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# EVIDENCE and CRIME SCENE RECONSTRUCTION

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A Guide For Field Investigations

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This manual serves as a companion textbook for a series of portable crime scene investigation courses offered by the author to interested criminal justice personnel, often at their own agency. The courses expose the participants to intense and realistic crime scene settings to develop individual abilities. Depending upon their function in the justice system, participants acquire proficiency in the processing, the investigation and the reconstruction of the crime scene.

The instructors for these nationwide programs have many years of experience in the investigation and reconstruction of crime.

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## **ACKNOWLEDGMENT**

This text represents the contributions of hundreds of people with whom I have been fortunate to be associated and from whom I have learned so much. The experience of being a trainer, while still performing field investigations and crime scene reconstructions, has provided me the opportunity to develop new ideas and see them put into practice by others. I wish to thank each of you who have contributed creative and workable solutions to the problems facing investigators of criminal activities.

To those of you who have given so much to me in everything I have tried, and helped me grow throughout life, my deepest appreciation and gratitude.

As is true in all things in life, together we can make a difference.

## ***DEDICATION***

This book is dedicated to those who respond to crime scenes of every description, but in particular, homicides. Each of you sees the impact of crime upon the victim, the families and the community. You truly see the face of crime, often the face of death. Your courage and perseverance, despite personal fatigue and the complexities of the courts, form the foundation of what is best in our justice system. Your dedication to honorably serve your community and protect every citizen's rights and freedoms makes you heroes.

This edition is dedicated to the "next generation" of investigator, be they sworn or civilian, who will step forward to serve their community and take up the fight against crime.

You are your community's hope for a safe tomorrow.

March 2015

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# ***INTRODUCTION***

## ***PUBLIC SAFETY***

Television depicts the fictional police investigator as collecting and analyzing evidence, performing field interrogations and arresting the perpetrator in a world with unlimited resources and technology. These theatrics are far from reality.

The investigation of any crime is a team effort with many steps progressing from the initial detection of the crime, to the ultimate trial of the accused. At each step, hundreds of decisions are made; some rapidly, others with consultation.

Police officers have a difficult set of priorities to balance as they perform their duties. As the officer responds to a violent crime, the responsibilities to protect life, property and to apprehend those who violate either, flash through the mind. These obligations and many others occupy the officer's attention at a given moment; often they will alternate in importance during the same instant. Yet, the actions of the officer in the effort to protect and preserve life may well affect the future processing of evidence and the outcome of justice. These are difficult demands; yet, every citizen expects each officer to not only balance these responsibilities, but also solve the crime in order to "catch the bad guy", "convict the guilty" and "protect the innocent" each and every time a crime occurs.

Like professionals in any other occupation, investigators would prefer to take time to study situations before them in order to make decisions. Unfortunately, criminal investigations often involve situations requiring split-second decisions. There may be only a brief instant to balance personal safety with the welfare of others or the preservation of the crime scene.

Knowledge combined with skills developed through experience gives the officer expertise which can make a difference in those split seconds. This text presents information intended to help the investigator balance "scholastic ideals" with the unpredictable circumstances encountered "in the line of duty."

## ***INTRODUCTION***

### **THE PROCESS ON TRIAL**

The importance of crime scene investigation came to the attention of the general public and the criminal justice system in the dramatic trial of O.J. Simpson during the mid 1990's. Though there have been many cases where television and the internet have delivered court transcripts, investigative reports and scene photographs to anyone with interest, this case placed the "investigative process" on trial in homes and classrooms all over the world accompanied by an abundance of television experts readily available to offer their comments on every aspect of the case.

The decades of the 90's also was the first full decade of forensic DNA analysis and ever growing DNA reference databases combining to form sensational investigations. The defense began to challenge the foundation of every aspect of investigations involving DNA. Legal challenge regarding the recognition, evaluation, collection, handling and processing of evidence at the crime scene now occur in almost every type of investigation.

The defense may challenge the officer's knowledge, skills, ability and integrity in any investigation. The challenges have been elevated not only because the expectations raised by television, but also because of a few corrupt investigators who have surfaced in the media. Media (internet) coverage has presented to the world the infrequent abuse of public trust, and in even rarer instances, intentionally criminal behaviors. These have led not only to greater defense challenges but also to governmental reviews and even to legislation.

Today's investigator is faced with challenges never before experienced.

This text aims at law enforcement personnel charged with the processing and investigation of crime; be it a simple burglary or a multiple murder. Its objectives are threefold:

- Orient the field officer in the realistic potential of contemporary forensic evidence analysis and scene investigation techniques;
- Develop the officer's ability to evaluate the evidence potentials while at the crime scene and take appropriate actions to preserve all the information the item contains;
- Provide suggestions for the officer to better integrate their scene efforts with all other aspects of the investigation.

## ***INTRODUCTION***

### **ORGANIZATION**

To help the investigator attain these objectives within crime scene investigation and reconstruction, this text is organized in eight parts which to build a solid foundation of knowledge useful to the day-to-day completion of investigative duties.

The first part “Evidence Awareness,” is an overview of the information which can be developed through the field evaluation and laboratory analysis of various forms of physical evidence.

The second part “Scene Processing,” provides the investigator with the methods and tools to “mechanically” process the crime scene and integrate the efforts with the overall investigation.

The third and fourth segments “Reconstruction” and “Special Evidence” emphasize scene analysis and crime reconstruction. They present introductory reconstruction concepts which are useful to the investigator of crimes against persons or property.

The fifth part “Advanced Reconstruction” presents more on the processes of reconstructing a crime and an example of one style.

The sixth part concentrates on response and logistical issues of “Major Scenes.” Administrative and investigative issues are presented to help prepare the investigator for the case which involves multiple bodies, multiple scenes, serial crimes, public figures, or “just plain weird” circumstances.

The seventh part “Safety,” deals with some of the very basic hazards to the investigator. It should be read by all involved in investigations who wish to avoid or minimize health hazards.

The last part “Techniques” contains a summary of some simple evidence collection techniques which may help the investigator get started. Also included is a glossary of terminology frequently encountered by crime scene investigation personnel.

### **INTER-NET**

Augmenting this text is an inter-net web site ([www.ncit.com](http://www.ncit.com)) which contains additional “tips and tricks” regarding the preservation of evidence, scene processing, reconstruction and major scene management. A PDF version of this text is also available at that site.



