



FORENSIC CREMATION

Recovery and Analysis

Scott I. Fairgrieve



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Dedication

This work is dedicated to my colleagues and students in the Department of Forensic Science at Laurentian University.

PREFACE

The objective of this book is to provide forensic professionals and students a synopsis of the challenges and practicalities of recovering and analyzing human remains that have undergone extreme levels of damage in fire contexts. Forensic anthropologists are often confronted with decomposing and fragmentary human remains that require analysis for identity and trauma. Human remains that have been burned to the point of little to no soft tissue remaining require special consideration by the analyst. The special consideration of which I speak begins right at the scene with the recovery of the cremated remains (or cremains). Many professionals who attend fire scenes, such as fire service personnel, fire investigators, forensic identification/crime scene investigators, coroners, and medical examiners, have a collective interest in the remains as well as the context in which the remains occur. Their collective expertise is needed for the successful interpretation of such fire scenes. However, the literature in this area, in general, does not consider the potential contributions of a forensic anthropological analysis. This book is to remedy this situation and provide an opportunity for forensic professionals to consider the recovery and interpretation of cremains from the point of discovery, through to the end of an analysis.

Although this book is not necessarily intended for experienced forensic anthropologists, those who have not had any experience with cremated remains may wish to go through the various chapters contained in this book in order to gain a knowledge base prior to casework. Other forensic professionals will benefit from the forensic anthropological perspective by instructing them as to the reasonable goals of the recovery and subsequent analysis of cremains.

The book begins with an overview of cremains in the forensic setting. This overview is important for those new to examining cremains as it will provide them with a range of contexts and the challenges that face those of us who process these scenes and perform the analysis of the cremains. This chapter also provides the reader with an appreciation of the wide range of preservation encountered in a variety of fire contexts.

The next chapter is a basic introduction to fire. This section is not meant for training individuals such as fire investigators, but it is really geared to those who in the forensic community, such as forensic identification personnel from police services, and even some forensic anthropologists, who have not had any formal training in fire as a mechanism for altering the chemical and physical properties of materials.

The cremation process as detailed in Chapter 3 of this book is primarily concerned with the means by which human tissues burn. Knowledge in this area is of the utmost importance as it has a direct bearing on one's ability to interpret the condition of the cremains, their position, and the circumstances in which the burning event occurred. This has implications for the means by which the recovery of the cremains proceeds.

The recovery of cremated human remains will be based upon the context of the cremains. This is true of all forensic recoveries of human remains. However, one must consider that cremains may be intermixed with building materials, automobile remains, or even buried in soil or submerged in water. The emphasis in Chapter 4 is that a flexible strategy to recover remains, while documenting their context, is essential to this process. As cremains tend to be extremely fragile, some analytical work must be undertaken at the scene during the recovery. Working closely with crime scene personnel will facilitate the safe recovery and documentation of the cremains at the scene. Documenting the location and position of the cremains can yield information that may affect the charges levied in a particular case.

Although some of the analysis may have had to be conducted, to a limited degree, at the scene, the full analysis of the cremains can be a long and labor-intensive exercise. Chapter 5 examines the physical alterations of bone by fire, including shrinking, warping, cracking, and fragmenting, and how they have important implications in the analysis of the cremains. This is particularly true for discriminating between fractures that are as a result of the heat from the fire, and those that are due to a perimortem trauma. This comes back to the idea of having a thorough collection of cremains from the original scene. Nonetheless, it is possible to generate a biological profile of the person in order to assist in finding candidates for identification.

The analysis of bone tissue that has been altered by the burning process, as presented in Chapter 6, will have implications for quantifying the histological differences between heat-induced fractures, and those that are from a pre-cremation trauma such as a gunshot wound or a cut mark.

The examination dental tissue for establishing a positive identification is typical in many fire scenarios. However, the extent of damage to dental structures and dental restorative materials and appliances by fire, may greatly affect a forensic odontologist's ability to establish identity. This is particularly true when the tissues surrounding the oral cavity have been eliminated by the fire and directly affected the enamel, dentine, and cementum. Chapter 7 provides the reader with a survey of the effects of fire on these tissues and how they may still be utilized in order to contribute to rendering an identity.

