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DNA, Cold Cases, and Human Remains

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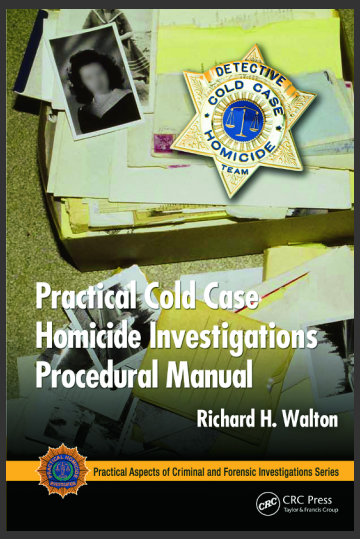

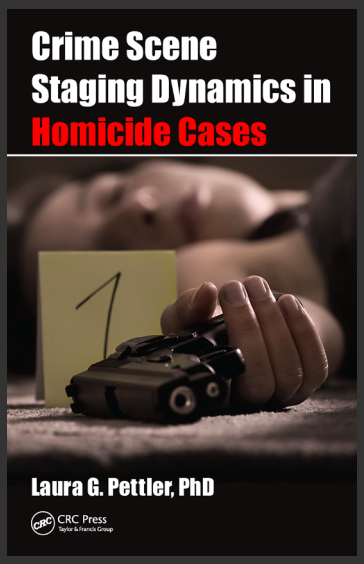

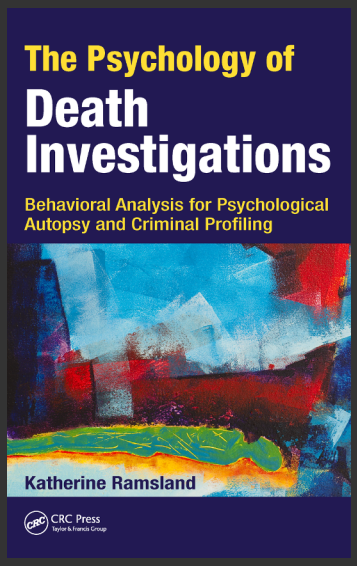

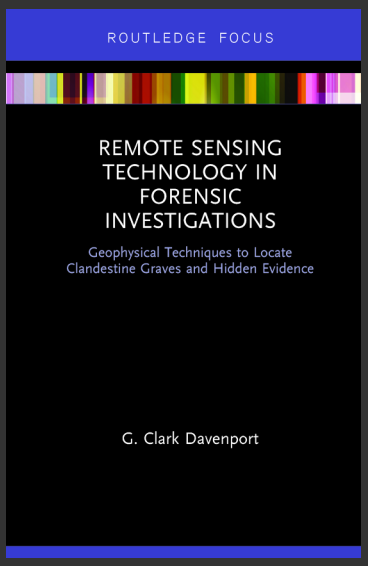

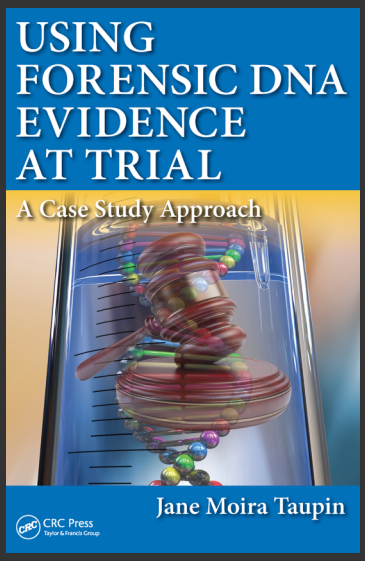

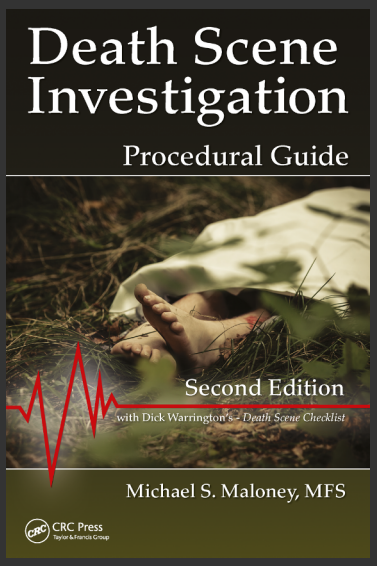

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Introduction

DNA, Cold Cases, and Human Remains, is a compilation of content from some of our most interesting and engaging books published over the last few years. DNA innovations are occurring all the time and even results from ancestry databases have started to be used to help solve some of the most confounding cases—including unsolved and long-standing cold cases. Cold cases can be some of the most challenging to investigate. Instances where leads run dry, or otherwise result in dead ends. Often these cases result from the discovery of human remains, left in woods or a field—sometimes ending up, years later, being linked to missing person cases. All books serve as a fascinating snapshot into just some of the complexities and nuances of investigation, analysis, and forensic evidence. This book features content from a range of CRC Press titles from some of the most highly respected professionals in the field, illustrates the breadth and depth of our titles and the range of topics. We hope you enjoy it!

Books represented in this collection include:

Cold Case Investigations from the book Practical *Cold Case Homicides Investigations Procedural Manual* by R. H. Walton looks at these forms of cases which present unique

challenges for investigators.

Crime Scene Staging and Cold Cases from the book *Crime Scene Staging in Homicide Cases by Laura Pettler in which the author focuses on the dynamics of crime scene staging, individuals' motivations, and how to identify efforts to stage a scene in natural deaths, homicides, and other situations.*

Psychological Autopsies: A Case Study from the book *The Psychology of Death Investigations: Behavioral Analysis for Psychological Autopsy and Criminal Profiling* by Katherine Ramsland introduces the reader to the utility of using psychological autopsies as a process to determine an individual's state of mind prior to death.

Recovering Clandestine Remains Using Remote Sensing Methods from the book *Remote Sensing Technology in Forensic Investigations: Geophysical Techniques to Locate Clandestine Graves and Hidden Evidence by* Clark Davenport looks at this tried and true technology to recover clandestine evidence and unearth buried human remains.

Interpreting DNA Profiles from the book *Using Forensic DNA Evidence at Trial: A Case Study Approac* by Jane Moira Taupin covers the underpinning foundations on which the forensic DNA revolution is based.

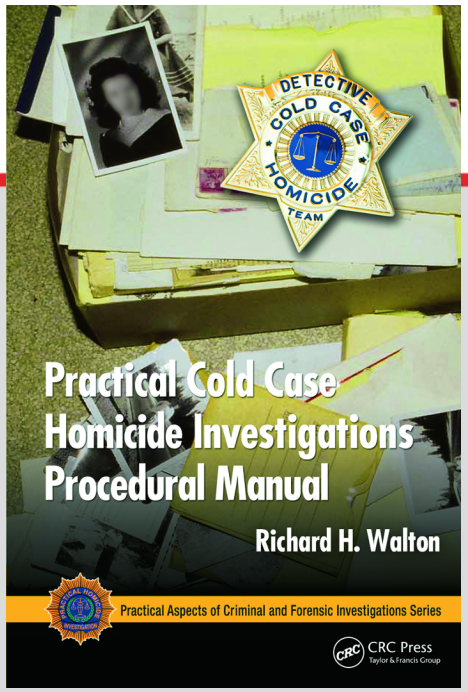
Collecting and Testing Biological and DNA Evidence from the book *Death Scene Investigation: Prodecural Guide, Second Edition* by Michael Maloney takes a thorough look at the proper collection and preservation of biological and DNA evidence for use in death investigations.

Please note this Free Book does not include references, endnotes and footnotes. Fully referenced versions of each book can be accessed through www.crcpress.com.

CHAPTER

1

THE COLD CASE CONCEPT



This chapter is excerpted from

Practical Cold Case Homicide Investigations Procedural Manual

by R. H. Walton

Learn more

THE COLD CASE CONCEPT

Excerpted from *Practical Cold Case Homicide Investigations Procedural Manual*

What Is a Cold Case Homicide?

Cold case is a concept.

There is no legal definition of a cold case homicide. Cold cases are mu ders previously reported to law enforcement and investigated, but which failed to result in the identification and arrest of a suspect and filing of crimi- nal charges. They are those homicides that other investigators, perhaps more experienced, tried to solve and could not. These are cases in which a suspect may have been known to the investigators, yet there was insufficient evidence for arrest and charging. Due to the passage of time and lack of investigative leads, the cases are no longer actively pursued by investigators. These also include those cases in which no perpetrator has been identified, and the case is a whodunit.

There is no one standard definition of a cold case homicide. What is considered a cold case homicide rests within the discretion of the law enforcement agency.

The term cold case is controversial and suggests that unsolved cases are unworkable, impossible, and offer no hope for future solution. This term may convey a false impression to family and friends of unsolved murder victims that their cases do not count anymore, that their cases will never be resolved.

Media focus and attention on this topic has:

• Encouraged those with knowledge of unsolved homicides to come forward

• Stimulated law enforcement organizations to become more proactive in reviewing cold cases

• Reminded those who have so far gotten away with murder that law enforcement does not forget and that their case has not been forgotten

• Enhanced the "CSI effect," in which jurors and the public expect technology and procedures they see on television, but which in fact do not exist or are overly magnified

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Agency Definition of a Cold Case

What is a cold case to one investigator or to one law enforcement agency may not be shared by other investigators or agencies. Theirs is the definition they design to designate the parameters for those cases to be classified and investigated as cold case homicides within the agency. Such cases may include homicides:

☐ In which the primary investigator has transferred or otherwise been detached from the case and the case is not currently assigned to an investigator

☐ In which no current investigative activity is taking place due to lack of investigative leads or information

☐ At least a year old that have had no activity for at least one year, or a case in which the primary investigator has been transferred from the unit and it needs to be reassigned to a new investigator

Various definitions of a cold case homicide or cases to be investigated are those with parameters that include:

☐ Unsolved cases prior to specific time period (i.e., 1990)

☐ Unsolved cases during specific intervals (i.e.,1960–1995)

☐ Long term missing-persons cases that have a high probability of being a homicide

☐ Unsolved cases with new leads yet no other resources available to follow up the leads

☐ Cases wherein enough time has passed that the perpetrator begins to feel confident enough to speak freely about his or her involvement (suggestively 5 years or more)

☐ Homicide cases older than 3 years from date of the offense in which no arrests have been made

☐ Homicide cases older than 3 years from the date of the offense that are "closed but active" or cases that were closed by arrest of a suspect but the charges were dismissed without the suspect going to trial

☐ Homicide cases less than 3 years old from date of offense (including closed but active) in which all leads have been reasonably exhausted and investigation or assignment as a cold case homicide has been authorized by a responsible

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authority

☐ Homicide cases in which the date that the death was ruled a homicide by the medical examiner's office is greater than 1 year after the original event that led to the decedent's death (This would include those cases wherein the victim dies more than 1 year after the fatal injuries were received.)

☐ Undetermined deaths of a suspicious nature older than 1 year fol- lowing the deaths

☐ Any case linked to a case under active investigation by a cold case investigation unit

☐ A case at least a year old that has had no activity for at least 1 year

Whether the scenario is a hot or cold homicide, investigators routinely seek to answer the questions and to construct the "murder book" to current standards:

☐ What happened?

☐ Why was the victim killed?

☐ Who had the opportunity to do it?

☐ How did it happen?

☐ Where did it happen?

As in a hot homicide scenario, cold case investigators may consider MOM (motive, opportunity, and means):

☐ Murder–suicide

☐ Thrill killing

☐ Self-defense

☐ Random killing

☐ Sex and sadism

☐ Love triangle

☐ Jealousy

☐ Drug connection

☐ Gang involvement

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There is no one-best-way or one-size-fits-all method of investigation.