## ***AWARENESS OF EVIDENCE***

### ***WHY EVIDENCE***

The goal of scene processing and case investigation is the identification, apprehension, prosecution, and ultimately the conviction of the **true** perpetrator of a specific offense. Every effort is made to extract evidence from the scene which will identify the true perpetrator, **or** exonerate an innocent suspect. To effectively do this, the Interpretation of evidence and its relationship to the commission of the crime should begin at the crime scene. The preliminary interpretation of evidence may quickly interact with information developed from subject interviews to corroborate or refute key statements or preliminary assumptions. This provides an effective path to better uncovering the story of how the crime occurred. Telling the story of how the crime occurred is a fundamental goal of what is referred to as “crime scene reconstruction”.

### ***APPROACHES TO EVIDENCE***

Some investigators collect everything from the crime scene, while others seize no evidence and rely upon witnesses. The former leads to the “tag and bag” mentality while the latter hinges on the frailty of human observations and recollection. There are those who would say not to collect an object unless its value to the case is clear at the time while others recognize “gut instinct” as reason to collect an object that may prove critical later in the investigation. These opposing concepts are best balanced by trained investigator who realizes that each case and each item of evidence is unique. The investigator will balance the goal of effectively collecting “relevant evidence” with the instinctive “gut feeling” to seize something destined to forever be “property” buried in the evidence vault! Anything that contributes to the “telling of the story of the crime” is evidence.

### ***RECOGNITION of EVIDENCE***

An object is easily identified as evidence when its value to a case is clear and significant. For everything else, the process is more difficult and the questions more complex. To effectively recognize not only **tangible physical evidence but also the intangible information it contains** at the scene, it is helpful if the investigator is armed with a thorough understanding of what can be learned from evidence, the investigator is better able to establish theory (or theories) of how a crime did or did not occur. This chapter defines the analysis potential of physical evidence and the probative value to an investigation.

## ***AWARENESS OF EVIDENCE***

### ***FIREARMS EXAMINATION***

This forensic discipline is often erroneously referred to as "ballistics" by many people. In the crime lab, the term "firearm examination" is used to refer to the analysis of ammunition components or to a weapon to determine 1) the type of weapon involved, 2) the model weapon, and 3) the specific weapon which discharged a bullet or casing. The matching of spent ammunition to a weapon is based upon the microscopic comparison of details placed upon the evidence bullet (or spent case) to patterns on test bullets fired from the evidence gun.

Thousands of laboratory examinations and many statistical arguments in academic circles have determined that no two weapons in use are capable of leaving identical microscopic features. These individual features will be different even in weapons assembled consecutively since the tools used to finish the metal surfaces do change as a result of metal-to-metal contact. Post assembly use only increases the individuality of each weapon.

### ***BULLETS AND CASES***

Within firearm examinations, bullets and expended cartridge cases constitute a very special category of frequently encountered evidence which offers details as to the type of firearm involved. The caliber, manufacturer, and the degree of wear to which the evidence weapon has been subjected can be determined without the weapon itself being found. These findings are based upon the general characteristics such as extractor and ejector marks imparted on cases, and land and groove rifling left on bullets by the barrel of the weapon. These characteristics can then be compared to the manufacturer specifications of weapons and ammunition to create a list of possible sources. Of course, if the weapon is recovered, individual markings on the evidence case or bullet can be compared to establish a "match" having the certainty of fingerprint identification.

In limited circumstances, it is possible to associate a specific bullet to the particular spent case that originally held it. The mouth of the case may leave unique marks that prove it was once crimped tightly around the bullet.

Computer technology provides the ability to "photo digitize" bullets and cases, enabling evidence comparisons among crimes occurring at different times, in different cities or even at opposite ends of the United States. These advanced methods may well be available in the crime laboratory serving your community.

## ***AWARENESS OF EVIDENCE***

### ***FIREARMS EXAMINATION***

#### ***WEAPON NOT RECOVERED***

An investigator is frequently concerned with establishing the fact that in two separate incidents the same weapon was used. In the event the weapon is not recovered, two or more recovered projectiles or casings can be compared to determine if they were fired or chambered in the same weapon. Forensic examination of the micro detail left on expended components by barrel rifling or cycling of the weapon allows these conclusions. The investigator must remember that these microscopic details are fragile and may be lost, as a projectile is deformed by passing through a target. The ability to match ammunition between criminal events is true for rifles, shotguns, revolvers, pistols or any other type of weapon which has rifling or which utilizes ammunition with casings. The use of computer imaging systems and national databases can allow the investigator to associate one investigation to another. If the crime lab has access to the national database of fired cases, the investigator should be aware of the potential to link similar cases around the nation.

#### ***CARTRIDGE NOT FIRED***

It is also not necessary for a cartridge to be discharged in order to "match" it back to a specific weapon. Semi-automatic, bolt or lever action and even some revolvers leave distinctive markings of extractors, ejectors, ramps, magazines or chamber surfaces on bullets and spent cases. It is therefore possible to match two cartridges chambered in the same weapon, but not fired, to each other, or to match them to a particular weapon. In semi-automatic weapons utilizing detachable magazines, it is possible to identify markings imparted from the lips of the magazine on the body of the cartridge case.

#### ***RELATED EVIDENCE***

There are several forms of firearms evidence which are indirectly associated with the bullets or casings. Gunpowder, lead fragments, flash burns, or the exact positions of cylinder and chambers, and operational condition of the weapon often provide critical information beneficial to reconstruction of the scene events. Details of the position of the weapon's cylinder, safety, hammer, trigger, bolt, firing pin, magazine release, choke, or the appearance of powder residues on the cylinder face must be noted and whenever possible photographed. The presence of a darkened "halo" around the leading face of a revolver cylinder is indicative of a cartridge having been fired from that chamber. Care should be used to note the chamber position of each cartridge in order to correlate "halos" to expended ammunition.

## ***AWARENESS OF EVIDENCE***

### ***RELATED EVIDENCE (continued)***

In addition to discharge or functional aspects of the weapon, there may be deposits of flesh, blood, saliva or other biological materials adhering to it. Fingerprints, either in visible or invisible form, may also be present on the weapon. Later sections will offer methods for collecting and storing these forms of combined evidence. However, as with all forms of evidence, *thorough notes and photography are the guardians of loosely adhering or fragile items such as these.*

### ***DOCUMENT***

Once properly recorded, evidence of this nature can help to determine the relative position of participants, the truth of a suspect's alibi, or the objective reconstruction of a scene. It becomes essential that each of these forms of information be precisely documented through thorough notes, sketching, and photography. Before collection and packaging, the cylinder should be marked and indexed to the frame of the weapon to record its position relative to the hammer. It is also helpful to include a scale in the photographs taken at the scene of the weapon in the event that details of safety positions, releases or cylinder positions are ever in question. Photographs should be taken of the "lock, stock and barrel" in all shooting cases (both sides). Even if there is nothing obvious as evidence on the weapon, remember that even the absence of evidence is, in itself, something that may provide information to the case investigation.