The ultimate goal of an investigation of human cremains in a forensic context is to answer who the individual is, where they died, when they died, how they died and by what means. The identity of the cremains is of paramount importance to the investigation as it not only puts a name to the remains, but is also provides new investigational leads. As indicated in Chapter 8, it is without question that the most common means by which to render an identification of human remains is through DNA and dental records. In the case of forensic cremains, DNA is extremely challenging, although worthy of consideration in some instances. All positive identification is predicated on having suitably documented antemortem medical records, such as dental radiographs, or other forms of radiographic material. In many cases, when medical records are either nonexistent or of such poor quality that they are unusable, a presumptive identification may be all that can be considered on the basis of the biological profile from the forensic anthropological analysis.

As challenging as the recovery and analysis of human cremains may appear, it is far from a hopeless situation. Cremains are able to provide extremely useful

information if those involved in the investigation can establish a team approach to these scenes in order to maximize the potential of the evidence.

The production of this book, although under sole authorship, is not accomplished without a team of very supportive people. This project came about several years ago due to my own involvement in recovering and analyzing forensic cremations. To that end, I wish to thank Dr. Barry McLellan, Chief Coroner for the Province of Ontario, Dr. David Legge, and Dr. Peter Clark, Regional Supervising Coroners for Northern and Eastern Ontario, respectively, for their continued support. The car and pit test fires were performed at the facilities of the Ontario Police College (OPC) in Aylmer Ontario. I would particularly like to recognize Mr. Jim Goodwin, from the Forensic Identification Training Branch of OPC for assisting with making the arrangements for fire permits and the resources to undertake these tests. Mr. Kim Adams deserves special recognition for all of his logistical support with obtaining automobiles to burn and the various fuel sources that were used in these tests. I would especially like to thank the Malahide Fire Service for providing me a house to burn down in these experiments. Mr. Rick Devine, team leader, and the other members of the Forensic Identification Training Branch of OPC, are thanked for their continued support during my stay at their facility. The pigs used in these studies were all humanely put down as a result of having an untreatable illness. No pigs were purposefully put down in order to perform this study. Other support in the field during these tests was provided by Ms. Tracy Oost, Curator, Department of Forensic Science, Laurentian University. Some preliminary library work was undertaken by Mr. Damian Fumerton. Further valuable advice and assistance with respect to finding obscure sources was graciously provided by Ms. Karen Neves of the W.K. Kellogg Health Sciences Library at Dalhousie University. Some assistance with manuscript preparation was rendered by Ms. Leeanne Croteau, departmental secretary. Finally, I would like to express my gratitude to my family for their patience and understanding during the past three years.

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1 Cremains in the Forensic Setting

1.1 INTRODUCTION

The study of the effects of fire, or any means of combustion, of human tissues is one that has always had forensic implications (*The Lancet*, 1893). The idea of disposing of human remains using fire is an ancient one (Baby, 1954). Archaeologically, funerary pyres, in one form or another, have been used as a means to dispose of bodies throughout human history and prehistory. Kaczmarek and Piontek (1982) note that cremation as a means of body disposal was spread in Central Europe from Neolithic times to the Early Middle Ages. Human cremated remains that have been dated to be as old as 25,000 to 32,000 years in the Lake Mungo region of Australia attest to the early practice of cremation (Bowler et al., 1970). Yet, as much as fire has the potential to destroy soft tissue and underlying hard tissues, namely bones and teeth, it is still noteworthy that it is almost impossible to completely destroy a body by fire or some form of combustion (Bass, 1984). The fact that human remains that have been “cremated” in archaeological contexts can be examined for determining the minimum number of individuals, age, sex, and even pathology, certainly suggests that the same should be possible in more contemporary situations (see Lange et al., 1987). However, the analysis of charred or cremated human remains in forensic contexts is far different from an archaeological analysis.