• Each cold case is investigated on its own merits and the circumstances surrounding the crime, building upon those records avail- able to modern investigators.

• Modern cold case investigation teams professional law enforcement practices with forensic knowledge and technology.

Primary Cold Case Solvability Factors: Changes in Technology and Changes in Relationships

The resolution of cold cases has been greatly enhanced by two factors: significant advances in forensic science and the natural tendency of human relationships to change over the passage of time. The human aspect speaks to the fact that loyalties can shift over the years, and witnesses or informants who were previously reluctant to speak may now be willing to come forward and cooperate with cold case investigators. On the technology side, forensic sci- ence has seen significant advances in:

• Trace-evidence analysis: hair, fiber, glass, soil, and paint

• Blood and serology analysis: DNA and CODIS (Combined DNA Index System)

• Firearms identification: National Integrated Ballistic Information Network (NIBIN)

• Fingerprint identification: Integrated Fingerprint Identification System (IAFIS)

• Blood-pattern analysis

Significant Changes in Law Enforcement Organization and Practices That Impacted Investigations: 1960s–Present

When investigating older unsolved cases, it may be helpful for investigators to understand the past practices and procedures of their agencies, as these have changed dramatically in the past 50 years.

• Size of department, personnel assignments, organizational structure, records and evidence documentation and retention practices, and organizational culture.

• Coordination among agencies was sometimes sporadic and informal, and rivalries and jealousies between some police departments and sheriff's departments have carried over to this day. The result is a lack of communication and coordination in

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the investigation of these and other crimes.

• This period has seen greatly increased selection and training stan- dards for police-empowered personnel to the present.

Standards for selection of detectives varied, and it was not uncommon that such personnel, especially in smaller agencies, were promoted for reasons other than demonstrated investigative ability. This may have contributed to some cases going unsolved, and a fresh review may identify avenues for investigation.

Agencies underwent significant changes in:

Evidence collection and maintenance procedures: Many agencies rou- tinely destroyed homicide evidence after a certain amount of time.

Report writing and documentation requirements: Changes from sum- mary to detailed report writing styles.

Office equipment and technology: From typewriters and carbon paper to microfiche and a variety of computerized systems.

Computerization of records and communications.

Past Crime Patterns That Have Affected Today's Cold Cases: 1960s–Present

The last quarter of the twentieth century saw a significant proliferation in drug and gang culture and stranger homicides. This impacted investigative methodologies and contributed to a decline in clearance rates.

Why Cases Go Cold

Conventional wisdom in a homicide investigation holds that time is of the essence, and if a murder is not solved within the first 24–72 hours, the chances of solving the case rapidly diminish. Understanding this reasoning may assist the cold case investigator today. At the outset,

• Witnesses were still centrally located and easier to locate.

• Their recollection of events was fresh and most accurate.

• Those with knowledge had not had a chance to get their stories and alibis straight among themselves.

• The chances of identifying and retrieving evidence was strongest at the outset,

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whereas as time passes, so does the evidence. In the ensuing interval, it may be damaged, lost, or destroyed.

For decades, this perception has guided investigators in their approach to homicide investigation, but changes in technology and human relation- ships have exploited the passage of time to an advantage.

Understanding Why Cases Went Cold Can Aid in Their Solution Today

Case factors over which police had no control as well as law enforcement organizational factors over which the police did have control may be identified in the case file review.

1. Case factors over which the police had no control included:

- Lack of physical evidence
- Lack of witnesses
- Lack of cooperating witnesses
- Inability to identify victim
- Weapon used
- Gang/drug related
- Crime-scene location (public versus private)
- Previous technology inadequate to fully analyze evidence

2. Organizational factors within the law enforcement agency may have included:

- Number of detective's originally assigned to case
- Detective's case load
- Initial response and documentation
- Initial investigation and gathering of evidence
- Leads not followed up (not uncommon in case file review)
- Promotion, transfer, and retirement
- Leadership, organizational commitment, and budgetary considerations
- Politics and personal agendas

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As investigators review their cases, these are good points to keep in mind.

Cases Most Likely to Go Cold

Turner and Kosa suggest that the cases most likely to go cold involve:

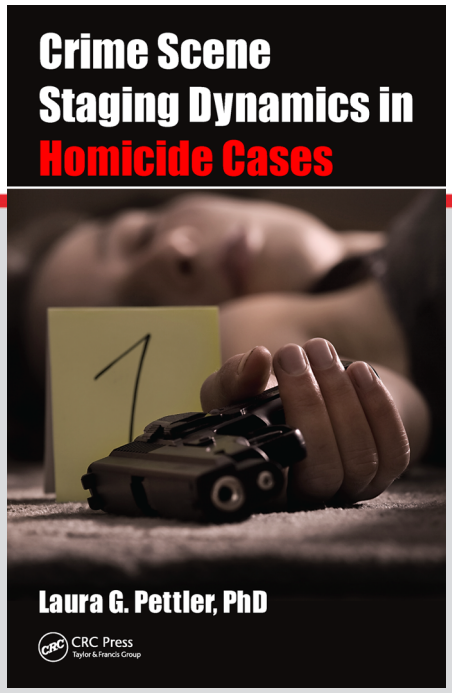
- Missing persons
- Gang/drug related
- Immigrants, transients, and homeless
- Unidentified victims
- Suicides
- Accidents
- Unclassified
- Unsolved murders of police officers

It is strongly suggested that unsolved cases be evaluated on individual case factors and not only on the age of the cases.

CHAPTER

2

THE FUTURE



This chapter is excerpted from
Crime Scene Staging Dynamics in Homicide Cases
by Laura Gail Pettler.

Learn more

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Victim Characteristics: Victimological Studies

Not much information is available about the victims of staging offenders yet in the empirical literature. While victimological information is plentiful in other areas of homicide studies, the handful of empirical studies on staging thus far have been mostly descriptive with some other types of analysis included in a few of them. The author opines that one of the most critical areas that warrants further research is on the victims of staging offenders. Research has shown that most victims are female. Research has also shown that someone they know murders most female victims. Research has shown victims are most often killed with firearms. But who are these victims? What are these victims' thematic similarities, commonalities, characteristics, and so on? All of which is so vital to understanding who the offenders are of crime scene staging in relation. Knowing that they are female and that either intimate partners or someone else who they are associated with kills them most often with a firearm is too broad to be much help.

Victim–Offender Relationship

Eke argued that crime scene staging could be a function of the relationship and the experience of the offender and the victim. Ferguson and Schlesinger et al. supported Eke's argument with the results of their studies. While Pettler's study yielded victim–offender-related results that modestly supported staging as a function of victim–offender relationship (e.g., in six homicide cases, offenders were boyfriends of the victims, three offenders were spouses of their victims, and two offenders were the son of their victims), these findings are believed only to be an outcrop of the broad definition Pettler used in that study specifically in relation to the parameters set for the purposive sample in this study. The results of more recent studies confirm the linkage between victim–offender relationship and crime scene staging; thus more research in this area is necessary. What is most interest- ing about victim–offender relationship again is that if an offender feels he or she is going to be thought of as the most logical suspect in the death of the victim, it often compels him or her to stage the scene theoretically speaking. Research has shown that intimate partners are more likely to murder than stage more; thus, further inquiry about the nature of those intimate relation- ships and recurrent themes, commonalities, frequencies, and so on would move the ball forward as well.

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Conflict and Confrontation

The concepts of primary conflict and secondary conflict as they relate to crime scene staging have been discussed in this book. To reiterate, primary conflict is the conflict between the victim and offender that precedes the murder, while secondary conflict is the conflict between the offender and investigators that is created by the murder of the victim. The author agrees with Ferguson's argument that confrontation (i.e., conflict) is a core, exacerbating factor in relation to crime scene staging, especially in intimicide cases. Future research on the types, commonalities, characterstics of, and other concepts related to the issue of conflict in crime scene staging could yield results that are significant for early identification and detection of staged crime scenes and for crime analysis purposes.

Victim Discovery

The author argued that the last person (i.e., the offender) to see the victim alive is most often the first person (i.e., the offender) to discover the victim's body or report the victim missing as confirmed by current empirical research conducted by Ferguson. Therefore, research that examines offenders, specifically in regard to how they discovered the victim, when they discovered the victim, why they claimed to have discovered the victim, what they were doing when they discovered the victim, where they discovered the victim, and related ideas via quantitative descriptive analysis would shed some light on this virtually uncharted territory of crime scene staging research.

Weapons

In her doctoral dissertation, the author found that firearms were the most commonly used weapons in her sample of staged homicide cases. Pettler found that 12 offenders used firearms, 4 offenders bludgeoned their victims, 1 offender used ligature strangulation, and 1 victim's cause of death could not be determined. Likewise, Ferguson and Schlesinger et al. reported similar findings; thus toward understanding murder weapon selection in greater detail, future research is necessary. Related to weaponry but not discussed herein is that of the weapon of poison. Thus far, the published literature has not included much on the use of poison as a murder weapon, but because poison could also be used as a murder weapon, it justifies its inclusion.

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Verbal Staging

Verbal staging or lying is the act connected to either the offender falsely supporting the physical evidence staged in a crime scene by way of verbal dis- course or the offender verbally falsifying that the victim is missing after the offender has disposed of the victim's body. Within the scope of this research, the author would also recommend focusing resources on studying the initial stories that are told to investigators at the onset and how those stories change and/or remain consistent across time, all of which should be analyzed using statement analysis. Second, along the same strain, research in the area of what offenders tell family and friends of the victim (and/or offender) and how those stories change and/or remain consistent across time might aid in the establishment of behavioral patterns when it comes to verbal staging among offenders before, during, and after the death of the victim. For example, based solely on the author's experience, this idea stems from the numerous cases where offenders who staged murders as suicides claimed they were coming out of the bathroom at the "time of the shot" or when the victim allegedly committed suicide with a firearm during an argument in the presence of the offender. While this idea is purely anecdotal, empirical research could lend credibility or refute this author's experience.

Behavioral Taxonomy

Both Ferguson and Pettler found that the effectiveness that crime scene staging typologies could have in practical application at this point is greatly reduced by the sheer overlap between behavioral patterns exhibited by offenders as examined in both studies. Ferguson and Pettler's independent studies are the only studies to date that have attempted to classify staged crime scenes using proposed typologies that are mutually exclusive of each other, because neither typological set was successful. Thus, again the author cautions others from utilizing any proposed typologies related to crime scene staging because at this point, no typological system is supported by the empirical literature. In order to be applicable in practical crime scene field application, any proposed typology would have to be substantiated by a very large sample size.

Crime Scene Staging and Law Enforcement Professionals

Former city of Monroe, North Carolina, police officer, Josh Griffin was convicted in 1998 for the murder of a Kim Medlin. Medlin was on her way home one late night in March 1997 when, while on duty driving his patrol car, former officer Griffin ran his blue lights and stopped Medlin to allegedly make a sexual advance toward her.

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Medlin never arrived home from work and her body was recovered 36 h later partially concealed under a pallet and other debris. While laboratory tests revealed negative results for biological or trace evidence connecting Griffin or his vehicle to Medlin or the crime scene, circumstantial evidence led a jury to convict Griffin of first-degree murder and first-degree kidnap- ping, thus sentencing him to life in prison.