### ***CAUTION***

Any testing or even "dry firing" of the weapon by any investigator must be avoided, as it could alter the mechanism of the firearm and render any laboratory conclusions invalid. The weapon must never be used to test-fire bullets, chamber or cycle ammunition, or test safety functions until a laboratory examination has been performed. The investigator should make every effort to minimize the handling of the weapon until it has been examined for loosely adhering evidence such as hairs and fibers, or fingerprints or gun powder residues in the crime laboratory. Internal parts may contain fingerprints of the legal owner, while the outside bears prints of persons handling the weapon. The ammunition within the weapon may also have fingerprints on them which can be developed (though in practice only infrequently) and searched against offender databases or against known subjects. Caution must be used in handling and subsequent packaging of these items. For those who ask the question of DNA from fired cartridge cases, the typical response is that the laboratory only infrequently has success. Many laboratories will not accept fired cartridge cases for DNA unless it is "the last lead" in an investigation.

## ***AWARENESS OF EVIDENCE***

### ***TOOLMARKS***

When two objects come into contact with a sliding or compressing motion, unique identifying marks are left on each of the objects' surface. These markings are forensically referred to as toolmarks.

Toolmarks are most prominent in crimes against property (forcible entry), but may also be found in circumstances such as automobile collisions, bitemarks or even the shovel imprints at illicit grave sites. The marks are unique to the objects and their manner of contact. The shape of the markings is referred to as "general" or "class" characteristics. Marks resulting from the manufacturing process, such as those left by casting processes, are not unique to a single object, but common to many and are referred to as "sub-class" details. These should not be used for identification. Typically the small striations caused by rapid wear of the manufacturing tools or by continued use of the object are called the "individual" or "signature" details used in identifications.

### ***GENERAL MARKINGS***

It is usually possible to determine the type of "tool" which left its mark on a surface by the nature of general or class characteristics markings left by the shape of the tool. For example, a screwdriver, crowbar or hammer will each leave quite different class markings. Common sense will often suggest the general type of object which caused a mark. It is important to consider the amount of force used in applying a tool to a surface, and then evaluate whether the marks were made by usual handling of the tool or by wielding the tool in an unusual manner. The resultant markings will be dramatically different. For example, a crowbar used to bludgeon may make contact with the body "points first" or curved portion first with an obvious difference in wound appearance.

### ***IDENTIFYING DETAILS***

Often, the need goes well beyond the question of "general tool" and asks: "Did a particular tool create a mark?" Marks on hard surfaces such as doorknobs, safes or even plastics, have enough microscopic detail to identify the tool. These are routine examinations and often very successful. Soft, porous materials such as wood or flesh rarely retain the individual detail necessary to identify a specific tool. From this type of mark the officer should expect that only the general class of tool can be determined; however, occasionally, a tool with a gross deformity can match a mark on wood or bone.

## ***AWARENESS OF EVIDENCE***

### ***TOOLMARKS***

#### ***COLLECTING THE MARK***

Though many of the lab examinations dealing with toolmarks may theoretically be performed by examination of photographs or by measurements of castings, the crime laboratory always prefers to examine the original item. The collection of the original toolmark is easily justified when the loss involved in a crime is significant. The decision to remove expensive doors, structural items, and fixtures is easy when there is a high dollar loss or a crime against persons. However, in many minor crimes against property, or in situations involving large objects, there is often doubt in the officer's mind whether it is worth the time, effort, and the victim's wrath to collect such items. The alternatives of photography and casting must be used; but the officer must realize that they will never be as good as the original markings. If casting is required, it is suggested that a synthetic product such as **Mikrosil** be used. These products are capable of preserving the microscopic details left by the tool in the questioned surface and may well provide sufficient individual markings to permit identification.

#### ***USE TO RECONSTRUCT***

The matching of a specific tool to a mark, or even just a conclusion that the tool is the same "general type" as that which made the mark, often proves useful in the reconstruction of a crime. For example, if lab analysis indicates only the general type of tool suspected, but can establish the angle and direction in which it was used, helpful information may be generated which far exceeds the laboratory matching a mark to a tool. An alleged crime may be refuted by a reconstruction which shows a door to have been open at the time marks were applied, pointing to "victim" fraud rather than a forced entry. Only the officer's thorough perceptions, measurements and documentation can provide the lab the essential information needed to interpret the test results, orient the tool, and reach the correct reconstruction.

## ***AWARENESS OF EVIDENCE***

### ***BIOLOGICAL EVIDENCE***

"Biological evidence" is a term of broad meaning. Historically, it included evidence from animals as well as humans. However, in today's forensic labs, biological evidence most frequently refers to human evidence as typically encountered by law enforcement. Biological evidence may include hair, blood, semen, saliva, skin, fingernails, fecal material or almost any other component of the body,

### **DNA ANALYSIS**

Since the turn-of-the-century, forensic labs have discontinued conventional typing of biological evidence such as "ABO" or enzymatic types and focused upon DNA techniques of analysis. DNA analysis is a mainstay of the crime lab today for several reasons. First, DNA is quite stable and can be analyzed on evidence several decades old (if stored properly). Second, DNA can differentiate a source to the point of either identification (statistically) or elimination. In addition, forensic DNA analysis, though easier when performed upon visible biological evidence, can also be performed on residues that cannot be detected by the eye.

DNA analysis as performed in the crime lab characterizes specific fragmentary components of DNA,. Forensic analysis does not reveal the physical appearance of the original host or any other descriptive characteristic other than whether the sample is from a male or female. The specific DNA fragments forensically tested in evidence samples have also been researched in known populations in order learn how frequently they occur. This known distribution enables the DNA expert to generate the statistical analysis of the evidence DNA results that guides their interpretation. The more of these forensic DNA fragments that can be identified, the more useful the results will be.

If the sample testing provides information on all the specific DNA fragments, then the DNA analyst can provide very convincing information regarding the probability that an evidentiary sample has the same DNA profile as a potential source. Quite often the probabilities are such that the numbers exceed the total human population on Earth today. However, even partial DNA results can prove helpful if the evidence results are to be compared to known sources such as suspect or victim samples.