Although the practice of cremation appears to have been a common feature in human history and prehistory, the use of cremation in western society as a means of funeral disposal of Christians was wrought with controversy, particularly in Great Britain (Thompson, 1891). The controversy over cremation has been noted by various authors to be a means of body disposal that can have important forensic implications in and of itself (*The Lancet*, 1893). Recent reports of possible commingling of cremated remains (henceforth referred to as “cremains”) returned to a family in error or simply a family suspecting that the cremains received by them were either incomplete or altogether the wrong person have necessitated investigation by forensic anthropologists (e.g., Murray and Rose, 1993; Kennedy, 1999).

Yet, as far back as 1892, it was recognized that the cremation of human remains may be an avenue for criminals to destroy evidence (*The Lancet*, 1893). More recently, in Germany, a system was put in place to have all bodies that will be cremated examined by medical doctors in order to note external findings and to review the entries on the death certificate (Uchigaski, 2004).

In the Canadian context, the vast majority of forensic inquiries into charred remains and fire deaths are primarily related to house fires. Consider that from 1992 to 2001 there have been, on average, 377 deaths per year with 3,048 injuries in that

same span of time due to fires. With an average of 60,109 fires and an annual loss of over \$1.2 billion, fire is no small concern to the public at large (Council of Canadian Fire Marshals and Fire Commissioners, 2001). In 2001 alone there were a total of 55,323 fires in Canada of which 10,876 were classified as incendiary (including suspicious fires and riots).

In the Province of Ontario alone there were 996 fatal fires from 1995 to 2004 (Office of the Fire Marshal of Ontario, 2005). An overwhelming majority of these (84%) occurred in residential properties. During this same period, 721 of those fatal residential fires are considered to have been preventable. It is reported that 1% of preventable residential fires in Ontario are fatal. By virtue of the fact that these deaths must all be investigated, they are all considered to be in a forensic context. The mandate of the investigation not only includes determining the cause of the fire, but also the manner in which that fire started. A specific act, or act of omission, by a person or persons now enters the territory of homicide.

As sobering as these figures are, they do not include fires that have been set specifically to dispose of remains in open contexts, such as clandestine bonfires. Clandestine contexts typically do not only involve the burning of the body, but also the mechanical mixing and crushing of cremains with the hope of rendering them down to an unrecognizable state.

Forensic contexts of cremains include any instances in which a fire has a legal consequence. Because virtually all fires have a forensic context, until cleared through the investigation process, the search for, documentation of, and the recovery and analysis of human cremated remains must be accorded the respect due to any remains associated with an investigation.

DeHaan (2002) notes that arson is an agent of murder and a means of destroying evidence of a crime that has already been committed. These incendiary fires, that is, fires that have been deliberately set, necessitate a team of experts to properly investigate these scenes. Among those experts noted by DeHaan are the fire investigators, pathologists, toxicologists, radiologists, and even odontologists. Conspicuously absent from this list are forensic anthropologists. Forensic anthropologists specialize in the analysis of severely degraded human remains. Their goals of analysis are not mutually exclusive of those of the fire investigator. Table 1.1 lists the analytical questions posed by both forensic anthropologists and fire investigators. If we examine this list more closely it is evident that if a fire proceeds to the point that the head and appendages have been rendered down to fragmented bone, the list of questions that is more suited to the analysis of the remains clearly falls under the auspices of the forensic anthropologist. It is the forensic anthropologist who is to conduct the analysis of bone fragments that are recovered from the scene. However, it is also the forensic anthropologist who should be at the scene in the first place in order to find, document, and recover the cremains.

This sort of analysis at the scene and during the postmortem examination is, without question, a team effort. However, the types of evidence some members of the team may usually handle may have been destroyed through the burning of the body. Fingerprints, DNA, and even extant dental work may not survive the cremation process to the level or quality needed to yield a positive identification.