In 2004, Kathleen Savio's body was recovered in a bathtub in her home. The medical examiner ruled her death accidental. Upon a second look in 2008, autopsy results were changed to homicide. Savio's former husband and father of her children, former police officer, Drew Peterson was convicted in 2012 of killing Savio and sentenced to 38 years in Illinois State Prison. However, prior to these events in 2007, Drew Peterson reported that his fourth wife, Stacey, had gone missing. Peterson claimed Stacy ran off

with another man to flee from life's obligations. Peterson is the only suspect

in the missing person case of Stacy Peterson. Because of cases like Kathleen Savio, where red flags were missed that the scene was staged by the offender in this case, additional research is necessary toward assisting law enforcement in recognizing the red flags early in investigations. Considering that Geberth argued that homicide investigators are very highly trained and well-educated law enforcement professionals and their training and experience would indicate that they would most likely be proficient in areas like crime scene investigation, the manner in which offenders with law enforcement experience is of particular interest. In light of Turvey's study of 25 staged homicide cases, which contained 5 offenders who were law enforcement professionals combined with offenders with prior law enforcement experience having been represented in more recent studies, further research in this area might help to identify the connection between the two variables toward shedding light on this concentrated target population.

American Cold Case Epidemic

According to Hargrove, "more than one-third of America's killers are getting away with murder," and homicide clearance rates have dropped significantly from around 90% in the 1960s to roughly around 65% in the 1990s. Cold case homicides and missing persons cases are cases that have remained unsolved for some period or a specific time or a case ruled homicide by a forensic pathologist, medical examiner, or coroner that has gone without an arrest. Cases go cold for many reasons, but one of the main reasons is because many cold cases lack the evidence to make an

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arrest. Sometimes, a case can be factually strong but legally weak. And many times, circumstances like these are completely out of investigator control. According to Walton, it is important to remember that law enforcement has no control over factors.

1. Lack of physical evidence in a case
2. Witnesses refusing to talk
3. Inability to identify the victim
4. Inability to determine the murder weapon
5. Inability to locate the primary crime scene

Beyond these reasons, there are several police agency organizational reasons why cases might go cold related primarily to leadership, politics, budget, personnel, management, and allocation of resources. The bottom line is many agencies are short handed, underfunded, and overworked leaving no one completely committed to take on the cold case work. These circumstances leave detectives with no time to work the hot cases adequately that keep happening every day let alone having time to focus on the cold cases piling up. Additional challenges are brought by detectives retiring, leaving the job due to transfer, being promoted or sometimes individuals leave the field of law enforcement altogether, which leaves cases in limbo waiting to be assigned to other detectives when possible.

According to Walton, cases that most often go cold are gang- and drug-related street crimes, missing persons, or cases involving immigrants, transients, or the homeless. Hargrove reported similar findings that substantiated Walton's claim. Following those types are unidentified victim cases, potentially staged cases as some type of accident or a suicide. According to Hargrove, the American murder problem became more violent, senseless, and random with the increase of stranger-to-stranger homicides and the exacerbation of America's illegal drug trade during the 1980s through the 1990s, which bred more gangs and more drug- and gang-related murders. This blurred the lines between the victim and offender, and the link between them became more challenging to identify along with motives remaining cloaked and physical evidence remaining bleak. The sheer number of homicides that were occurring during this period brought about new challenges for law enforcement, and insufficient investigations became more

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commonplace leaving violent offenders to roam free with the opportunity to offend again. Although proven ineffective, the homicide investigatory paradigm remained seated on suspect and motive rather than the shift seen today toward the victim and physical evidence. All of this combined with a lack of training, education, and experience of some law enforcement personnel continued to contribute to the backlog.

The most accurate and relevant American cold case statistics known today come from the analysis of case details contained in the files housed by the Federal Bureau of Investigation of nearly one-half million homicides and nonnegligent manslaughter cases that occurred between 1980 and 2008 in the United States. Although this analysis conducted by Scripps Howard News Service published

in 2010 revealed the very clear pattern, which was that most of America's 185,000 cold case homicide victims are young, minority males, the second most significant pattern it revealed was that the majority of female cold case homicide victims are those suspected to have been murdered by someone they knew, such as a close associate like a spouse, boyfriend, or other type of intimate partner. This finding is remarkable in that it supports the victim–offender relationship link identified in empirical crime scene staging studies conducted by Eke, Ferguson, and Pettler, which found that the female victims are most often killed by someone they know and whose killers are more often likely to stage the scene of the murder in some way in an attempt to simulate a legitimate death because these offenders automatically know they will be considered a suspect immediately. This finding is also significant because it is reflective of the likelihood that suspects are known to investigators in many intimicide cases, but most likely these cases are largely circumstantial possibly due to the initial response, documentation, identified evidence, and overall investigation where the earmarks of staging were missed, supported by the fact that if investigators revealed that these victims are potential victims of intimicide, crime scene staging might be occurring more often than the previously published literature predicted. But what about all the cases that were actually murders that were ruled suicide, accident, and so on? Those "cold cases" are not included in any of these numbers because they are not considered unsolved "homicides." The manners of death in these cases were not ruled homicide, and therefore, the author would argue that the actual number of unsolved murder cases in the United States far exceeds findings of Hargrove.

The days of lone-detective homicide investigation are over. Gone are the days

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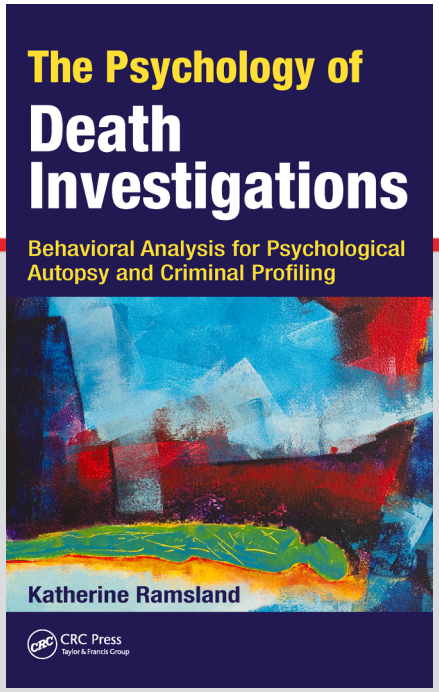
where speculation, intuition, and instinct bring cases to fruition. The homicide investigations of the 1980s and 1990s clearly demonstrated the dire need for the development of a new investigative technique that responds appropriately to the ever-changing ways homicides occur in America today. Interdisciplinary teams consisting of all types of investigators, crime laboratory personnel, various types of medical professionals, attorneys and legal professionals, and a wide array of experts in criminology, psychology, biology, chemistry, anthropology, entomology, and physics, coupled with tremendous new technological advancements are the here and now and the future of scientific homicide investigation today. It must become the norm that this interdisciplinary team come with extensive homicide experience, proficient quantitative and qualitative interview techniques, strong deductive reasoning skills, creativity and innovation, motivated and enthusiastic, yet patient and analytical, but with the hunger to go to the ends of the earth to catch a killer. In addition to these attributes, experts in bloodstain pattern analysis, shoot- ing incident reconstruction, linguistic analysis, forensic criminologists and psychologists specializing in victimology and suspectology all grounded by the scientific method are a must-have too. Pursuant to this shift, in order to address America's cold case homicide problem, the author would argue that an interdisciplinary, scientific, systematic review of many of the 185,000 cold cases is warranted, which might yield new information for investigators to use to reopen and reinvestigate the case toward making the arrest.

Kenneth L. Mains, cold case detective for the Williamsport, Pennsylvania, District Attorney's Office, was assigned a very challenging cold case where a young woman and her school-age daughter had been brutally murdered in their home. The case had been cold for more than a decade when Mains was assigned and in no time at all did he realize that a scientific, interdisciplinary approach was needed to help move the case forward. This revelation sparked Detective Mains' idea to create a society where experts from every discipline and beyond banded together as volunteers to provide scientific, interdisciplinary, and professional case review for law enforcement agencies afflicted with part of the backlog of America's cold cases. In May 2013, Detective Mains reached out to some of the top practitioners in the United States inviting them to sit on the newly founded American Investigative Society of Cold Cases (AISOCC) Honorary Review Board.

CHAPTER

3

BEHAVIORAL ANALYSES IN PERSPECTIVE



BEHAVIORAL ANALYSES IN PERSPECTIVE

Excerpted from *The Psychology of Death Investigations: Behavioral Analysis for Psychological*

Among the most glaring problems for cold cases are (1) gaps in information, which can lead to (2) working within an incomplete frame that gradually feels complete. Investigators can come to believe they are working with all of the facts merely because they have mastered the set of facts available. The urge to get closure supports this illusion. In addition, reporting mechanisms from past decades might contain undetected bias or imprecise information that was good enough for investigations at the time, such as in the following case from 1934.

On the morning of November 24, John E. Clark and his nephew Clark Jardine picked up firewood in the woods off Rt. 233 near Pine Grove Furnace on South Mountain in Cumberland County, Pennsylvania. They went along a dirt road and spotted a green blanket about 50 feet away, under bushes. Clark thought it might be a deer carcass. He walked over to look underneath, only to see the corpse of a fully dressed young girl lying on her side. Knowing something about police protocol, he dropped the blanket, but he could see from the outlines that something else was under it.

The state police arrived within an hour, with coroner E.A. Haegele and District Attorney Fred J. Templeton. Under the blanket, they discovered the bodies of three young girls, dressed in coats with fur collars, lying on their right sides next to each other. They looked like sisters. The smallest one lay in the middle. Underneath them was another blanket, damp from released urine. Nothing with the bodies assisted to identify them. Even the manufacturer tags had been removed from their clothing. Based on weather conditions and dampness on the top blanket, it was assumed that they had been placed there during the night before it had rained, or possibly earlier.

Two days later, a hunter heard the news and gave police a black leather Gladstone bag that he had found just over 2 miles from the girls' bodies. It contained clothing for children and adults, as well as a note- book. Inside, in a child's scribble, was the name "Norma."

Police were already wondering about another connection. On the same day that the children were found, around the same time, the bodies of a young couple were discovered inside a deserted railroad flag- stop near Duncansville, 100 miles northwest of Pine Grove Furnace. Both had been shot 8–10 hours earlier, the woman twice. It appeared to have been a suicide pact. The first shot to the woman's heart had not damaged her clothing, which she appeared to have held out of the way. It was a close-range wound. The man was shot in the side of the

BEHAVIORAL ANALYSES IN PERSPECTIVE

head. As reports came in from witnesses who had seen them walking on the tracks, an abandoned 1929 blue Pontiac sedan was located at a lovers' lane in Mifflin County. It had a burned tube on the exhaust pipe but no license plate or gas. Were these two decedents related in some way to the children? If so, there were many other questions.

Thanks to widespread press accounts and serial numbers from the car, relatives were located in California. They helped investigators piece together a story. Yet some of it made no sense. The dead man was Elmo Noakes, 32. Two of the girls were his daughters, Dewilla, 10, and Cordelia, 8. Noakes' wife, Mary, had died during a self- administered abortion 2 years earlier. The oldest girl, Norma, who was 12, was Mary's daughter with another man, who had sued after her death to get custody. Noakes had left Utah at this time to move to California. The adult female victim from the Duncansville incident was Noakes' 18-year-old niece, Winifred Pierce, who had dropped out of high school. She had helped him take care of his children but did not live in his house. There were rumors among relatives that their relationship was improper.

Autopsies conducted by two physicians, with blood analysis, ruled out carbon monoxide poisoning or any type of known and testable poi- son. Dr. Milton Walter Eddy from Dickinson College conducted hair analysis to determine what chemicals the girls might have ingested. The children's brains were turned over to Dr. Moffitt for further examination. Haegele could not identify a definitive cause of death but concluded that the girls had been smothered. It seemed likely that their father was their killer, although he could not rule out Winnifred. The younger ones had shown evidence of nosebleeds. They had not died from strangulation or blows, although Norma had a nasty bruise on her swollen fore- head and a scratch on her cheek. The coroner thought there was evidence of sexual molestation on Dewilla, the middle girl, because there was some genital irritation. It appeared that they had not eaten in 18 hours (although this indicator is deceptive). They had been dead from 12 to

72 hours before being placed in the woods.