## ***AWARENESS OF EVIDENCE***

### **DNA**

#### **DNA DATABASES**

Governmental agencies have collaborated to create databases of known DNA profiles. The databases operate under strict control and adherence to the regulations concerning who may be subjected to DNA testing. In some locations, only the most serious convicted offenders are placed into the DNA database. In other locations, anyone arrested of a felony is immediately sampled, tested and placed into the database for long-term retention. These combined databases contain several million DNA profiles accessible and searchable to qualified forensic laboratories.

The individuals within these databases have been “DNA profiled” using the same DNA fragment components as the crime lab performs on evidence samples. Therefore the results of evidence testing can be compared to the profiles in the database to develop a possible name as the source.

Selected DNA laboratories have a specialized computer dedicated to the DNA Database. Specific personnel are trained and authorized to access this computer to input the evidence results and request a search for a profile that is similar within the database. The number of times the search has been successful has long since proven the value of such a system. Many investigations that have been stopped cold have been ignited by DNA testing and a useful “hit” or lead developed from the database search.

#### **MORE SENSITIVE**

Visible biological materials usually result in full forensic DNA profiles that have the highest potential for comparison to other evidence or to known sources. Samples the size of a period at the end of this sentence can yield full forensic results suitable for direct comparison or database searching.

The forensic lab has also developed the ability to test traces of DNA samples that are invisible to the eye. Indeed, “blind swabbing” an area where there is no visible biological evidence may be done when the investigator thinks that a surface may have been contacted during a criminal act. For example, the person who wields a knife or firearm or uses a tool will likely deposit traces of their DNA on predictable surfaces. The strangler leaves DNA on the victim’s throat. **If these surfaces have not been handled by multiple people, then useful results may be obtained.** The greater the numbers of people handling a surface, the greater the diversity of DNA fragments deposited on it **and the less likely a DNA profile related to the perpetrator can be developed from trace amounts.** The fewer people that handle a surface, the more likely useful laboratory test results can be obtained.



## ***AWARENESS OF EVIDENCE***

### *DNA (continued)*

#### **FASTER?**

The improvements in DNA analysis not only include increasing the sensitivity and the development of DNA databases, but also the ability to perform the testing faster. Forensic DNA testing performed in the 90's took large amounts of sample and time to perform. Contemporary forensic laboratories routinely test a biological sample and have test results available within a week. The only delay in today's crime lab stems from the huge number of requests for DNA testing not in the time to perform the analysis. Requests for DNA analysis happen in burglaries, robberies, auto thefts as well as any form of assault or death investigations. The crime lab faced with limited resources is forced to prioritize the overwhelming requests and create a delay for some requests in order to accommodate others. The requesting agency should communicate case circumstances to the lab to insure the samples receive proper analytical priority.

### *INVESTIGATOR'S APPROACH*

#### **MATERNAL DNA**

Certain genetic factors are passed on from maternal ancestors in the form of mitochondrial DNA. DNA analysis can prove parentage, which in turn helps to identify the "bloodline" of an unidentified body. Mitochondrial DNA of the mother or maternal siblings may be compared to the unidentified body (parts). Comparable results may then point to the likely identity of the body.

#### **FAMILIAL SEARCH**

In some jurisdictions, it is possible for the evidence DNA profiles to be searched against the DNA database with the intent to learn if there are any profiles similar enough to establish **that a family member** of someone within the database may be the actual source of the evidence DNA profile. The profiles that are returned from this search are carefully screened and then used in conjunction with other investigative leads.

These limited familial searches serve to point the investigator to a potential suspect, not to identify a perpetrator. If a reference sample can be obtained, from the potential suspect, then a direct comparison of the reference DNA profile can be made to the evidence sample. No identifications can be made unless a known DNA sample is obtained from the suspected source. In limited circumstances, unconventional reference samples include cigarette butts, beverage bottles, and even napkin wipes that are discarded by known subjects. The contributor of these sources must be established by reliable testimony and serve only to justify the legal warrant to acquire buccal or venous references samples.

## ***AWARENESS OF EVIDENCE***

### DNA (continued)

#### TRACE LEVEL DNA

Full genetic profiles can be obtained using samples of DNA nearly the size of a single cell. If biological material of any kind can be found at the scene, its DNA content can be analyzed. Because the methods of forensic DNA analysis are so sensitive, a new threshold of contamination concern has arisen for any evidence item that may have trace levels of DNA. Handling must be restricted and then with only **fresh** and very clean gloves. Even the breath of the detective or evidence technician may add their DNA profile to that already on the evidence item. The protective gloves usually worn to prevent bio-hazard contamination to the officer have now become essential to prevent DNA from the officer from contaminating the micro quantities of DNA to be tested. In some circumstances, surgical masks should be considered to reduce possibilities of contamination.

It is also possible to transfer DNA from one surface to another, as in handling a door handle and then touching another secondary surface such as a drinking glass. This ability to transfer DNA has a direct impact upon the significance and interpretation of DNA analytical results to the overall investigation. Caution dictates to **never** handle evidence without first considering the possible contamination of DNA to, or from, its surface.

#### STANDARDS?

Forensic comparison requires proper standards from the potential sources. Without these standards, the lab will probably not begin analysis. DNA standards must be provided from each of the subjects in the crime, be they suspect or victim, even if the individuals have been previously tested by forensic facilities.. A venous sample or a cheek swab (buccal swab) can serve as a “known” or “standard.” Only when this standard sample is obtained can a comparison of the evidence sample results be performed and the likely identity of the contributor determined.

When very low levels of DNA are present, it may be necessary to have reference DNA, not only from case subjects, but also from those processing the evidence on scene or later.

#### COLLECTION

These DNA capabilities can be performed from samples collected and stored using processes involving a simple swab of the stain. It may also be required that a “background sample” of the surface from which the evidence swab is obtained and a “blank swab” of the collection device and water be collected. Evidence containing biological materials should be packaged in a container which permits some air circulation to enable further drying and slow degradation of the stain. The packaged evidence swabs or original stains are preferably stored at or below freezing temperatures.

## ***AWARENESS OF EVIDENCE***

DNA (continued)

### ***WHERE OBTAINED***

Samples for DNA analysis can be obtained from a variety of sources:

- 1) Those collected from within the body and its openings.
- 2) Those from outside the body adhering to flesh, clothing, fixtures or structural components.

The investigator should anticipate the same battery of lab tests and equally valid results from both of these categories.

### ***IN THE BODY***

Vaginal, oral and anal samples are usually examined for the purpose of finding seminal fluid or saliva which will lead to the genetic material of the assailant in a sexual assault. Lab analysis of these types of samples is typically successful because of the high concentration of genetic material present. However, the host (victim) DNA is also present; therefore is essential to collect a standard from the host as well.

