more attractive to certain species of insects at one stage of decomposition and more attractive to other species at another stage of decomposition (Anderson 2001, p. 144). It was with this change-in-odor problem in mind that we tried to assess the effectiveness of the commercially available pseudo corpse scent produced by Sigma-Aldrich Co. The intent was not to demean the product for its attempt to assist in the training of cadaver dogs, but it was felt that the product did not truly cover the entire spectrum of human remains decomposition odor, falling short on the spectrum end that includes skeletonization. Pseudo scent formulations 1 and 2 were newly obtained in order to identify the primary chemical components using gas chromatography and mass spectrometry. Formulation 1 is used for early detection and in environments below 0°C. Formulation 2 is for postputrefactive detection. The results of the analysis detected “GABA, 2-pyrrolidone, and DBU” in formulation 1 and gamma-aminobutyric acid (GABA), 2-pyrrolidone and DBU, and “putrescine or 1,5-diaminopentane” in formulation 2 (Foye 2014). These findings corresponded well with a more detailed study by Stadler et al. (2012) even though the experiment “was only conducted in 1-D GC/MS, yielding a much lower resolution” (Foye 2014). It was determined that even though the compounds that were isolated in the pseudo scent are some of the elements that make up decomposition odor, they may not be the primary components that are necessary to accurately mimic the odor of human decomposition and may not reflect all of the spectrum of human decomposition. (For further discussion of the chemistry of human decomposition, see Chapter 9 herein.) Stadler et al. (2012) found that the pseudo scents were “oversimplifications of the decomposition odour and do not contain compounds that have been previously reported within the headspace of decomposition.” And like the Foye (2014) study, Stadler et al. (2012) feel that a pseudo created with a “larger variety of compounds that represent the variation seen during decomposition would be beneficial” and make a “more effective canine training aid.” Vass (2012, p. 240) indicates that the accurate prediction of which compounds will exist at any specific decompositional event is difficult because “the mechanisms of compound formation and the taphonomic influences are not yet fully understood.” But Vass’s list of odor mortis compounds and taphonomic variables provides a basis for what compounds should be present at a decompositional event (see Table 2 in Vass 2012).

Forensic anthropologists have often been privy to conversations both praising and criticizing dog-and-handler teams brought in to search a site in question. In the past, the negatives have come from the underlying beliefs that while it is known that dogs can sniff out drugs, explosives, and living people, it is harder for them to detect residual cadaver odor because accelerated dehydration of human remains makes the odor decrease (Galloway 1997). In addition, part of this difficulty in detecting residual cadaver odor is also due to the fact that it is hard for volunteers to access actual human remains to train their dogs. Sometimes, the human remains can be hazardous to both the dog and the handler. So those who train dogs occasionally resort to using pseudo scents. Pseudo scents are chemical concoctions that artificially recreate a scent that is supposed to resemble the odor of human decomposition. It is difficult to develop a scent or series of scents to mimic the stages of decomposition.

Forensic anthropologists such as Bill Bass, with his Body Farm, and subsequent faculty members and students at the University of Tennessee, as well as other universities, have worked for many years examining the decomposition of the human body in various situations and climates (Bass 1997; Galloway 1997; Gill-King 1997; Rebmann et al. 2000; Rodriguez and Bass 1983; Ross and Cunningham 2011; Stejskal 2013). There are basic stages to decomposition of the human body:

1. Three stages when the body is in a putrid phase
2. Three stages when it is in a bloating phase
3. Four stages of a body destruction and decay phase (Rebmann et al. 2000; Stejskal 2013)
Galloway (1997) notes five phases:

1. Fresh
2. Early decomposition
3. Advanced decomposition
4. Skeletonization
5. Extreme decomposition

Whatever the process through the spectrum of decomposition, future efforts need to be made to train dogs on actual decomposition materials that reflect this entire spectrum, from a freshly deceased body to dry bone skeleton, and/or to develop not only pseudo scents that cover the early stages of decomposition, which they currently do, but also fainter scents that mimic the dwindling decomposition scents found in skeletal material.