A restaurant owner in Philadelphia reported that a family had come in recently. The man was looking for work. He mentioned that his children had become a "burden" and he had been unable to buy meals for them. It seemed possible that Noakes had tried getting work. Failing, he had committed filicide and then suicide.

Noakes' relatives recalled that his mother had recently purchased a 1929 Pontiac

BEHAVIORAL ANALYSES IN PERSPECTIVE

sedan for him, the first car he had owned. The next day, the entire family had vanished, with money still due on the car. Noakes had failed to pick up 2 weeks of severance pay owed to him ($50), possibly because the only way to get it was to say he was quitting and, from other behavior, it seemed clear that he did not want anyone to know about his trip east. The reason remains unknown.

As of November 10, Noakes had given no indication to family that he was leaving. The departure was hasty: food was on the table in his home and lights were on. He left California on November 11, covering 3,000 miles in 7 days in an unfamiliar car. He seemed to have failed in his mission, whatever it was, and had begun the trip west, going more slowly. He settled his retinue at a tourist camp in Langhorne on November 18 and remained for two nights. He and Winnifred went to the movies while the girls starved. The girls probably died on November 21. Elmo and Winifred placed the bodies and drove away, possibly trying to use the car to commit suicide. The tube on the tailpipe and the empty gas tank suggested they had tried this method and failed. They had hitch- hiked to Altoona.

They spent the night of November 22 at the Congress Hotel. The next day, Elmo attempted but failed to sell his glasses. Instead, he sold Winifred's coat, whereby he acquired $2.85 to purchase a defective single-shot Stevens .22 rifle. They walked along the railroad track until they reached the station. They were seen here on Friday night, November 23. They were discovered dead the following morning. One of them had set a small fire in the abandoned shed where their bodies were found, as if burning some papers. The autopsy reports were not available for them, but newspaper accounts indicated that Winnifred had never been pregnant. Her virginity was not confirmed.

As detectives identified Noakes and pieced together his route, it seemed that he had used fictitious names: J.C. Gardner, J.C. Malone, and J.C. Cowden. It was possible that he was trying to avoid the court order that had been served in Utah to turn over Norma to her biological father, although it had no weight in California. Yet this would not account for the haste in which he left or drove to his apparent destination, Philadelphia. Noakes had served honorably in the Marine Corps until April 1922. It seemed that he had worked a number of jobs temporarily, sometimes leaving the family for long periods to go work else- where. Why he had not sold the clothing in the Gladstone bag to get money, or sold the car, remains a mystery.

Family gossip, picked up by True Story magazine, was that Elmo and Winifred were romantically involved. The article had been written by the girls' aunt but possibly

BEHAVIORAL ANALYSES IN PERSPECTIVE

revised by staff writers. Accordingly, Elmo became physically abusive every time Mary was pregnant. She had health issues after the birth of Dewilla and had a miscarriage before Cordelia was born. Yet relatives insisted that Elmo had been a good father.

Other theories were suggested for cause of death that would make it an accident. Yet no one could explain why Elmo would have left his children on a blanket by the side of the road rather than take them to a hospital. One idea was that he believed he could marry his niece in Pennsylvania but then discovered he could not. However, he did not need to travel the entire length of the state to learn this. There seemed to be a reason he went to Philadelphia, but no one could discover it. He did not seem to know anyone there and witnesses said he did not ask about anyone or any addresses.

A later family theory, hoping to cast a more benign light, was that Noakes (and potentially his whole family) had lead poisoning from living and working in mining areas of Eureka, Utah. Mining operations during this period used zinc, arsenic, mercury, and lead. However, lead poisoning does not account for some of his actions, and he did not have quite a few of the most common symptoms.

Although this cold case was not fully resolved, the manner of death is clear, although with hints of familial abuse from a father with anger issues and an inability to make his life work. Meticulous behavioral analysis assists to dismiss some notions, even if it cannot resolve all of the questions.

A cold case mentioned in Chapter 6, in which child killer John Joubert was linked to an unsolved murder in Maine, also demonstrates the value of behavioral interpretation for linkage analysis. So does the case above involving Torrez.

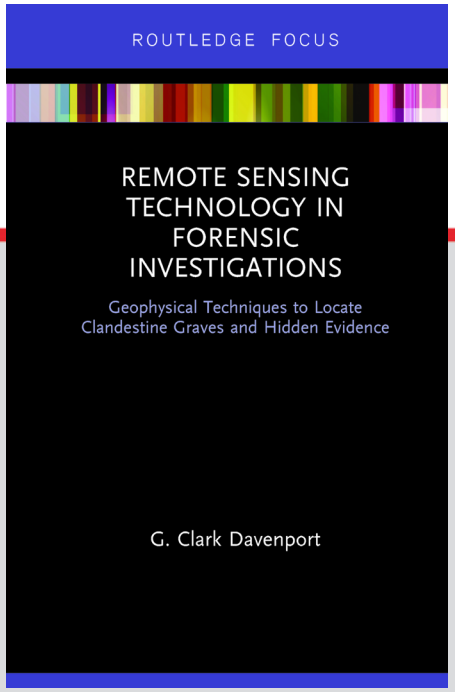
SUMMARY

Psychological analysis has its challenges when it comes to the type of certainty that the courts desire. However, this does not negate its value. Whether an investigator needs a psychological autopsy or a profile and whether it is for determining manner of death, linking crimes, or detecting staging, behavioral analysis remains an important aspect of evaluating and reconstructing incidents. The more investigators collect and interpret how to learn the finer points of mental state and human behavior, the fewer errors will be made.

CHAPTER

4

PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS



This chapter is excerpted from

Remote Sensing Technology in Forensic Investigations: Geophysical Techniques to Locate Clandestine Graves and Hidden Evidence

by Clark Davenport.

Learn more

PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS

Excerpted from *Remote Sensing Technology in Forensic Investigations*

Before a geophysical survey is to be performed, the forensic investigators should possess a working knowledge of the following factors.

Overall Statement of Objectives

Review of available site information to provide a descriptive assessment of the site:

- Target size and depth
- Proposed survey methods and survey locations
- Time constraints

Site-specific conditions are as follows:

- Surface: location, size, access, vegetation, climate
- Subsurface: soil types, groundwater, geology
- Sources of geophysical noise
- Site ownership, warrants
- Previous investigations

Integration of additional investigations includes the following:

- Aerial photography, historical and current
- Cadaver dogs
- Soils and vegetation
- Scavenging
- Previous excavations
- Historical weather records

PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS

Formulation of the Survey Plan: Questionnaire

Table 3.1 presents a questionnaire designed to provide information that can be utilized in the search for clandestine graves or evidence. Much of the basic information on the questionnaire will be useful for investigators to develop search strategies or a search footprint.

Save questionnaire as a new document on your computer before completing.

NECROSEARCH CLANDESTINE GRAVE QUESTIONNAIRE
(copyright NecroSearch International 1989, revised 2015)

NecroSearch is a team of civilian and sworn specialists whose aim is to assist law enforcement agencies in the detection of and recovery of evidence from clandestine graves. All information supplied on this questionnaire is strictly confidential. Please advise NecroSearch of any special needs or concerns you have in your investigation.

NECROSEARCH HAS THE RESOURCES TO ASSIST YOU WITH ALL PHASES OF YOUR INVESTIGATION, INCLUDING TIMELINES, RESEARCHING BUILDING "AS-BUILT" PLANS, WEATHER REPORTS, LOCATION OF MAPS, UTILITIES, HISTORICAL AERIAL PHOTOGRAPHS, ETC.

PLEASE CONTACT US FOR HELP!

Requesting Agency:
Agency Case Number:
Contact Person:
Address:

This Block for NecroSearch Use
N.S. Case No._____
N.S. Contact_____
Date Presented
Actions Taken:

Phone Number: Ext:
Alternate Phone Number: Ext:
FAX Number:
E-mail Address:

Note: We realize that you may not have all of the information requested on this questionnaire. For justifications for the questions, check notes at the end of this questionnaire.

You may wish to provide estimates or educated guesses, but please identify them as such.

1. **Information based on:** Witness statement Suspect(s) statement/confession
   ___Informant Anonymous source Other (specify):

2. **Victim Information:**
   Name: Date of Birth: Sex:
   (Use separate sheet for each victim)
   Height: Weight:
   Any type of artificial medical devices?[a] Any other metal you suspect buried with body?
   Drug Use[b]:
   What clothing do you think the victim was wearing?

3. **Suspect #1 Information:**
   Name: Age: Sex:
   Height: Weight:
   Any physical disability or impairment:
   Is suspect capable of carrying victim? Yes No
   If so, how far in the suspected terrain (e.g., more or less than 50 yards)?

If there are additional suspects, please add them here with height, weight, etc.

(Continued)

PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS

NECROSEARCH CLANDESTINE GRAVE QUESTIONNAIRE

4. How well did the suspect(s) know the area and possible hiding places?[c]

   Are there other areas and hiding places well known and frequented by these suspects?

   Have you eliminated these other areas from consideration?

5. What was suspected date and time the victim was killed (is this an estimate)?

6. Where was the suspected site the victim was killed (is this an estimate)?

   Where is the suspected site of burial or concealment (Latitude/Longitude/Street address)?

   What is the distance between the last known victim location and suspected site of burial?

7. What was the reported time interval between death and burial or concealment?
   What type of light was available (moon, sun, street-lights, etc.). We can help with this.

8. How did the victim reach the suspected site or area? Is this an educated guess?

   Walked under own power?

   Carried?

   Dragged? By how many individuals?

   By Vehicle (inc. ATV)? Make/Mdl/Color?

   By Boat? Make/Mdl/Color?

   Other:

9. Suspected access to area?

10. Are there any safety hazards our personnel should know about?

11. What is the terrain in the suspected area?

12. Was the body suspected to have been disposed of in an area to be covered over by construction[d]?
    If yes, explain:

    Please give us construction drawings (as built) of any building on the site if you suspect that the body may be hidden in and/or around them. We can help look this upif you wish!

13. Was the body suspected to have been disposed of in an area of heavy vegetation or trees[d]?
    If yes, explain; please describe:

14. Was the body suspected to have been disposed of in water[d]?
    If yes, explain; please include the water body type (stream, river, lake, reservoir, wetland, well, etc.) and name:

    If yes, was the body suspected to have been weighted?

    If so, what *specific* type of material was suspected to have been used?

    What other types of water structures/facilities (i.e., dams, canals, irrigation turnouts, pipelines, bridges, wells, etc.) are located on or around site?

(Continued)

PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS

NECROSEARCH CLANDESTINE GRAVE QUESTIONNAIRE

15. What were the ground conditions in this location at the time of the suspected concealment or burial (e.g., rocky/sandy)?

16. Have weather records been obtained?
    What weather records are available for review from the time frame of the suspected concealment or burial?
    We can help you obtain these records if you do not have them.

17. Do you suspect that a grave was dug?
    If not, how do you suspect the victim was concealed?

18. If you suspect a grave was dug, what tools were suspected to have been used?

    Have any of those tools been recovered?

    If so, have those tools been analyzed and are those reports available?

    How many individuals were suspected to have been involved in the digging?

19. Was earthmoving equipment suspected to have been used?
    (If you suspect the use of this equipment, it may be possible to eliminate some sites by having a person knowledgeable with that specific equipment review the suspected site)

    If so, what type of equipment?

    Has any equipment been recovered?