Though it is possible to microscopically find cellular material supportive of "forcible entry" in a rape, the medical examination of the victim is best suited to find the anatomical signs of force. It is not reasonable to expect the lab to prove the crime of rape, only to corroborate that contact did or did not occur as indicated by testing of the evidence.

### ***OTHER BODY FLUIDS***

The crime scene investigator frequently encounters body excretions as evidence. If their importance to the crime scene reconstruction is great enough, every effort should be made to collect and preserve any body fluid encountered. The DNA specialist will likely have the means of extracting and testing the DNA sample under even the worst conditions. Crime labs are skilled in developing analytical techniques for very small quantities of human biological samples from a wide variety of surfaces and dealing with a variety of contaminants, or less than ideal sample storage environment histories.

### ***DNA WHICH SAMPLE?***

Because of resource and time constraints, the DNA analyst must examine those samples *with the highest probative value*. Case circumstances and investigative questions usually point the analyst to those samples. Frequently, investigative information may conflict between medical examination, autopsy, witness statement and follow-up reports. Depending on the specific case, the forensic scientist, investigating officer, medical personnel and attorney should work together to establish the need for additional samples to be subjected to DNA analysis,

## ***AWARENESS OF EVIDENCE***

### *DNA (continued)*

#### ***CONTAMINATED SURFACES?***

Human biological materials are often subjected to a variety of harsh environmental conditions and recovered from very soiled surfaces. Even those may provide forensically complete genetic profiles. The crime laboratory is prepared to process these stains and provide reliable analytical results after they give consideration to the effects of contaminants existing on the evidence surfaces. When “DNA” samples are collected from a larger item, investigator should consider the need to collect “background standards” from the original items surface.

#### ***VICTIM SECONDARY REFERENCES***

There may be situations where the “known sample” (standard) of the subject DNA may be difficult to obtain, such as a missing person who years later surfaces as found bones. There may be intimate artifacts attributable to the victim such as hair brushes that can be used. Alternatively, mitochondrial DNA may prove useful.

If a subject receives a transfusion, venous samples collected as standards may be compromised. In those instances, the buccal scrape will be the best sample to collect. As a last resort, standards may also be obtained from worn clothing, bandages or a compress stained prior to transfusion. If all else fails, the area under the body at the crime scene may be used as a “standard”.

#### ***PATTERNS OF DNA***

In addition, there is much information contained in the shape of “bloodstains” shed upon surfaces which can assist in the reconstruction of the movements and activities of the source. This “blood pattern interpretation” requires experience and experimentation well beyond the training of most investigators or laboratory personnel. However, it is within the ability of every crime scene team member to be able to recognize the significance and to record the patterns for subsequent analysis by skilled experts. Details as to the collection, preservation and interpretation of the shape and patterns of these stains follow in later sections.

#### ***REMEMBER***

The investigator should realize that crime laboratories providing DNA analysis are highly skilled in the genetic analysis of **human** DNA, even in samples recovered from difficult environmental conditions.

For the investigator seeking genetic analysis of other evidence such as plants and animals, special facilities such as wildlife or botanical laboratories exist. Many of these specialty labs provide non-human DNA services with the highest standards of forensic acceptance and court admissibility.

## ***AWARENESS OF EVIDENCE***

### ***PHYSICAL MATCHES***

Physical matches of torn or broken edges can establish with absolute certainty that two or more objects once formed a single item. This is one of the most conclusive forms of laboratory examinations available today and requires expertise and academic training readily available in most crime labs. Physical matching looks at the contour interface between two objects for sufficient details to determine if they once joined. A preponderance of such details leads the experienced examiner to the conclusion of a match between the two or more items of evidence.

### ***THE MATCH***

Physical matching is quite different from toolmark analysis, although both use the common term "match" with slightly different meaning. Toolmark or impression evidence is examined for exacting detail within the outline of the transfer (such as tracks of a car, scratches from pliers on the doorknob, or the imprint left by a soiled shoe on paper); whereas "physical matching" relies more upon torn or broken edges and their rebuilding, much like the pieces of a puzzle or the assembly of a broken vase.

### ***SMALL PARTICLES***

The investigator often recognizes the possibilities of matching torn or broken edges of a large object but doesn't realize that it is also possible on a much smaller, even microscopic scale. Physical matches can occur at any magnification: from the broken pieces of a baseball bat, to the fractures in a license plate frame, to the smallest paint chip or shard of glass. Regardless of the size of the objects compared and matched, the conclusion carries the same degree of certainty; that these objects were at some time originally one piece. However; it is imperative that the investigator collect as many pieces of the broken object from the crime scene so that any fragments that may yet to be recovered from the suspect's possession can be compared for the physical match.

A physical match may be easier to achieve with larger objects; however, it is far more probable that a suspect will inadvertently carry away from the scene or leave behind the smaller items rather than the larger. The investigator who collects only some of the broken pieces at the crime scene may have to settle for a lab report which concludes that the pieces are "similar" instead of an absolute match.

## ***AWARENESS OF EVIDENCE***

### ***PHYSICAL MATCHES***

#### ***OTHER "MATCHING"***

Other elements of physical matching examinations include: 1) restoration analysis or the re-assembly of fractured pieces of objects such as bottles, lamps, and pottery; 2) the rehabilitation of a surface altered by fire, chemical, or mechanical means as in the case of documents and serial numbers obliterated from engine blocks, bicycles, or firearms.

- 1) An object may be broken by the passing of a bullet, blunt force or by any of the violence surrounding the crime. These items may be "restored" if the pieces are recovered. For example, an automobile window shattered by a bullet can be "rebuilt" and the point of entry and trajectory revealed. Or critical portions of an automobile involved in a pedestrian fatality, despite efforts to remove and conceal the damaged parts, could be re-assembled to enable the matching of associative evidence to link a source with the evidence.
- 2) In order to conceal or destroy evidence of the elements of a crime, a perpetrator may resort to the use of fire or chemicals. In either case it may be possible to restore the item to its original condition. For example, checks from an armed robbery which have been burned in a fireplace may have writings restored by photography or instrumental methods.

#### ***REMEMBER***

Despite the obvious match that can often be seen by the officer, the items should never be placed into contact with each other in order to prevent surface contamination of trace evidence. If the laboratory is not able to match the surface contours, it then evaluates trace evidence transferred between the evidence items. It may then be possible to at least conclude that the objects were at some prior time in contact with each other.

## ***AWARENESS OF EVIDENCE***

### ***TRACE EVIDENCE***

The term "trace evidence" applies to a wide variety of materials such as glass, fibers, hair, paint, soils and the like. Properly obtained trace evidence can be analyzed and the **general nature** of each identified.