CADAVER DOG AND SCENT OF BURNED OR CREMATED HUMAN BONE

While cadaver dogs can detect the varying stages of decomposition, including skeletal remains, if the dogs are trained properly, they also can detect human cremated bone. Fairgrieve (2008, p. 64) found that a dog trained correctly can detect cremated human bone even when it is largely devoid of its organic components (heavily calcined). The detection of cremated remains hinges on the availability of the scent in the air. If the scent is locked into the soil, i.e., buried subsurface, successful detection lessens. (See Chapter 8 herein regarding the aerodynamics of odor.) So, Fairgrieve (2008) suggests that at a fire scene, a soil auger 1 in. in diameter be used to probe soil disturbances to help potentially release human remains cremation scent and increase the availability of that scent into the air, and the turning of the soil exposes scented soil.

In addition, dogs are able to find where cremated human remains had been. A fire pit was indicated by an informant as the location of some missing people. Two separate cadaver dogs “indicated on a series of large stones used as part of the boundary of the pit” (Fairgrieve 2008, pp. 65–66). These stones, when analyzed, were found to have charred bits of human flesh. The pit, when examined, had only a portion of a human hand. The question remained, where were the rest of the remains of the missing individuals? The dogs continued to search the area and indicated on the joists of a small wooden bridge built over a creek. Cremated human material had gotten stuck in the bridge joists. Subsequently, after a search near the bridge of the creek floor some 3.5 ft. in depth, some cremains were found. An accomplice indicated that after the burning, they had dumped the cremated remains off the bridge and buried the rest in a pit on the property.

POSITIVE AND NEGATIVE: JUDICIAL CASES WITH CADAVER DOGS

Some recent court cases are worth discussing as to issues that are arising for scientists, including the author, who are involved in cadaver dog testimony.

WISCONSIN v. EUGENE J. ZAPATA

In 2007, I was asked to evaluate documentary materials on two dog-and-handler teams that were going to be involved in the case of State of Wisconsin v. Eugene J. Zapata (2006CF001996). I would serve as a witness evaluating the dog-and-handler teams. The case involved a wife named Jeanette Zapata who was missing from her home in Madison, Wisconsin, since 1976. The thought was that her husband, Eugene Zapata, may have killed her. There was no body. Dogs were brought in to search the properties where Eugene Zapata was known to have visited: his home on Indian Trace, a storage locker in Sun Prairie, and his car, among others areas. Carren Corcoran and her dogs, Cleo
and Norse, and Theresa Christ and her dog Sammie were the dog-and-handler teams involved. The documentation I was supplied included information on each dog’s training as it related to searching for living and dead humans. The information included discussion on the conditioning and agility exercises as well as obedience training required for the dogs to become cadaver dogs and search-and-rescue dogs. Documentation was provided showing the training of the handlers as well. The handlers noted the body language the dogs provide when they come in contact with the odor of human remains, actual deceased human remains, and distractions. The distractions included animal bone, actual living people, other dogs and animals, a child’s toys, sardines, rabbit and squirrel hair, and dead mice.

Corcoran’s dog Cleo had been trained on various aids to detect human remains during sessions from 2000 to 2006. The aids included animal bone (turkey, turtle, and deer, for example); animal tissue (dead mice); animal blood (pig); body wipe from a human cadaver; cadaver water; human teeth (dry and bloody); burned human teeth; human skeletal remains (modern fresh and dry); historic skeletal remains (Cleo indicated on buried human remains in a historic cemetery that was used from 1878 through 1914); historic and prehistoric Native American human skeletal remains (whole and fragmented remains); burned human bone; human tissue; human brain matter; a mummified finger (1–2 years old); one-half of a human cadaver; decompositional materials from a human cadaver; a human scalp portion that had been decomposing for 2 years; grave dirt, dry; grave dirt, wet; adipocere; placenta (also frozen placenta); umbilical cord; foreskins; human hair; and burned human hair.

Corcoran also trained Cleo to detect smaller amounts of human material. She started with a general search and then progressed to a more detailed and specific search, which allows the dog to pinpoint smaller human body materials. For example, Cleo was able to detect a small amount of human hair placed under a brick in a hallway (documented 1/26/02). Cleo also indicated on a trace of brain matter in a puddle of water (documented 5/16/02). At times, Corcoran made a handler error, which she was able to sort out and correct. Cleo indicated on a small toy, and Corcoran said “no,” but in reality, the dog was correct (documented 1/14/03). In actuality, there were two human teeth with the toy. So, Corcoran subsequently rewarded the dog, indicating that the dog was fact correct.