    If so, has this equipment been analyzed and are those reports available?

20. What type of covering do you suspect was used (soil, rock, brush, logs, lumber, concrete)?

21. Has anything happened since burial or concealment to alter the grave site (flooding,construction, fire, paving)?

22. Do you suspect the body was wrapped, if so how?

23. Has any physical evidence been recovered in the general area that is or may be associated with the victim(s)?

24. What scavengers (including birds) are in the area?
    What kinds of evidence (e.g., scat, hair, nests)?

(Continued)

PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS

NECROSEARCH CLANDESTINE GRAVE QUESTIONNAIRE

25. What vegetation was believed or reported to have been present at the time of excavation?

26. Who owns the property to be investigated?
Has consent been obtained to enter and work the scene?
Has a search warrant been obtained?
Is the owner/manager/caretaker available to give history and details?
What is the history of the site?
What information exists on location of known underground interferences (dumps, wells, septic and sewer systems, tanks, pipelines, animal graves)?

27. What maps of the area are available? We can help you with this.
Topographic Forest Service Bureau of Land Management (BLM)
National Park Service Soil Conservation Service
Real Estate Developers Local Utilities
Others

28. If outside the United States, what land/resource management agencies are available? We can help you with this.

29. What resource bases exist in your local area? We can help you with this.
(Specialists at universities, colleges, utility companies, private firms, and equipment such as aircraft, cameras, geophysical equipment, and tracking/cadaver dogs?)

30. Are pre- and post burial aerial photographs available?
How many years before burial or concealment?
How many years after burial or concealment?
What types? Color B&W Infrared Stereo Digital
Source? US Government City & County Tax Assessor Highway
Department Pipeline Company Railroad Public Service Private
We may be able to help you obtain these photographs. However, photographs taken by your agency are extremely important!

31. Is an aircraft available to use for site photography?
For site viewing?

32. Are site photos available? If not, can they be taken?
Are photos available from or can they be taken:
Early morning around sunrise? Late afternoon around sunset?

(Continued)

PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS

NECROSEARCH CLANDESTINE GRAVE QUESTIONNAIRE

Elevated position (e.g., tree, buildings, fire dept. ladder truck, etc.)? Ground level?

Photos of surrounding areas and access into site (roads, paths)?

33. Has any technical examination of the area been performed by others (foot searches, digging, geophysical surveys, dog searches, search and rescue, etc.)? If yes, describe briefly what was done and what results were obtained.

Please provide the name(s) of the experts used and copies of their reports.

34. What reasons do you have to believe that the area in question is the area containing the grave? Is there any other information that you could offer that helps make this gravesite and grave unique and that would assist us in locating it? Our experience shows that some killers dispose of victims in unique ways. An understanding of disposal methods will help us to evaluate your case.

35. We have discovered that a timeline of events can be crucial in solving a case. If possible, please provide a synopsis and time line of the events. We can help with this.

Finally if you are successful in your search for a clandestine grave, we would appreciate receiving information on the particulars of the grave for our database. Information such as distance from the nearest town, nearest road, upslope or downslope, and type of covering, will help us all in evaluating and assisting in future cases.

PLEASE FEEL FREE TO CONTACT:

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President, NecroSearch International, Inc.
1713 Willox Court, STE A
Fort Collins, CO 80524
(970) 227-6514

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EXPENSES: NecroSearch members do not charge for their time. The **agency** requesting NecroSearch assistance will pay for all expenses incurred when NecroSearch members conduct a search, and will pay for travel and lodging expenses. Mileage within the United States will be reimbursed at US government mileage rates.

[a]We need to know of any metal buried with the body for remote sensing technology.
[b]Drug use is suspected to affect scavenging patterns.
[c]Research shows that bodies are hidden more often in locations owned or known by the perpetrator. Known areas are where the suspect uses for recreation such as hunting, fishing, and camping, as these may be areas within the suspects comfort zone for body disposal.
[d]These things affect ground-penetrating radar and other remote sensing technology.

PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS

Excerpted from *Remote Sensing Technology in Forensic Investigations*

Presurvey Site Evaluation

Owing to the limitations of geophysical surveying, as much site information as possible should be gathered prior to conducting any surveys. Other information, for example, potential sources of geophysical noise—such as fences, buildings, and power lines—should be identified from air photographs, maps, or visual reconnaissance. For example, the US Department of Agriculture, National Resource Conservation Service (USDA NRCS) has published ground-penetrating radar (GPR) suitability maps of most of the contiguous states. These maps provide an idea of the suitability and effectiveness of GPR in areas based on soil attributes. Soil attributes have been collated from State Soil Geographic and Soil Survey Geographic databases. These databases have also been used by USDA NRCS to produce state-specific soils maps (https://www.nrcs.usda.gov/

wps/portal/nrcs/detail/soils/use/maps/?cid=nrcs142p2_053622).

A check with a local USDA NRCS soil scientist can provide very definitive data about a site of concern.

Geophysical measurements are generally made in a series of parallel lines or a cross-grid pattern across the survey area. Grid lines can be laid out with rope or tape, and grid stations along each line can be marked with flagging on plastic pin stakes. The size and depth of the objects sought determine the spacing of measurement stations or survey lines. In forensic surveying, line and station spacing may be on the order of 0.5–1 m or less. Performing a test survey over a known or a constructed feature is highly recommended. For example, in searching for a clandestine grave, a similar grave could be constructed if the details are known. This provides an opportunity to observe the type of response the instrument chosen for the survey will give. This type of calibration survey will also provide information on the optimum line spacing and station interval

to use in a grid to be able to detect a specific target.

Concurrent with the geophysical survey, a site features map should be developed to document the location of surface scrap metal, power lines, buried utilities, roads, topographic and cultural features, and soil and vegetation changes observed at the site. This information will be used during the data interpretation stage to provide a better under- standing of the significance of geophysical anomalies detected. A site features map also offers an excellent visual presentation for a jury.

PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS

Equipment

Electronic geophysical equipment, often subject to field and travel- related abuse, is susceptible to different problems, all of which may affect the quality of recorded data. All equipment, when supplied by the manufacturer, is calibrated to a nationally or professionally accepted standard. Equipment calibration often diverges from these standards owing to age and use; thus it is a standard, professional practice for geophysicists to perform field calibrations prior to the start of a survey. It is recommended that the make, model, and serial number of each piece of equipment used in a survey be recorded along with the data and place of the last manufacturer's calibration. It may be possible to perform a survey when an instrument is known to be out of calibra- tion, but the results will not stand up to legal scrutiny.

Personnel

The complexity of an investigation will dictate the level of personnel education and experience necessary to perform a geophysical survey. Where a single geophysical method is proposed for an investigation, a qualified geophysicist specializing in that method should be used to perform that survey. Where multiple methods are used, an organization providing comprehensive geophysical expertise should be used to perform the surveys. Instrument operators who are not trained geo- physicists are typically less experienced in data reduction and interpretation routines than trained geophysicists. However, nongeophysicists may be trained and qualified to operate specific instruments under the supervision of a qualified geophysicist.

There are 29 states and 1 territory with geologic registration or licensure requirements for geologists, geophysicists, or geoscientists. Some of these states require that geophysical surveys be performed by, or under the supervision of, a licensed or registered professional. The results of a geophysical survey performed by an unregistered individual in a state that requires registration may not be able to be used in a court of law.

Reporting

A written report of findings should include as part of the case file copies of the geophysical profiles and/or contour maps depicting the results of the survey. The following items should be discussed in the report: description of the site,

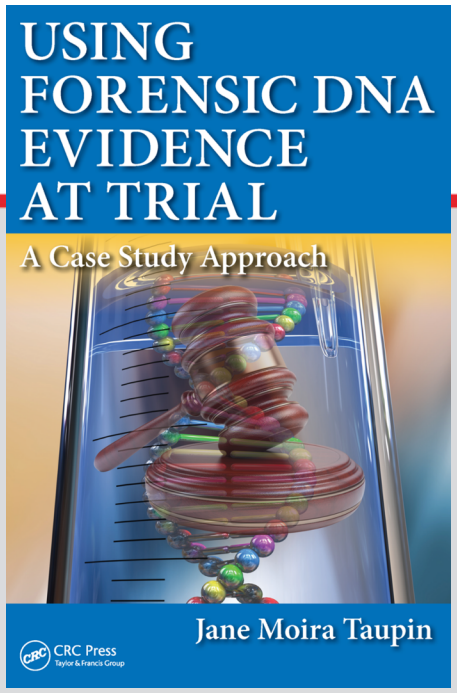
PRESURVEY PLANNING AND POSTSURVEY REPORTING REQUIREMENTS

description of the survey procedures and equipment utilized, survey grid parameters, an interpretation of the results and their significance, and any conclusions and recommendations. The report should contain all data sheets, computer printouts, plots, and the site features map.

CHAPTER

5

INTERPRETATION OF DNA PROFILES



This chapter is excerpted from

Using Forensic DNA Evidence at Trial: A Case Study Approach

by Jane Moira Taupin.

Learn more

INTERPRETATION OF DNA PROFILES

'DNA' stands for 'deoxyribonucleic acid'. It is a molecule that holds the information and instructions for an organism. There are 23 chromosomes, bundles of genes, in the human 'genome' of the molecule. Half our DNA is inherited from our mother (from the egg in fertilization) and half from our father (from the spermatozoa).

Each person's DNA remains the same over their life and has the same composition throughout the body. This is exploited in DNA profiling as the DNA from a blood/semen/skin cell deposit at a crime scene can be compared with the DNA from a reference mouth (cell) swab from a victim or suspect.

Parts of DNA are 'tandemly repeated' sequences, and the variations between these tandem repeats in humans are called polymorphisms. Short tandem repeats (STRs) are used in forensic science and tend to be tetra (4) repeats which are repeated 5–30 times. Markers, which examine different locations on the molecule, are typically chosen from separate chromosomes to avoid any problems with linkage between the markers.

A genotype is the set of alleles in a human; an allele is an alternative form of a gene. A 'homozygous' genotype means that there are two identical alleles at the same locus; the same allele number has been inherited from both the mother and the father, for example a 16,16. A 'heterozygous' genotype means that there are two different alleles at the same locus; different alleles were inherited from the mother and the father, for example '16,18'.

A DNA profile is the combination of genotypes obtained for different loci. It is important to remember that multiple loci are examined in DNA profiling to reduce the possibility of a coinci- dental match between unrelated individuals.

Human beings have cells that contain the DNA. The size of an animal cell is about 10–20 micrometres (μm) which is about a fifth of the size that may be visible to the naked eye.

A plant cell is about 100 μm in diameter, an animal cell about 10 μm, to 1 μm for bacteria and 0.1 μm for a virus. Finally, an atom has a diameter of about 1 Å or ten thousandth of a micrometre. Figure 4.1 depicts the relative sizes of cells.