### ***EXPECTATIONS***

Rarely can the **absolute identification** of an item's origin be established through the analysis of trace evidence unless the object has an unusual shape, or properties, or is of limited manufacture. The investigator should not expect to learn the exact source of trace evidence. For example, blue cotton fibers cannot be "matched" to a specific pair of denim pants. Glass can be distinguished from plastics and various glasses from one another but rarely can it be linked to a specific source (e.g. broken window at scene). Soils can be differentiated from one another; so can wood, fibers, hair, and almost anything else. The conclusion "consistent with" often appears in trace evidence reports. Frequently a preponderance of "similar" trace evidence will imply an association between two or more seemingly unrelated crimes.

Trace can be a powerful tool for the serial crime investigator seeking to link multiple crimes to each other or to a potential perpetrator. Laboratory analysis of trace evidence is very time-consuming and requires special expertise and equipment available often available from the crime lab.

### ***PRECAUTIONS***

Trace evidence often appears where least expected. Caution must be applied in approaching items which may bear trace evidence. For example, when an officer recovers a set of pliers used to force entry into a scene, he may be tempted to re-enact the crime to match the pliers with entry marks on the doorknob. If the items contact each other, trace contamination may occur. The defense may argue that the trace evidence was not the result of the burglary, but rather, a result of the actions of the officer. Or imagine a glove found at a suspect's home that is taken to the crime scene to compare it with one found there. The investigator must protect trace or biological evidence on the glove from the possibility of cross contamination from the crime scene. Here again, the defense might allege the investigator's accidental contamination of the item in order to impugn lab results.

### ***REFERENCES***

A key to the success of trace evidence analysis is the collection of (known) reference materials occurring in a particular area. For example, a body dumped by the side of the road will rest on vegetation and soil. Samples should be collected as "reference materials". These references capture the trace attributable to the "dump site" location, just as other trace evidence found on the body may reveal where it has been or even implicate the vehicle used to transport the body.

## ***AWARENESS OF EVIDENCE***

### ***TRACE EVIDENCE***

#### ***LOCATION OF TRACE EVIDENCE***

Just as important as the analysis of trace evidence is the location in which it was found. The precise position of trace evidence may provide more information than the chemical nature of the trace item itself. For example, a crowbar with hairs imbedded in blood on the lug end conveys more interpretive information than merely finding hair in the bottom of an evidence bag containing the crowbar. Therefore on scene documentation and collection of trace evidence requires careful observations and packaging.

What of the officer who recovers a firearm at the scene of an assault or murder? In his haste to unload the weapon, little or no care may be taken to note the adhering flesh and fibers. In addition, subsequent handling by the curious might further destroy the evidence forever. It is always necessary to consider the trace evidence which can relate objects to each other. ,

#### ***RECONSTRUCTIVE VALUE***

Trace samples such as paint, fibers, soil, glass, metal transfers, wood chips, powders, cosmetics or almost any other very small items are useful in resolving questions about the paths of motion and location of participants. For example, a defendant denying contact with the victim of an assault might well have his alibi questioned by the identification of cross-transferred fibers or other trace items of evidence on the clothing of both parties. Casual contact on a crowded dance floor might explain the transferred fibers on outer garments but would hardly explain threads from the suspect's sweater appearing on the victim's underclothing, or an accumulation of trace evidence which describes the home of the suspect, his car or even the very clothing he was wearing the time of the attack.

#### ***REMEMBER***

Not only is the identification of the trace evidence important, but also the precise location in which it was found, especially in reconstructing the crime. Imagine the heightened value of finding hair similar to the victim on the head of a hammer consistent with the crushing damage to a victim's head. These points add emphasis to the need for the careful collection, packaging, and handling necessary of each item at the crime scene and not waiting to remove it at another location with the hazards of transport and short term storage.

Searching and processing of trace evidence should always start with the investigator **evaluating the item "on-scene"** to determine the stability of the trace material on the evidence item and then take appropriate action such as photography, removal and special packaging.



## ***AWARENESS OF EVIDENCE***

### ***FRAGILE EVIDENCE***

This broad term includes such items as the filaments of lamps, charred documents, prints in soft surfaces (including bite marks), very thin paint chips suitable for a physical match, and many more such items that lack structural integrity or may lose positional value. The following is an explanation of the capabilities of the analysis of fragile evidence, with some precautions to the investigator in dealing with these items.

#### ***LAMP FILAMENTS***

The laboratory can determine the functional condition of vehicle head lamps, tail lamps, brake lights or of almost any other incandescent and halogen bulb. It is possible in most instances to find out if the lamp was illuminated at the time of impact or at the time of breakage. The two critical diagnostic features of 1) melted glass adhering to the filament wires or support posts, and 2) bent filaments which curve out of shape and alignment require careful preservation and packaging. In order to best preserve these features, the wiring plug to which the lamp was attached should be removed along with the broken lamp assembly. It is also helpful for the officer to collect the mate to the lamp and the estimated speed of the impact. Modern vehicles will have sensors which track vehicle behavior and can provide acceleration or deceleration information helpful to lamp examinations.

It must be remembered that the lamp represents a history of the accident which broke it. If there were multiple impacts, then the lamp may show only the effects of the last impact. Because of the fragile nature of this evidence, a container should be carefully selected to protect the items from accidental mechanical damage in transit. Any interpretation of this type of evidence must be based upon an understanding of the complete scene.

#### ***CHARRED DOCUMENTS***

The writing on burned paper, in some circumstances, may be restored chemically or interpreted through special lighting, optical devices, and photographic methods. This type of evidence frequently results from an effort to destroy elements of a crime. The charred pieces can be examined and the original markings restored. However if the pieces are broken in the collection and storage process, analysis may yield far less information for the investigator, and a vital link to the crime may be lost. Therefore, great care must be exercised in the collection of these items and in their packaging. It is suggested that when found in the crime scene, the investigator refrain from handling the items. After photography, they should be placed onto a sheet of paper or cardboard and then placed onto loosely layered cotton and hand carried to the laboratory.

## ***AWARENESS OF EVIDENCE***

### **FRAGILE EVIDENCE**

#### ***FRAGILE IMPRINTS***

It is as possible to conclusively identify the source of imprints in soft surfaces such as soaps and butter as it is with deposits on harder surfaces such as dirt. The primary difference is the extremely sensitive nature of the medium in which the print is pressed. With this type of evidence, collection must always begin with comprehensive photography using oblique illumination from several directions. Once photographed, preservation measures can include removing the entire object, transferring the print to a more durable surface, or lowering the temperature of the surface of the object and then casting the imprint. More details on this method of collection will follow in the "casting" section of this book.