TABLE 1.1**A Comparison of the Analytical Questions Posed by Forensic Anthropologists and Fire Investigators with Respect to Human Remains**

Forensic Anthropologist's Questions	Fire Investigator's Questions (DeHaan, 2002)
Are the remains human?	Are the remains human?
Are the remains of recent forensic interest?	Who was the victim?
How many people are represented by the remains?	What was the cause of death?
What is the age at death of the remains?	What was the manner of death?
What is the sex of these remains?	Was the person alive at the time of the fire? If so, why did he or she not escape?
What is the genetic affiliation (sometimes referred to as race) of these remains?	Was death due to the fire or only associated with it?
What is the living stature of the remains?	
Are there any identifying characteristics present on the remains?	
Is a positive identification possible based on the above?	
Is there any evidence of pathology, including trauma, that is either antemortem, perimortem, or postmortem?	
What is the manner of death?	
What is the cause of death?	

The six investigative problems listed by DeHaan (2002) have a significant overlap with those questions approached by the forensic anthropologist. Clearly, the first four of DeHaan's list have been expanded by the forensic anthropologist to address specific issues concerning identification. However, if the remains are in the condition stated above, then pathological evidence may not be as forthcoming. In such a circumstance, the best practice is to have the forensic anthropologist work with the forensic pathologist. In addition to chronicling perimortem pathology, long-healed fractures may lead to medical records that will ultimately yield a positive identification.

Question five of DeHaan's six may never be answered, particularly if soft tissue has been eliminated. With the absence of soft tissue, so goes the evidence of soot in the trachea, or toxic gases in any of the tissues or blood. This is particularly true with clandestine cremations. Should a perpetrator feel that the chosen location for the cremation is sufficiently private for him or her to tend to the fire for a prolonged period of time, then there is an opportunity to render the remains to a state consisting of bone and ash.

This is not to say that the question concerning the victim's state of consciousness or vitality are inappropriate; it is rather more practical to state that these questions are more realistic from a forensic evidence perspective when soft tissue or witness accounts are present.

It is, without question, that death due to an incendiary house fire can kill unsuspecting victims. In such a case, death being due to the fire can be difficult to ascertain if the fire is in a reasonably remote location and the fire goes unreported. Although human remains may be evident in a fire scene shortly after it has been extinguished, or the majority of the superstructure has collapsed, a persistent smoldering of material may eliminate any persisting soft tissue.

DeHaan notes, justifiably, that the fire investigator's job is to consider the body and its clothing as elements of fuel load and a potential cause or even point of origin for the fire, whereas the homicide investigator will be better able to appreciate and interpret the various elements of a violent death scene. Yet, with the omission of a forensic anthropologist there would be a considerable lack of expertise on the scene to handle questions of faunal versus human remains, as well as the recognition of skeletonized remains.

DeHaan's basic recovery recommendations include establishing a scene grid and wet-sifting debris through sieves of various sizes. Although these actions are generally recommended, there are certain details of methodology that need to be expanded upon. For example, all screening must be done away from the actual scene to prevent cross-contamination. Without someone on scene with the experience to recognize fragmented bone and dental remains, these items can be easily missed. Moreover, the position and location of cremains in a structure must be mapped so as to preserve their context. Screening of material as a sole method of recovery will destroy contextual evidence. The presence of a forensic anthropologist on the scene as part of the investigative team is clearly a much-needed resource in order to maximize the potential of the evidence related to cremains and their context.

The forensic context demands that an analysis of any human remains follow a certain set of procedures defined by law. In Ontario, such law is covered in the Coroners Act (R.S.O. 1990 c. C.37, s. 31 (1)). Specifically, any deaths not attended by a physician must be investigated in order to answer the following five questions:

1. Who the deceased was?
2. How the deceased came to his or her death?
3. When the deceased came to his or her death?
4. Where the deceased came to his or her death?
5. By what means the deceased came to his or her death?

In order to facilitate answering these questions, the coroner in charge of the case will ideally have a large team of experts upon whom to call for assistance. This team includes:

1. **Police.** Police will be involved at the scene, procure evidence at the scene, and carry out the investigation.
2. **Coroner.** The coroner will initiate the investigation and ultimately be responsible for issuing a death certificate indicating the answers to the five questions outlined above.
3. **Forensic Pathologist.** The pathologist, ideally with a forensic background, is the person responsible for the legal examination of the remains. A coro-

ner's warrant for the examination of the remains will name a pathologist to do the examination. The examination, external and internal, is performed to provide the coroner with answers to the five questions. The examination is also an opportunity to obtain samples from the remains in order to send on for further examination.