Human and animal cells are not only tiny but also colourless and translucent. Staining techniques are used to visualize the cells

INTERPRETATION OF DNA PROFILES

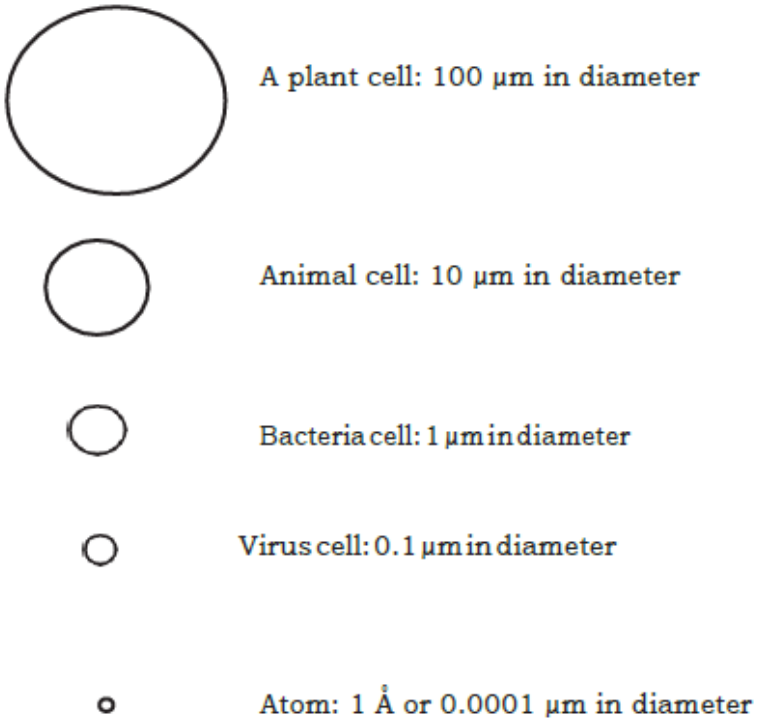


FIGURE 4.1 Relative sizes of cells (not to scale).

INTERPRETATION OF DNA PROFILES

under a microscope with magnification. Sperm and skin cells are quite different in appearance. Sperm appear like tadpoles (with or without the tails) and skin cells are round to oval.

The DNA obtained in a forensic investigation needs to be in a form that can be interpreted and compared to DNA obtained from other people. Obtaining DNA from inside the 'nucleus' (core) of the cells is the mainstream form of DNA profiling. A type of analysis that focuses on the Y chromosome, a sex-determining gene from inside the nucleus, is called Y-STR profiling.

Mitochondrial DNA is found in the mitochondria outside the

nucleus of the cell but still within the cell membrane. Different techniques are used to locate and analyze this mitochondrial DNA. This type of DNA profiling is used in the analysis of human and animal DNA.

DNA profiling is used as a comparative technique. The DNA result of a crime sample is compared with that obtained from a reference sample from a person. DNA profiles are relatively straight forward to interpret when there is sufficient DNA, and it appears to be from a single source. Mixtures and partial pro- files of DNA introduce further complexity. The resulting potential lower discrimination and evidential value could be crucial in a criminal case.

The particular technical steps in the process to produce a DNA profile are explained in detail in forensic DNA texts such as Butler.

The main steps in the technical process for DNA profiling are as follows:

- Sample the crime deposit and separate biological matter if possible.
- Extract the DNA and clean up the sample.
- Measure the quantity of the DNA.
- Target the specific areas of interest within the DNA molecule and the repeat fragments.
- Produce multiple copies of these fragments.
- Sort the fragments according to size and measure against a standard.

INTERPRETATION OF DNA PROFILES

The following case from the United States describes an exam- ple of incorrect placing of samples in vials, and a DNA database match that subsequently excluded the original accused (Innocence Project).

CASE 4.1 Sample Switch; Database Exclusion

A masked man in a blue hooded sweatshirt and ski mask burst into a woman's home in Las Vegas in 2001 and forced her to drive to an ATM for money. He ran away when the woman's husband spotted them. Police followed 18-year-old Dwayne Jackson and his cousin Howard Grissom who were riding bikes and thought they could be the suspects. They looked inside a car in the driveway of their house and discovered a blue hooded sweatshirt with a ski mask in the pocket. Both Jackson and Grissom denied involvement.

Jackson's DNA profile matched that from the DNA on the sweatshirt. The DNA was the only evidence con- necting him to the crime. Jackson pleaded guilty as the other charges of kidnapping and burglary carry- ing lengthy terms would be dropped if he did. He was imprisoned for 4 years and released in 2006.

During November 2010, the California authorities contacted Las Vegas police and informed them that someone else in the DNA database system matched the crime scene sample for the crime for which Jackson had been convicted. Howard Grissom had been sentenced for an unrelated kidnapping and attempted murder in southern California in 2008, and he was serving a 41-year jail term. It was his DNA profile that matched the DNA profile from the sweatshirt. It was discovered through a forensic review and reanalysis that a laboratory technician had put Johnson's sam- ple into Grissom's reference vial and vice versa in the original case.

Dwayne Jackson was pardoned in 2011.

We can predict that DNA profiles produced from references will be single source and good quality. If they are not, then a further sample from the person can be taken. Crime stains are not so amenable.

The association of a particular body fluid and a DNA profile is not implicit. It would be desirable if DNA from different types of body material could be differentiated. Currently, however, DNA profiling does not reveal what body fluid or tissue source from which the DNA profile originated.

INTERPRETATION OF DNA PROFILES

The only cells that can be separated are sperm (the 'male seed') from other cells. Skin cells from different people, or within one person's body, cannot be separated.

Extraction

Extraction of the DNA from the sample is the next step. The cell membrane is broken open to release the DNA. The process also aims to remove protein and other matter so that inhibition from these materials in the copying process (see amplification step) is reduced. The method of extraction of the DNA from the sample will depend on the nature of the sample. Epithelial cells from 'touch'

DNA require a simpler and quicker extraction to isolate the DNA than that from spermatozoa or hair roots.

Samples from crime scenes require scientific judgement as to the method of extraction. Dyes from within the substrate such as denim jeans may colour the extract, with consequent inhibition of the amplification. Additional material may degrade the DNA itself, such as mould.

The resulting DNA profile obtained may reflect inhibition or degradation of the sample. Another extraction technique, and a repeat DNA analysis, may be required on the sample to obtain an optimum profile. Evidence of degradation or inhibition of the DNA in the sample may be observed in the DNA profile itself (see the following text).

When DNA profiling was first introduced in 1986, a method of separation of sperm from cells was also introduced. 'Differential lysis' selectively enriches the sperm concentration in vaginal fluid/semen mixtures, thereby avoiding the problem of the victim's DNA (which is in great excess) masking the male perpetrator. This is the only protocol to have remained unchanged throughout the past three decades in forensic laboratories.

The following case study shows how contamination occurred between two separate cases in the DNA extraction step of the analysis.

INTERPRETATION OF DNA PROFILES

CASE 4.2 Extraction Contamination; Database Match

A young man from the south of England was accused of raping a woman in Manchester, a city in the north to which he claimed he had never been. Adam Scott subsequently spent 5 months on remand in custody after it was allegedly found, through a database search, that his DNA profile matched that of the semen found on a medical sample from the woman. The DNA was the sole evidence against the accused. He was released in March 2012 after being found 'the innocent victim of an avoidable contamination'.

The two low vaginal swabs, two high vaginal swabs and two vulval swabs from the woman were found to have semen. This semen was separated from the cellular material (the differential lysis or extraction process) to remove the female cells. All the swabs had male DNA profiles from the semen fraction that were identified as the victim's boyfriend. One of the vulval swabs produced a mixed profile containing the victim's boyfriend and another incomplete DNA profile. The unknown male DNA profile was loaded onto the national DNA database. There was a partial DNA profile match of Scott with a probability of 'one in one billion' of obtain- ing chance DNA components in an unrelated person. The opinion of the scientist was that the DNA matching Scott most likely came from the semen.

The government inquiry found that a plastic tray sample holder was mistakenly reused and loaded into equipment by a laboratory worker as part of the robotic DNA extraction process, instead of being disposed into a rubbish bin. Saliva from Scott from an unconnected earlier 'spitting incident' was extracted in the same tray 'well' before the DNA from the vulval swab from the woman. Basic procedures for the disposal of plastic trays were not followed, records not maintained and nothing was done to mark trays once they had been used.

This case had a similar problem to Case 2.1. That is, all the other evidence belied the DNA result. The DNA result was used to prove that the accused had sexual activity with the complainant.

The following are noted:

- Only one of six swabs had DNA that 'matched' the accused.
- DNA from sperm cannot be differentiated from DNA from saliva once extracted.
- It is not possible to imply sexual activity without a consideration of context.

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• Remnants of DNA may remain after an extraction, sufficient to produce a searchable profile, and is often thrown away.

A laboratory may state that a sample was processed at different times and by different people, and thus contamination between samples is unlikely. However, this case demonstrates that this may not always be true in the robotic and mass extractions of samples.

Consideration of the time of deposition of semen was impor- tant in the following case from the author's files.

CASE 4.3 Time of Deposition; Mixture of Semen; DNA 'Match'; Cold Case

A cold case murder was reopened. The body of a woman was found naked and brutally battered near a walking trail in a national park. A blood-stained rock was near her body which was alleged to have caused her death. Semen was found from medical swabs inside the body. Advances in technology led to DNA obtained from the swabs and then a search of databases.

Two men were charged with the murder. One man pleaded guilty to murder and to unlawful sexual inter- course. The other man said he had consensual sex with the woman before the murder. He claimed he had nothing to do with her murder or of taking her to the park. The defence argued that the evidence was incapable of convincing a jury of his guilt.

There was DNA from the semen of the medical swabs that indicated at least three individuals, and possibly four. The two convicted men were considered to have contributed DNA. There was an 'unknown individual A', never located, who was also considered to have contributed DNA to the mixture.

The judge directed the jury to find the accused not guilty. Even if the DNA matched the accused and showed he had sex with her, it did not prove he partici- pated in the rape and murder of the victim or that he was even present when the crime occurred.

INTERPRETATION OF DNA PROFILES

Mixtures of DNA in semen are problematic. If there are two or more male contributors suspected in a sample, then Y-STR may be useful.

Extraction techniques (not just automation) can be adapted and improved if there is a problem suspected in the fabric or substrate on which the biological deposit lays. An intriguing multiple murder from Japan illustrates the principle.

CASE 4.4 Extraction; Blood Stains; Degradation

A large fire started about midnight in the office and home of the director of a family-run miso (fermented soy bean paste) factory in 1966. Four corpses were discovered in the burnt out ruins. The bodies had many stab wounds and were identified as the director of the factory, his wife and two of his children. Two months later, an employee of the factory was arrested based on circumstantial evidence, and he confessed after prolonged interrogation (20 days). The prosecution declared that the accused had worn pyjamas during the crime but no blood was found on them. During the trial, some 14 months later, five items of clothing were found in a miso barrel in the factory. The clothing had blood stains in a drip pattern. This clothing was then declared as the clothing worn by the accused and not the pyjamas. There was an ABO blood group B stain on the right shoulder that matched the blood group of the accused. The death sentence was confirmed in 1980 based on this evidence, but a retrial was requested by the defence.

Eventually in 2011 DNA analysis was conducted on the samples from the clothing. Because the samples were contaminated with miso, an extraction method was used to separate the blood from the miso. DNA profiles were able to be obtained. The blood stain samples, which were thought to originate from the victims, could not be interpreted because there were no victim reference samples.

After the DNA results were submitted to the court, a reference sample was obtained from the incarcerated man. His DNA profile did not match the critical DNA profile obtained from the right shoulder of the clothing. A retrial judgment was issued by the court in 2014 recognizing the DNA evidence. The court suspected the items of clothing used in the original trial were forged and the accused man was released immediately.

The day after the accused was released, the managing director's eldest daughter, who had given testimony, was found dead from causes unknown.

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Quantification

The main aim of the quantification step is to determine how much of the sample can be added for the amplification stage. The DNA extracted from a crime sample may not just be human but also be, or include, animal and plant DNA. Quantification is human specific (or at least higher primate). STR primers are also human specific.

Ideally all samples will have the same amount of DNA added to the amplification mixture. Too much DNA will result in off-scale peaks, peak imbalance and split peaks. Too little DNA may result in poor-quality profiles. Profiling kits have recommended ranges of the amount of DNA that should be added, which varies from

0.5 to 2.0 nanogram (ng).