#### ***INDENTED WRITINGS***

The pressure used to apply inks or pencil to a page of paper will often leave behind an indentation on the underlying pages of a note pad. Other than oblique lighting and photo documentation, no other means of enhancing the impressions should be used. Collect these items with great care and place into a rigid container for transport to the crime lab to be subjected to electrostatic detection analysis (ESDA). Frequently ESDA can visualize what was written or printed two and three pages above the examined page!

#### **REMEMBER**

With indented writings, the paper itself may accumulate genetic materials from the handler of the paper. Depending upon the "handling" history of the "indented document", DNA analysis may or may not be performed.

#### ***VOLATILE EVIDENCE***

Gasoline, diesel, kerosene, lighter fluid, alcohols, perfume and other volatile materials can be differentiated from one another. If liquid samples are available, it may be possible to distinguish the various grades of gasoline or diesel from one another. Occasionally, even the manufacturer of the volatile material may be identified. However, once a volatile is permitted to partially evaporate (as in the presence of a fire), many of the identifying features disappear. Once a volatile material such as gasoline has been exposed to heat (weathered), it may be impossible for a lab to reach conclusions meaningful to the investigation. Most frequently, the lab will classify the sample in accordance with the types of carbon chains present, not the manufacturer or distributor of the original product.

This material must be packaged in a container which seals the vapors and prevents loss of the volatile components (cans or special lined bags). Avoid containers which may dissolve in the presence of volatiles. Evidence should be collected from as many locations in the scene as possible. Standards must be collected if the intent is to show the origin of the evidence.

## ***AWARENESS OF EVIDENCE***

### **OTHER FRAGILE and DIGITAL EVIDENCE**

#### ***ARSON - REASONABLE EXPECTATIONS***

Often, the investigator expects the laboratory to pinpoint the exact source of the volatiles. As with other forms of fragile and trace evidence, the answer to these questions is usually "consistent with" or "could have shared a common origin." It is likely that there are just not enough individualizing characteristics in the sample to positively identify its source. The rare exception to this occurs in instances where the volatile sample from the scene is really a mixture of several fluids such as oils, gasoline, lighter fluid and thinners which are also found within a single container. It may not be unusual for such a container to exist in the suspect's garage or in the garage of tens of thousands of innocent handymen. It is the particular blend of volatile materials which becomes critical to the case, despite the fact specific the manufacturer of each product cannot be identified.

#### ***DIGITAL MEDIA***

Though some investigations may occasionally encounter the types of fragile evidence described above, virtually **every** investigation will involve some form of digital media devices such as "pads, notebooks, readers, smart phones", and even automobiles and cameras. On a routine basis, users voluntarily enter (and delete) data from these devices; while the device itself compiles massive amounts of data of which the user is unaware. For example, the history of use, geographic location, sequence of activity, links to networks and correspondence, and in many cases even external environmental conditions are commonly tracked. If the device is connected to a network, even more data regarding social, business and network contacts can be recovered.

Collection of such devices emphasizes the traditional scene documentation techniques and special emphasis on detailed observation of the devices operational condition (displays, links, power status, etc.) and the use a frequency shielding container designed to block transmitted signals which may instruct the device to destroy fragile data.

Collection of the device may be by relatively straight forward means; but recovering the data usually requires specialized training and support resource as well as a warrant (as per *Riley v California*). It is very difficult to totally delete digital data and it is usually recoverable given the correct handling of the device from the moment it is encountered.

#### ***REMEMBER***

Be watchful at the scene for paper or electronic documentation of passwords, logons and other access data. Many users maintain a list of their many accounts and passwords. And remember, when in doubt, contact specially trained resources for guidance and scene assistance.

## *PROCESSING THE SCENE*

### *THE FUNDAMENTALS*

The processing of a crime scene to efficiently extract the information it contains begins with the basics. The scene investigator must keep in mind the following four fundamental concepts. Of course this is only after the safety of all persons at the scene is insured and the requirements of “search and seizure” are considered!

- 1) Secure the scene perimeter as soon as it is practical, thereby protecting the evidence from contact by non-essential personnel.
- 2) Organize and search for and recognize what is critical evidence, what is supporting evidence, and what is not evidence at all. **Protect the evidence from alteration or inadvertent loss.**
- 3) Record the particular scene in question using a wide variety of techniques. Not all scenes can be recorded by the same methods. Consider sketching, measurements and all forms of photography.
- 4) Reconstruction of the actions of the crime (to some degree) is a goal of evidence collection at the scene; however, it relies upon the evaluation of evidence as it resides within the crime scene. Provide factual observations to interviewers so they are better able to design a line of questioning and separate deception from truth.

### *EVIDENCE AND CLUES*

The investigator must consider all of the information conveyed by the evidence AT THE SCENE, including time, functional operation of the item and spatial relationships between items. These are intangible concepts which cannot be packaged for collection and preservation. Therefore, they must be observed, interpreted and documented in order to retain them and share them with others. These are commonly referred to as the intangible “clues” in any crime scene investigation. The investigator who integrates these well documented intangible clues into the investigation and potential crime reconstruction will develop details that will actually help evolve a more detailed theory that will lead to more evidence from the crime scene.

The well factual interpretation of evidence at the scene also provides the law enforcement interviewer a preliminary reconstruction of the crime. With that information, he or she is better able to form the content of the interview and recognize deception from truth.

## ***PROCESSING THE SCENE***

### ***IMPLEMENTING THE SCENE PROCESSING***

The fundamental objectives of scene investigation are to:

1. Establish as much information about the participants as possible,
2. Identify and document a corpus delicti.
3. Evaluate all evidence within the scene for intangible clues.
4. Identify evidence related to the elements of the criminal activity especially those that can dissipate rapidly with time.
5. Tell the story of the crime! Reconstruct the actions and events within the scene for the benefit of the scene investigators as well as the detectives conducting interviews.

### **GETTING STARTED**

The nature of the problems encountered is the same for the small or the large crime scene. Every scene is a balance of time, talents and resources available to the agency combined with a fluid line of communication between the scene and those conducting interviews. The fundamentals steps to getting started are as follows.

1) The officer responsible for the scene must assess the restrictions and demands of manpower, materials, and the level of knowledge necessary to complete the crime scene processing. The assessment should be on-going. The investigator who is aware of the resources available within his own department, and within and allied agencies, can most efficiently complete the scene processing.