Theresa Christ trained Sammie to be able to detect human remains by using the following aids during training sessions during the years 1999 through 2007: animal tissue, animal bone (including fresh pork bone), body wipe from a human cadaver, cadaver-scented tennis balls, Native American skeletal remains (both historic and prehistoric), baby teeth, adult teeth (dry and with blood), human blood, pig blood, modern human bone (complete bone and bone fragment), nail clippings, human brain matter, placenta, baby umbilical cords, methane, baby hair, adult hair, burnt bone, burnt teeth, grave dirt, adipocere, calf tissue, decompositional materials from human cadavers, and cadaver brick. The wide variety of actual human body material used in the training of these three dogs is important in that it made these dogs very good at discerning human cadaver residue.

Five videotapes taken of the dog-and-handler teams in the act of searching areas relevant to the Eugene Zapata case were offered for examination and evaluation. The tapes were provided to me without sound, which was frustrating, as I was supposed to evaluate the video for indications made by the dogs in question. This lack of sound was critical because an important part of an indication/alert by the three dogs was a bark, which of course could not be heard on any of the videos. So, as an evaluator working with only the silent movements of the dog and handler on the tape, I had to focus more intently on the face and body language of the dogs in order to pick up when I thought the dogs were indicating. And, of course, I could see the bark action. The lack of sound prevented me from hearing any discussion about what areas the handlers had cleared and any discussion by the handlers and police about the search areas. Even with those restrictions, I could see that the dogs did provide clear indications that human cadaver residue was present at the search areas. I was advised that Corcoran and one of her dogs searched the self-storage facility in February 2007. The dog indicated at a specific storage unit door multiple times (both outside with the door closed and, with the door
open, inside the same unit) during a comprehensive search in which the dog did not indicate at other storage units. In a search of a car in question, two dogs indicated on the trunk of the car.

While cadaver residual odor was present, detected by dog-and-handler teams, recorded by video, and witnessed by an evaluator by visual inspection of silent videos, the circuit court judge for the Zapata case denied the admission of the cadaver dog evidence. The judge relied on Brooks v. Colorado.5 The judge found that the canine-produced evidence was relevant and the witness concerning that evidence qualified, but determined that the admission of the evidence would not assist the trier of fact (the jury). The judge also, citing Brooks, said that the dogs were of a breed characterized by an acute power of scent and had been trained to detect human remains, but determined that the dogs had not been found by experience to be reliable in detecting or alerting to human scent remains. He made no decision on the question of whether the dogs were “placed on the trail where the person being tracked was known to have been,” an issue primarily for tracking dogs. As to the question of whether the dogs detected the odor of human remains within a reasonable time frame, the court said it did not have to reach that issue. The court believed that a cautionary jury instruction would be insufficient to overcome the possibility that the canine evidence could be more prejudicial than probative because people, because of legend, rumor, or experience, would give the canine evidence more credence than the statistics would support. The judge indicated that to establish the dog’s reliability might have required further investigation of the areas searched.

The Zapata trial ended with a deadlocked jury. In October 2007, less than a month after the mistrial, prosecutors requested a retrial. With the retrial looming. Eugene Zapata admitted that he killed his wife with a draftsman paperweight, strangled her, and wrapped a cord around her neck. The body was placed in a poplin tent placed in a car and taken to a farm field. Later, the remains were moved to a storage locker in Sun Prairie and then disposed of in the Juneau County landfill (Treleven 2008). So based on the statement by Zapata, the dog-and-handler search teams that searched the car and storage locker facility very likely did detect residual cadaver odor.

**California v. Lyle Herring**

Other courts have admitted evidence of a cadaver dog to establish the presence of a body. In a recent California case, California v. Herring,6 the defendant, Lyle Herring, also was found guilty of murdering his wife without the presence of a body as evidence. Herring appealed the guilty verdict, saying the cadaver dog evidence was improperly admitted. This appeal was rejected and the judgment affirmed. The crux of the appeal involved the attempt to exclude the cadaver dog evidence because it “lacked foundation and corroboration” under the California Evidence Code. California v. Malgren7 sets requirements for admitting dog-tracking evidence:

1. The dog’s handler was qualified by training and experience to use the dog; 2. The dog was adequately trained in tracking humans; 3. The dog has been found to be reliable in tracking humans; 4. The dog was placed on the track where circumstances indicated the guilty party to have been; and 5. The trail had not become stale or contaminated.8