4. **Toxicologist.** Tissues may be examined chemically, for various compounds, in order to assist in determining the cause of death. For example, in fires, a common question to be asked concerns whether or not the decedent was alive at the time of the fire, and hence inhaled any smoke. Blood and tissue samples are commonly analyzed for carbon monoxide levels in the blood (COHb). As three-quarters of all fire-related deaths result from inhalation of toxic smoke (Spitz, 1993), this is an important question.
5. **Forensic Odontologist.** The use of recovered dental tissues from fire victims is a common means of establishing a positive identification. Generally, teeth are remarkably resistant to heat, due to contraction of muscles around the mandible, locking the jaws in place, and the cheeks, tongue and lips acting as insulators. However, prolonged burns can directly affect teeth by melting out dental restorations and fracturing enamel, cementum, and dentine. Even dental remains in such an advanced state of destruction have the potential to provide evidence of the location and type of dental work (Fairgrieve, 1994).
6. **Forensic Anthropologist.** Ideally, forensic anthropologists work closely with the forensic identification officers at scenes in order to assist with the recovery and documentation of human remains. The remains in such instances are typically in an advanced state of decomposition or of a fragmentary nature. In the case of cremains, the recognition of human bone material will likely be an issue with most scene officers. It is in these instances that forensic anthropologists are particularly valued for their services. Likewise, a postmortem examination of such remains usually is done as a team effort with the forensic pathologist and odontologist. However, should there not be any soft tissue remains present, then the forensic anthropologist's analysis will make up the bulk of the report on the recovered remains. A forensic anthropology analysis consists of examining the remains for age at death, sex, race (genetic affiliation), stature, presence of pathology, postmortem interval (i.e., how long since death occurred), and aspects of positive identification.
7. **Forensic Entomologist.** Forensic entomology in these contexts is usually associated with assisting in determining a postmortem interval. The succession of various insect species and their respective times of development are of particular interest. Although it is generally thought that tissues denatured by heat, in essence cooked, result in a slowing of decomposition, it has been noted that the successional waves of insects onto burned carcasses seems to occur earlier than on unburned carcasses (Avila and Goff, 1998). Yet, fire can consume soft tissues to such an extent that there is no entomological activity to speak of. To that end, a forensic entomologist is of use when there is some preserved soft tissue.

8. **Forensic Botanist.** The use of botanical remains as a source of estimating the postmortem interval is a burgeoning area of forensic science. Cremains may act as a source of nutrition for plants and promote growth in areas of scatter. Likewise, the forest floors contain evidence of any previous forest fires and can be useful in putting a limit on a possible date of deposition of remains. This is not a resource to be ignored.
9. **Fire Investigators.** Fire investigation in Ontario is under the purview of the Ontario Fire Marshal's Office. These investigators are responsible for determining the cause of a fire. They work with police and other forensic specialists who would be involved in the analysis of samples procured from the scene.
10. **Other forensic specialists.** Other specialties, from forensic chemists to explore the use of volatile ignitable liquids (VILs) (also known as accelerants) at a scene, or recovered from the body, to structural forensic engineers to comment on the collapsing of a building, are all part of the team involved in such investigations.

Although it is clear from the above list of specialists that there is a remarkable team of people behind such investigations, it is beyond the mandate of this book to examine all aspects of the interaction with these specialists. However, this book advocates the expansion of the list of experts typically used in fire investigations to include a forensic anthropologist.

This book deals with the occurrence of cremated human remains in cases of suspicious death. A suspicious death is considered to be in a forensic context until proven otherwise. Forensic contexts involving cremated remains are amongst the most vexing, as fire is an effective way of destroying evidence, or so it would seem. Although fire can effectively eliminate soft tissue from the body and also alter hard tissues, namely bones and teeth, these remains, under the right circumstances, can still yield a great deal of information. In his analysis of the cremated archaeological remains of the Ohio Hopewell, Baby (1954) was able to comment upon the age, sex, pathology and precremation treatment of these people. Baby was able to diagnose forms of arthritis, and even a case of club foot, from the Hopewell cremains. Clearly, age, sex, race, stature, pathology, manner, and cause of death need not be written off as being indeterminate just because the remains have been rendered down to a fragmentary state in a fire. Even important information, such as body position and location within a structure, sometimes critical pieces of evidence, can be determined through careful examination and recovery practices.