If no DNA is quantified, many laboratories previously stopped at this point. Now, many laboratories will go ahead and perform the steps below in order to attempt a DNA profile. The quantification step is known to be less sensitive than the actual profiling step so an attempt at a result may be made if the evidence is considered crucial and/or necessary to the case, even if no DNA is quantified in this step. The absence of a quantifiable amount of DNA in the sample may mean that low-level DNA considerations need to be implemented in any further step in the analysis and interpretation.

Amplification

The amount of DNA extracted from forensic samples is very small. Amplification makes many copies of the DNA material. More than a million copies of the target DNA can be obtained in a few hours through a number of amplification 'cycles'.

The technique for the amplification of the extract is called polymerase chain reaction and can be utilized on very small and degraded samples. It targets the 'STRs' with specific sequence 'primers' and these are what are amplified. Each primer is labelled with a fluorescent light-reactive coloured dye in order for detection under a laser in the detection step. Thus the amplification step also enables detection.

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A 'cycle' traditionally numbers 28. A highernumber of cycles were used to obtain a result from smaller amounts, and increased cycles were used in 'low copy number' techniques (up to 34 cycles). It was stated that a laboratory may not be explicit that low-level techniques are being used. The PowerPlex21 kit, using 21 markers on the molecule, uses 30 cycles in its conventional typing.

Separation and Interpretation

The amplified DNA fragments are separated, detected and ana- lyzed. This is called 'autosomal' STR profiling. There are 22 pairs of 'autosome' chromosomes in humans that are not involved in determining the sex. The remaining pair of chromosomes is the sex-determining X and Y chromosomes.

The detection of dye-labelled fragments is now by capillary electrophoresis. Electrical current is applied to move the samples along the capillary and they are separated. A laser excites the dye labels, and the emission is captured in digital form and ultimately measured (in relative fluorescence units).

A DNA profile is pictured in laboratory case files as an 'electro- pherogram' (known as 'EPG'), an electronic printout representing the distribution of peaks across the chosen markers. It is this dia- gram from which scientists determine factors such as the quality and quantity of the DNA present, the number of contributors and artefacts. Figure 4.3 is an example.

The height of the peak is measured in terms of relative fluores- cent units (along the vertical axis). The horizontal axis relates to the molecular weight (how large the fragment).

One of the presumptions in determining a 'match' between a crime DNA profile and a reference DNA profile is that the peaks (or alleles) are designated correctly in both profiles. There are three kinds of alleles in a crime stain profile:

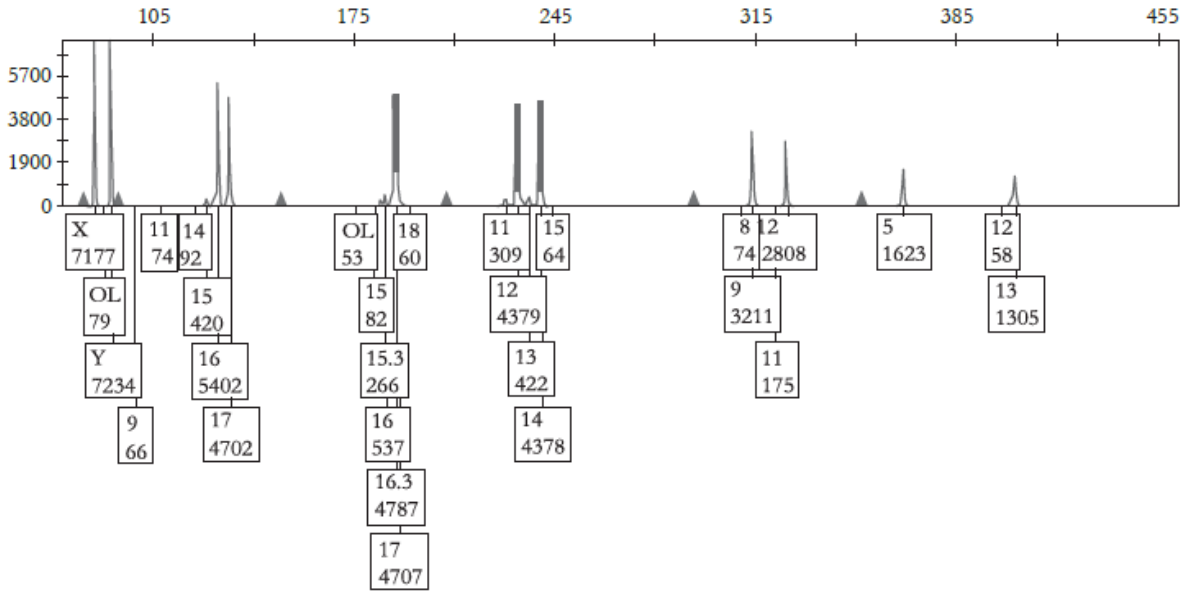
• Alleles which are unmistakeable

• Alleles that may be masked by an artefact

• Alleles that have dropped out completely and are therefore not detected

A forensic DNA report may include a 'table of alleles' which compares the crime scene sample DNA profiles with reference

INTERPRETATION OF DNA PROFILES



An electropherogram, diagram of a DNA profile. Representation of DNA fragments; alleles are higher peaks. Vertical axis represents the intensity of signal, correlated to the amount (units in relative fluorescence). Horizontal axis represents the weight of fragment, larger weights to the right of the axis. There are small peaks marked OL, and other small peaks not marked but considered stutter (echo of large peaks).

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samples DNA profiles. These tables most often also include the accused sample and the complainant sample. The alleles are those which are designated by the forensic scientist at a particular locus and correspond to the values detected at the locus for a particular profiling system. The PowerPlex21 system examines 21 loci, including amelogenin, the sex marker. Table 4.1 shows a table of alleles of three samples – the crime scene sample, one accused reference sample and one complainant reference sample.

Analytical Threshold

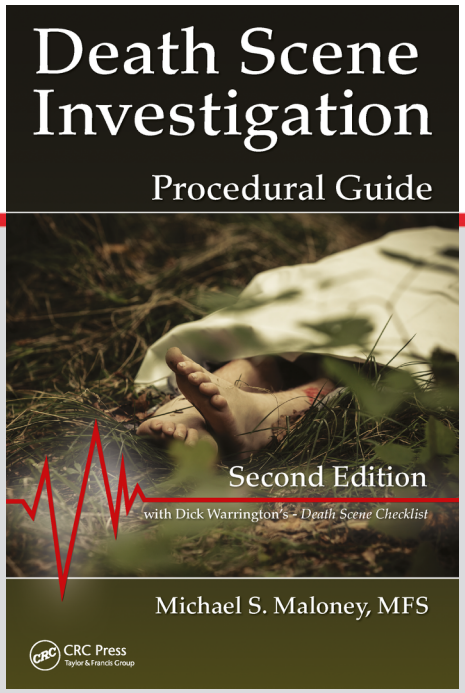
There are thresholds used in the interpretation of a DNA profile and the designation of peaks. The 'analytical' threshold is a level above which a peak may be determined as a real peak, distinguishable from noise. Validation studies should be performed in the particular laboratory to determine the analytical threshold. Some laboratories determine the analytical threshold for each DNA profile or EPG determined on the signal-to-noise ratio.

The stochastic threshold is the other threshold sometimes used in the interpretation of an EPG, particularly with low-level profiles

CHAPTER

6

BIOLOGICAL EVIDENCE



This chapter is excerpted from

Death Scene Investigation: Procedural Guide, Second Edition

by Michael S. Maloney.

Learn more

BIOLOGICAL EVIDENCE

Excerpted from *Death Scene Investigation: Procedural Guide, Second Edition*

Biological evidence is found on the body and clothing of the victim or perpetrator and at the scene. Biological evidence is a valuable source in determining physical presence or contact as well as actions within a scene. Handling biological fluids and stains is hazardous due to blood-borne pathogens. Hepatitis B virus and human immunodeficiency virus are of particular concern. Treat all biological fluids as sources of blood-borne pathogens.

Touch DNA

Touch DNA refers to an incidental transfer of genetic material (DNA) when an object is handled, touched, or brushed up against. The DNA of the person may be transferred through shed skin cells or body fluids.

Detection

- The "touch" transfer is latent, not visible to the naked eye.
- Its possible location, and therefore collection point, is determined through an analysis of the body and evidence in context of the dynamics of movement within the scene.
- Touch DNA should be expected to co-reside with latent or patent fingerprint impressions. Obvious locations at the scene would be at points of entry or where items of physical evidence had to be manipulated by the perpetrator.
- Obvious locations on the deceased may include the upper arms, wrists, or ankles of a victim that was dragged, or the inner thighs or breasts of a sexual assault victim.
- Other locations may be less obvious, but all possible locations of touch DNA on the victim should be thoroughly examined.
- Nothing precludes collection of both DNA and fingerprint evidence.
- Touch DNA can be sampled from areas associated with latent finger-prints transfer by swabbing areas that lack any ridge detail. Swab the areas surrounding the print or areas of relief (e.g., edges, textured aspects of the object that will not hold ridge detail). If the investigator can see a fingerprint impression but it is obviously smeared and lacks ridge detail, there is strong possibility that touch DNA could be retrieved from that surface.

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Preservation and Collection on Items of Evidence

• Cyanoacrylate (Superglue™) fuming for the preservation of latent prints serves a dual purpose, as it also preserves touch DNA. This is an ideal method for preserving both possible prints and DNA on weapons.

• Touch DNA may be collected by swabbing the suspected transfer area with multiple swabs moistened with distilled or sterile water. The swabs should be rubbed over the suspected area for at least 15 seconds.

• Do not use standard cotton swabs for touch DNA collection. As the swab is rubbed against the area, the cotton tends to degrade and fall off. This is the very area of the swab that most likely holds the genetic material. Swabs made of rayon or polyester are the better collection method.

• Alternatively, typical small tape tabs (e.g., Post-it sticky flags) can be used if the area to be sampled is dry. The tabs are pressed against the area to be sampled and submitted for evaluation. The adhesive has no known detrimental effect on the DNA itself.

Biological Fluids and Stains

Biological fluids such as blood, semen, saliva, and urine may be left on the body of the deceased or at the scene. These stains may be either wet or dry, or in some cases pooled.

Detection

See Figure 41.1.

• Visual detection may be supplemented with strong oblique lighting. This is the least effective method.

• Ultraviolet lighting (100–400 nm) often fluoresces semen, urine, and occasionally saliva. Use caution when exposing any area believed to contain DNA to extended exposure to ultraviolet light

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Figure 41.1 Searching for biological evidence may require scans with various light sources. Strong white light, UV light (pictured here) and an ALS light.

as UV light does have a detrimental effect on genetic material. Long wave (315–400 nm) UV is preferred over short wave (100–280 nm) UV light.

• Semen, saliva, and urine will fluoresce when exposed to an ALS tuned to 450–485 nm and viewed through orange goggles.

• Blood, however, does not fluoresce when exposed to alternate wave- lengths of light. It absorbs all light and appears black or dark. Blood is best visualized when exposed to 415 nm of light and viewed through yellow goggles. The appearance of the stain will be like a dark hole in the background material and the resulting contrast should allow the investigator to visualize and photograph the blood better.

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The Body and Scene Analysis

• Typically, the presence of a stain in the appropriate scene context is sufficient to indicate it is biological. If a stain looks like biological staining and is in an area where biological staining would be expected, it should be processed and collected. A presumptive test is not necessary.

• Occasionally stains may appear in such a context that their biological origin or forensic significance is questioned.