In a quick synopsis, Lesley Herring and Lyle Herring were having marital difficulties. On or around February 9, 2009, Lesley went missing. A neighbor, after walking his dog, saw Lyle when the elevator door opened at the first floor. Lyle had a 6 ft. tall × 2 ft. wide dolly with a large 5–6 ft. × 10–12 ft. rug. Lyle looked crazed. Later, around midnight, Lyle was seen pushing an empty dolly. Lesley never showed up to work and did not call anyone. After the disappearance, Lyle gave his son his Cadillac, and his son installed subwoofers in the back of the car. Lyle tried to enter Mexico supposedly to look for Lesley because he and his wife had planned to spend vacation time in that country. He was detained. Later, an investigator inquired in Mexico if Lyle ever asked about his wife when he went to Mexico. He had not.
A cadaver dog named Indiana Bones (Indy for short) was used in searches by Karina Peck, who operates out of the Los Angeles County Coroner’s Department. Indy and Peck had trained for over 690 h together. The dog had located 752 training aids with only 3 false alerts, which makes the dog’s “training reliability...99 percent.” On February 19, 2009, Indy searched Lesley’s condo and related areas, such as the carport where she parked her car, Lyle’s parking space, a walkway behind the condo, and a storage unit in Burbank, and none of these places made Indy alert. Indy did alert on the “base of the garbage trash shoot in the complex, although he did not alert to the trash access point near Lesley’s condo.”

The next day (February 20), Indy searched a tow yard where both Lyle’s and Lesley’s cars were being held along with another car. Peck let Indy go with no prompting, and Indy went to the rear of a Mitsubishi and “alerted to an area of the rear of the vehicle where the floor carpeting meets...the plastic trim of the edge of the rear compartment.” This area was removed, and Indy did not alert in this area again. At a later date (February 25), Peck and Indy returned to the same facility to search Lyle’s Cadillac. Indy alerted in four areas: the driver’s-side floor mat, the backseat floor where there happened to be some speaker wires, a hole where speaker wires exited, and trunk mats. Peck and Indy also alerted on two dirt piles near a merry-go-round in Griffith Park, an area where Lyle had been seen after Lesley’s disappearance.

The court, on appeal, addressed Herring’s contention that the cadaver dog evidence was inadmissible, stating that even though the trial court did not “discuss each Malgren factor,” it had “clearly considered those factors, because the court had read the parties’ papers, which discussed Malgren.” Then each factor was addressed, showing that under Malgren, there was “sufficient foundation to admit the cadaver dog evidence...” Peck and Indy were adequately trained and had extensive experience, with Peck certified as a handler (factor 1). It was found since that the job cadaver dogs do is “analogous to what tracking dogs do, the foundational element was therefore satisfied” (factors 2, 3, and 4). Evidence pointed to the possibility that Lesley’s body may have been placed in “one or more of Herring’s cars: on the night Lesley disappeared, witnesses saw Herring pushing a dolly and a large rug to the garage.” As to the fifth factor involving staleness or contamination of a trail, “if say a blood swatch or an entire decedent was completely contained and not touching directly, the fact that it was placed in a vehicle, the scent emanating from that would be collected in that vehicle and as it remains closed especially that odor will permeate [and] be retained.” These residual scents will be picked up by canines. Finally, the court of appeals found that other evidence indicating that Lesley was dead corroborated the evidence furnished by the cadaver dog.

**U.S. v. Edison Burgos-Montes**

Other courts have seen limits to cadaver dog evidence but have found that its admission was not sufficiently prejudicial to overturn a conviction. In the recently decided First Circuit case, **U.S. v. Burgos-Montes,** Edison Burgos-Montes, who had been convicted of killing an informant (Madelin Semidey-Morales, called Semidey) in order to either prevent the informant from testifying or as retribution for the informant giving evidence to the government, appealed his conviction on various grounds. Included in the appeal was a challenge to the testimony of cadaver dog handlers. At the trial, testimony was introduced that a cadaver dog had alerted when “led by an area on Burgos’ property where one of the officers had identified a possible grave site approximately six months before.” No bodies were found. The testimony was used to “suggest that, because the dog alerted, the jury could conclude that the location had, at one point, concealed a human cadaver.” Burgos objected to the testimony, questioning whether a “cadaver dog could reliably locate a spot in which human remains had been buried...and that the government had failed to lay a proper basis for its reliability under Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 113 S. Ct. 2786, 125 L. Ed. 2d. 469 (1993).” The testimony was allowed by the district court, and Burgos-Montes challenged the testimony on appeal. The United States Court of Appeals reviewed the objection and agreed with Burgos that the government
did not lay out much of a case that a dog could reliably identify a spot in which there had been (presumably months earlier) a human cadaver, as opposed to simply responding to animal remains or to the leash-holding handler’s conscious or unconscious cues. It is one thing to use a dog to identify a place in which one might look to see if human remains are present. It is quite another to use a dog to identify dirt that was once exposed to a human cadaver. The prosecution witnesses offered virtually no evidence that the scientific reliability of such a use had been established, or that their investigation protocols were generally accepted for such a use. Burgos’ experts...offered much common sense, noting, for example, that the officer using the dog on a leash that alerted...was the officer who had previously identified the suspected spot.