Although the mandate of this book is to look at the recovery, analysis, and interpretation of evidence from cremains in a forensic context, I will not ignore what can be done with human remains with varying degrees of burns. However, the focus of this book will largely involve those burns that can be classified to the fourth degree and beyond. This specifically refers to burns that have not only destroyed soft tissue, but also are directly charring the underlying bony tissue. It is very possible for a body to exhibit many degrees of burns at the same time. Bodies do not burn evenly, even if put into a situation that has a uniform temperature (a rare situation indeed).

As we will see, the body, due to its structure, reacts to fire according to muscle density, tissue depth, and even degree of exposure to a heat source.

It is obvious to most people what burnt flesh may look like. Most are familiar with the concept of skin slippage (the separation of the epidermis from the dermis) that can result from exposure to fire. Some are even familiar with the pugilistic pose that can be seen in fire victims. This pose was at one time interpreted as evidence that the victim was “fighting” for their life. Yet, when many people think about people trapped in buildings, we can often hear on the media the claim that nothing was found but ashes, so there was, *de facto*, no body to recover. Although a misconception, clearly, the idea that a body is reduced to “ashes” is perpetuated in western culture. The most famous reference is found within Christian burial rites. Some measure of understanding decomposition of the body breaking down to small components is certainly contained within the phrase, “ashes to ashes and dust to dust.” This idea that remains eventually end up being nothing more than unrecognizable dust is further reinforced by western crematoria preparing remains in such a way that they can be “spread” by family members in locations of significance to the decedent. Of course, it is not realized by the general public that after the cremation process has taken place, which included a coffin and its accoutrements (metal items removed), the cremains are sent through a mill in order to grind the fragments to a size that will be appropriate for “viewing.” This idea of the cremains being merely dust that is beyond analysis is far from the truth. This is not to say that forensic analysis of cremains is always going to be successful at answering all our questions; however, there is a great deal that may be done to chronicle who, what, when, where, and by what means, this person met their demise.

1.2 CREMAINS IN CRIMINAL CONTEXTS

A general survey of the forensic anthropology literature for reports concerning cremains in criminal contexts tend to speak of cases where a perpetrator attempted to dispose of remains so that they are not discovered (e.g., Fairgrieve and Molto, 1994). Hence, a missing person stays missing indefinitely. Yet, as noted above, the fact that, as Bass (1984) put it, one cannot completely eliminate a body by fire, attempts are still made by perpetrators to do just that. In my casework experience, I have found that the amount of work needed to render a human body to an “unrecognizable” state is clearly not appreciated by the perpetrator. This is particularly true when this is undertaken in an outdoor context.

Other criminally based contexts may include cremation burials. In these instances the cremains are relocated to another site and buried. A variation of this is the burial of cremains within an actual pit dug in order to facilitate the burn. Once completed, it is simply filled with soil. These burials can be particularly vexing to investigators if the original location of the pyre is thoroughly cleaned by the perpetrators. In one case, a fire pit of approximately 3 meters in diameter demonstrated a large amount of ash, and the remains of hinges, glass, nails, and carpentry staples—all indicative of burned furniture (Figure 1.1). After 5 days of going over this site using an archaeological recovery methodology (Chapter 4), the only human remains found were a middle phalanx of a hand and the distal (elbow) end of a humerus



FIGURE 1.1 An outdoor fire pit approximately 3 meters in diameter served as a crematory pit in a homicide case. (By permission of the Regional Supervising Coroner, Northern Ontario.)