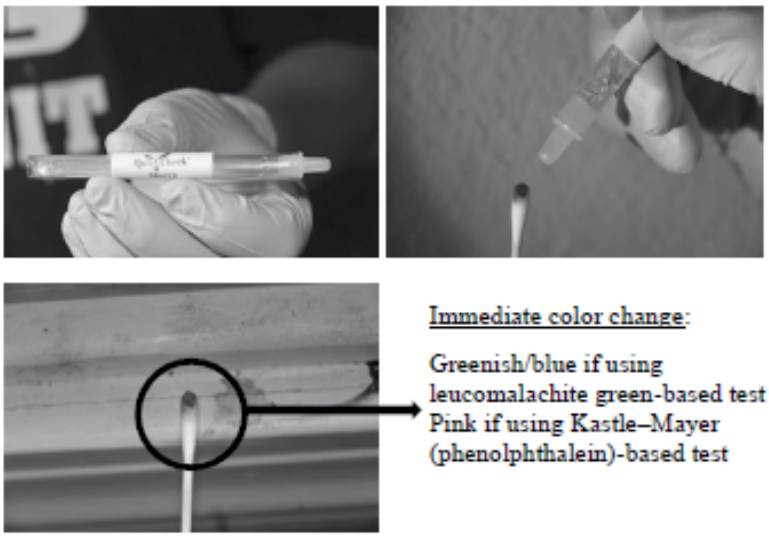

Figure 41.2 Presumptive blood test.

• Presumptive test kits are available that may be used on scene to establish a stain is blood, semen, or saliva. This does not confirm that it is a human sample, but it may assist the DSI in deciding what stains should be sampled (Figure 41.2).

• Human-specific test kits are also available for field use. These allow the stain to be confirmed as human blood, human semen, or human saliva at the scene (Figure 41.3).

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Collection of Biological Stains

Biological evidence is usually encountered in one of four conditions:

- Dry: contains no moisture, crusty
- Wet: a damp stain or area of biological staining
- Liquid: a pooled area of biological fluid
- Tissue: an actual piece or fragment of tissue

General

- All stains should be thoroughly documented and photographed prior to collection. Include close-up photography, both without and with scale. Note: If you are illuminating with UV light, remove any skylight or UV protective filter from the lens or the camera will not capture the image.

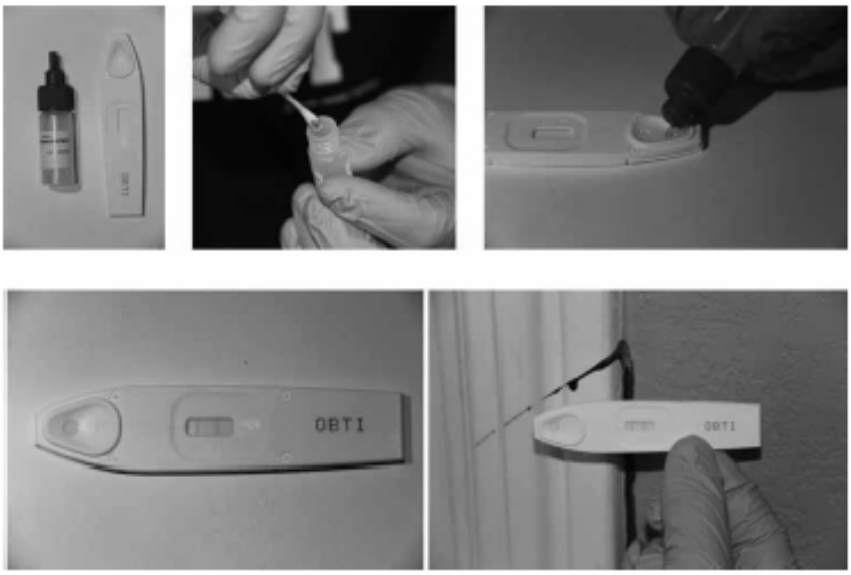

Figure 41.3 Presumptive blood test, human (primate) specific. Positive indicated by parallel blue lines, one at the control (C) position and the other at the test (T) position.

BIOLOGICAL EVIDENCE

• As collection efforts move from one stain to the next, the potential for cross contamination should be minimized. Either use disposable instruments for collection or instruments that have been cleaned in a 10% household bleach solution for 5 minutes. In addition, two pairs of gloves should be worn, with the outer pair being changed between unassociated stains or samples.

• With prior approval from the medical examiner or coroner, use an indelible marker pen and draw a discreet arrow to any suspected wet semen observable on the body. Once dry, stains that were visible at the scene may not be visible.

• Use an indelible marker pen and circle any suspected wet semen observable on sheets, items of clothing, or other objects. Once dry, stains that were visible at the scene may not be visible.

• If the stains are located on bedding, mark the side that was exposed during the assault and indicate which end was at the head and which was at the foot of the bed. Allow wet stains to air-dry before folding.

• If collecting and submitting the object itself, no control sample is required. Otherwise, obtain a sample from an uncontaminated area on the surface where the stain was found.

• Before folding an item, place a clean piece of paper over stains to prevent cross transfer of the stain to other portions of the item. Do not fold the item through a stain.

Dry Stains

See Figure 41.4.

The Body

• If a dry semen stain is located on the body, discreetly indicate the location with an indelible pen.

• Use the injury mapping technique to photograph the stain as out- lined in Chapter 9, “Autopsy Protocol and the Investigator’s Role.”

• Photograph the stain using UV and ALS.

• Lightly moisten a sterile swab(s) with distilled or sterile water (do not use saline solutions) and swab the stain.

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• Saturate the sterile swab(s) with as much of the sample as possible. It is important not to dilute the stain too much.

The Scene

• Submit item if practical or cut out the section containing the stain.

• Collect as much of the stain as possible.

• If the item cannot be seized or the stain cut out, collect dried stains with clean, moistened sterile swabs.

• Lightly moisten a sterile swab with distilled or sterile water (do not use saline solutions) and swab the stain.

• Saturate the sterile swab with as much of the sample as possible. It is important not to dilute the stain too much.

• Continue to saturate swabs with the stain until the swab comes away clean or until six to eight swabs have been collected.

Figure 41.4 Collecting a dry sample of blood after moistening the swab with distilled water.

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• Air-dry the swabs.

• Take a control sample with an additional swab, identically moist- ened, swabbed on an adjacent unstained area of the substrate, and also air-dried. Package separately as "control sample."

Wet Stains

See Figure 41.5.

The Body

• If a wet semen stain is located on the body, discreetly indicate the location with an indelible pen.

• Use the injury mapping technique to photograph the stain as out- lined in Chapter 9, "Autopsy Protocol and the Investigator's Role."

• Photograph the stain using UV and ALS.

• Using a sterile swab(s) (lightly moisten if necessary), collect the stain.

• Saturate the sterile swab(s) with as much of the sample as possible.

The Scene

• Submit item if practical, or cut out the section containing the stain.

• Collect as much of the stain as possible.

• Allow stain to thoroughly air-dry prior to packaging.

• If the item cannot be seized or the stain cut out, collect wet stains with clean, dry cotton swabs.

• Saturate the cotton swab with as much of the sample as possible.

• Continue to saturate swabs with the stain until the swab comes away clean or until six to eight swabs have been collected.

• Air-dry the swabs.

• Take a control sample, as described above, using an additional swab, and collect separately as "control sample."

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Figure 41.5 Collection of a wet sample of blood using a swab fitted with integrated swab cover to allow for drying and prevent contamination.

Liquid Stains

See Figure 41.6.

The Scene

- Withdraw a sample from the depth of the stain (not at the surface or at the bottom) using a pipette or syringe.
- Place sample in an EDTA test tube (purple top) for DNA testing. Gently mix by rocking test tube back and forth several times.
- Place sample in an ACD test tube (yellow top) for serology and alcohol testing. Gently mix by rocking test tube back and forth several times.
- Refrigerate sample and send to lab as soon as practical.
- An alternate, but less preferred, method is to collect liquid stains with a clean cotton swab.
- Saturate the sterile swab with as much of the sample as possible.
- Saturate and collect six to eight swabs. Let dry before packaging.

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Packaging

• Swabs suspected to be from different stains or contributors must never be packaged together!

• All swabs should be thoroughly air-dried and placed in labeled swab boxes. The swab boxes are then packaged in a porous container (bag or box).

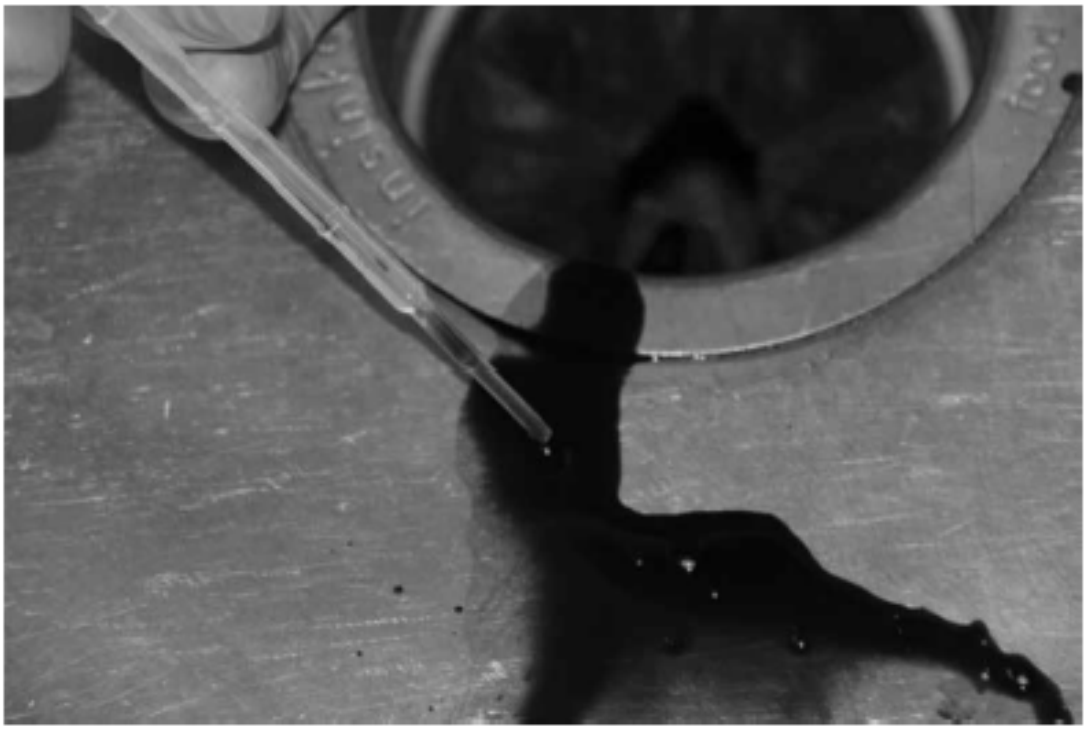

Figure 41.6 Collecting a liquid sample of blood with a disposable pipette. The sample is then placed in the appropriate collection tube.

BIOLOGICAL EVIDENCE

• Swabs from the same collection sample must be packaged in separate swab boxes and containerized; they may be placed in the same secondary package.

• Individual swabs can be marked by the use of tape wrapped around the shaft onto itself, well away from the substance being sampled, where the collector's initials, date, and time (and possibly the location from where the sample was taken) can be recorded.

• Items of clothing or bedding that contain biological stains must be thoroughly allowed to air-dry before being packaged in a porous container.

• Biological stains should never be permanently packaged in nonporous containers (e.g., plastic bags). The only exception would be using plastic as a temporary container for the purpose of transporting the item to a drying area.

• The time biological materials are allowed to stay in nonporous packaging should not exceed 2 hours.

• All items of evidence should be noted on the proper evidence custody document and entered into the evidence custody system.