While the court agreed with Burgos on this objection, there was more than enough evidence to support the previous verdict of conviction of Burgos for murdering Semidey, so the admission of the canine evidence was declared harmless error, and no retrial was required.

**CADAVER DOGS AND DETECTION OF HUMAN REMAINS IN WATER**

In the 1960s, air-scented dogs that were part of the navy’s waterdog program were used in Vietnam to prevent attack by surface snorkelers and submerged divers swimming at important facilities such as bridges and docks along rivers and coastal shoreline. The use of air-scented dogs around water continued sporadically into the beginning of the 1980s to help search for missing persons who may have drowned (Ostarkamp 2011).

Dogs are commonly used now in water searches for possible submerged bodies. Studies to date have focused on fine-tuning our understanding of how scent-bearing materials that separate from a submerged body are transmitted through the water and into the air to be detected by air-scented dogs (Ostarkamp 2011). Recently, Healy (2010), while realizing dogs are a valuable source in detecting submerged remains, proceeded with an alternative detection method, side-scan sonar, to detect pig cadavers in submerged environments of Central Florida. Normally, a dog is placed in the bow of the boat or on an attached platform in front of the boat. The boat is low in the water, and the air-scent dog sniffs the air just above the water. Upon an indication made by the dog, a buoy is placed in the water, marking the area. (For the use of dogs on bows of boats to detect whale scat, see Chapter 23 herein.)

There are variables that can affect a dog’s ability to detect an odor, such as the temperature of the air and the movement of air between the scent and the dog, as well as the experience of the dog and handler (Healy 2010; Rebmann 2000). Healy’s (2010) side-scan sonar was successful in detecting submerged bodies in clear terrain in shallow lakes and ponds. Small bodies were better detected using a side-scan sonar of 1,800 kHz, 20 m swath width, while medium to large-sized bodies were better detected using a side-scan sonar of 900 kHz, 20 m swath width. However, Healy feels that with vegetation in the waterway that is involved with the terrain subsurface, divers, GPR, and water-search dogs are more appropriate for detecting a submerged body in these conditions (Healy 2010, p. 81).

**FUTURE DIRECTIONS**

The forensic anthropologist/bioarcheologist is intimately involved in the locating, excavation, and analysis of human remains. The laws of burial, taphonomy, and the process of decomposition are a primary focus of the bioarcheologist because that information dictates how mortuary interment behavior of prehistoric individuals is evaluated. Because of this interest, especially with skeletal remains, the forensic anthropologist can work in concert with cadaver dog-and-handler teams by increasing the effectiveness of recovery of surface and subsurface remains through ongoing training of teams that are trying to increase their expertise with the fainter odors associated with end-stage decomposition.
Cadaver dogs are often helpful during investigations and are often credited with finding bodies, after which other evidence is developed to conduct a prosecution. Cadaver dog evidence may be critical in the prosecution if a body is never found but the alerts of a dog corroborate other evidence indicating that there was a body at a location relevant to the prosecution's theory of the crime. Forensic anthropologists can help set protocols for the use of cadaver dogs because their taphonomic research can help describe aspects of the location where the body may have been buried or hidden for a time. Forensic anthropologists also can be involved in the training exercises and certification tests of cadaver dog-and-handler teams and help refine the search techniques of the teams. Better development of the detection of end-stage decomposition will help not only in locating the recently deceased but also in the pinpointing of historic graves in cemeteries with missing grave markers. Dogs find things. We all know that.

ENDNOTES

1. A program at Western Carolina University headed by Paul Martin and Professor Cheryl Johnston specializes in workshops helping cadaver dog handlers.
2. 975 P.2d 1105, 81 ALR 5th 779 (Colo. 1999).
5. See also California v. Craig, 86 Cal.App.3d 905, 150 Cal.Rptr. 676 (Ct. App. 1978).
6. 786 F.3d 92 (1st Cir. 2015).