(upper arm bone) in fragmentary condition. Given that an informant had described two individuals having been in the fire, the question then arises as to final location of the other remains. Moving of remains usually arises as a result of a perpetrator with time on their side. The realization that cremation of a body in order to render it down to what would appear to be unrecognizable portions is a labor-intensive exercise that seems to result in frustration on the part of the perpetrator. However, some perpetrators simply help the process by actively crushing the cremains using whatever implements are at hand. It is not atypical for the perpetrator to then mix the cremains, while actively crushing them. Finally, placing soil over the cremains is the final step.

The environment is a key player in the concealment of buried remains. Clandestine burials, in general, are usually done in such a way that they may be detected if one recognizes the characteristics of the burial. As one digs a hole, the entire matrix of the soil, and its respective layers, are disturbed. This also means that any air pockets or gaps in the soil matrix are destroyed. The soil is typically piled into a mound adjacent to the hole. With placement of the remains in the hole, the soil is then put back into the hole. However, the placement of that soil is not in the original order of the natural soil layers. The mixing of soil layers and the resulting compaction of the soil, due to the destruction of previously formed air pockets, make it difficult to fill the hole back in with a sufficient amount of soil. Additionally, the soil originally piled next to the grave will not all be recovered unless the perpetrator uses a ground sheet to keep this soil separated from the ground adjacent to the scene. A residual amount of soil originally taken from the grave usually remains next to the grave. Soil placed back in the grave will undergo a period of settling. This will result in the outline of the grave boundary being visible. In wet temper-

ate climates, the grave outline may be visible as a large pooling of water due to the change in the drainage of the soil in the grave. In cases of a whole body being placed in the grave, there will often develop a second depression due to the decomposition of the body and the collapse of the body's chest. Graves dug in areas of vegetation, will also show signs of the excavation. Broken and dead plant life due to the severing of roots, and the breakage of shoots from moving a body, or even damage from a shovel, can act as clues to the location of a burial. However, it must be stressed that based upon the type of flora present, the rate of species recovery must be taken into consideration. Consultation with a forensic botanist is a necessity at all burial scenes involving plants.

In the burial environment, the body can act as a source of nutrients for the associated plant life. As the body may act as a highly concentrated source of nutrition for the associated plants, it is important to realize that an uncovered body may in fact promote the recovery of the plants on and around the grave. Buried bodies that have been covered by a tarp or shower curtain, and tightly wrapped, are not in a position to act as good sources of plant nutrition. Likewise, with the burial of cremated remains, the act of subjecting human remains to fire, acts as a means of advancing decomposition to a stage where the decomposition rate within the soil is slower than would be found in uncharred cases. In such a case, the cremains are not acting as a source of nutrition for the overlying plants.

Burials of a clandestine nature tend to be sloppy due to the rate at which they were undertaken. In essence, the perpetrator is usually trying to rid themselves of the body as quickly as possible. To that end, a grave is usually very shallow and only roughly conforms to the actual dimensions of the body. However, in the case of cremains, the body has been rendered down to bone fragments and the volume required to bury the cremains is not nearly that of a whole human body. To that end, smaller pits are dug and the cremains are shoveled into the burial. Likewise, the depth of the burial may be substantially more than a burial dug using a shovel for an intact victim due to the compacted nature of the cremains.

The quality of the cremains in the burial environment is typically very good. As most archaeologists have encountered, the carbonization of bone, and even plant materials, can act to preserve these materials for hundreds of years (e.g., Baby, 1954; Merbs, 1967; Gejvall, 1969). Such materials have been recovered from archaeological middens (the technical name for a type of garbage dump).

Another clandestine context for cremains out of doors includes the setting of forest fires in order to conceal a homicide. In such a scenario, the victim is either killed in a forested context, or the body of an already dead victim is transported to such a location. A fire is started in the wooded area with the intent that if the victim is found, their death will be misinterpreted as a result of the forest fire. The problem for the perpetrator is that the body usually does not burn to such an extent that internal organs and other soft tissues are completely eliminated. There is a great chance of the body being thoroughly, if not completely, recovered. If by happenstance a fire swept through an area with skeletal remains already present, the fracture pattern of such bones due to the heat may be distinguishable from charring of bones with flesh present (Stewart, 1979). However, Buikstra and Swegle (1989) do not support this position, so such an interpretation should be treated with caution.