2) The initial walk-through of the scene, with the responding officer detailing his observations to the investigator, should follow a restricted path to reduce contamination of the scene. The primary investigator can use this to gain familiarity with the location; those responsible for processing the scene may use the walk-through to take a few photographs or begin a rough sketch. The purpose of this walk-through is to internalize the overall scene and gain a better perspective of the location and establish a foundation of information upon which reconstruction will grow. The investigator should take note of key ideas and perceptions as he gains an overview perspective. All members of the scene investigation team must be aware of the size and scope of the scene and their roll in it. Each person must continuously re-evaluate the resources needed, fulfill their part of the investigation, and not hesitate to request additional help as necessary. If possible, withhold neighborhood canvassing until as much information as possible is learned from the scene itself. If field interviews will be conducted, establish a communication process to update the interviewers with the latest scene information and in turn be updated by their findings during interviews.

## ***PROCESSING THE SCENE***

### ***IMPLEMENTING THE SCENE PROCESSING***

3) The second walk-through with selected team members should give the investigator more information and expose other team members to the scene. The rough sketch should gain more detail; more photos should be taken; the mechanics of scene processing organized; and team-member assignments intelligently made. No evidence will have as yet been picked up and the walk-through will have been confined to a restricted path.

4) The scene investigation team may end the processing with a review of their overall activities in the scene. The “measurement table” described later in this section and the sketch often serve as very easy tools to share field findings and detail the evidence gathered during the scene processing. Item numbers applied to the chart must coincide with the packaged evidence numbers; the corpus of the crime must be listed and measured into the sketch and table; the physical elements of the crime demonstrating entry, method of victim control by the perpetrator and subsequent actions must be included. The team must also evaluate each item in light of the question: “Is the relationship of these two items important?” and include those details in the documentation.

### ***REMEMBER***

These initial steps to get prepared for the full scene processing should be performed at every scene, even if only a single investigator is at the site. Identification of the corpus delicti, the story of the crime and collection of all, the critical evidence is always the goal.

The investigator must never make the mistake of collecting property and assuming the recording process can be done later. There is no way to go back to get the information. It will never be the same. Information which materially affects the reconstruction of the scene, either to support or refute a theory, must be properly collected. The product will be a more detailed reconstruction and a successful court presentation.

## ***PROCESSING THE SCENE***

### ***IMPLEMENTING THE SCENE PROCESSING***

#### ***SECURE THE SCENE***

When discussing the processing of a crime scene, the essential role of the officer to protect the health and safety of the citizenry cannot be overlooked. It is the execution of this primary role which can result in the inadvertent destruction or relocation of evidence by the officer or medical personnel.

The first personnel to arrive at the scene must be concerned with the protection and preservation of life or searching for an aggressor. However, they should also be aware of the importance of evidence in order to secondarily reduce alteration of the scene. It is possible to safely fulfill the officers' primary obligation to citizen welfare and minimize alteration to the scene. Once the location is rendered "safe" it is essential to restrict as much as possible access and physical contact with the crime scene and document the essential activities of the initial responding officer.

#### ***METHODS OF SECURING***

The perpetrator of a crime, in his haste to flee the scene, is most likely to leave behind small pieces of evidence. It is these same items which are subject to destruction by the responding officer and the medical response team. Every effort should be made by the officer to alert all personnel as to the physical locations of greatest sensitivity. To this end, the use of ropes and barricades are often effective, provided administrative orders exist keeping the unnecessary personnel behind those lines. If administrative orders have not been previously developed, one technique to gain order at the scene is to turn over full scene responsibility to the senior officer or to have all making entry write a report. This is effective in reducing the numbers of curious personnel who ignore perimeter barriers and enter the scene.

#### ***EARLY IN THE EMERGENCY RESPONSE***

Medical personnel, police officers, coroners and district attorneys should be made aware of the investigative impact of their initial and long term activities at the scene. These "first responders" may use digital photographs, or documented observations to capture the potential impact of their actions upon the original scene conditions. The condition and position of the body as well as bloodstains on garments and the activities of medical personnel should be recorded by the initial responding officer and communicated to the investigators and crime scene processing team.

A team approach to scene response, combined with prior team training will better define the various roles of the assigned personnel. This understanding of individual roles at a scene will help to avoid or at least reduce the confusion often encountered at the most complex crime scenes.

## *PROCESSING THE SCENE*

### *IMPLEMENTING THE SCENE PROCESSING*

### *CLEAR THE SCENE!*

Sometimes a crime scene can draw “extra” law enforcement personnel who may not have immediate purpose within the scene. In these instances administrative orders and physical barriers may not prove enough to keep them away from the scene itself. Two suggestions are offered:

- 1) Establish an “outer perimeter” holding non-enforcement personnel (community and media) back from the scene. Within that perimeter, closer to the scene itself, create a second perimeter in which departmental staff may gather for a “first hand” view of the scene and update briefings.
- 2) When all else fails, experience has shown that the scene can be cleared of staff reluctant to leave by prominently using a video camera and “bright light.” This is often faster than any other method. It seems that most do not want to be documented as being in the scene or in “file footage” which may be subpoenaed for court!

Once the location is secured, it is important to remember that:

- 1) **SOMEONE** must be in charge of processing the scene. That person should be the most knowledgeable in physical evidence and reconstruction, yet not necessarily the highest ranking officer. The person in charge of scene should report directly to the case investigator on a regular basis.
- 2) **THE FEWER** the better in the scene. Idle hands and feet are better kept outside the scene perhaps taking photographs of the crowd or performing other tasks such as field interviews directly assisting the case investigator.
- 3) Those that make up the processing team must have knowledge of what the other team members are doing, but must **KEEP TO THEIR OWN TASKS** and not wander off into another area of search or responsibility. Share information regularly, but avoid “group gathering” in the crime scene.
- 4) **EVALUATE** the value and information contained in all evidence at the scene. Opinions and/or results must be **REPORTED TO THE OFFICER IN CHARGE** so that the scene processing remains coordinated with the rest of the investigation and ongoing interviews. Don’t withhold information or clues from the case investigator by being a “tag and bag” processor. Evaluate all evidence and communicate the observations and critical evidence to all members of the investigative team.



## *PROCESSING THE SCENE*

### *IMPLEMENTING THE SCENE PROCESSING*

#### *SCENE LOGISTICS*

As staff arrives on scene to process the crime and conduct an investigation, there will always be two areas of organizational concern. One encompasses the “administrative issues” and the second focuses upon issues relating to the investigative processes. A brief overview of these warrants discussion here as they affect all types of case investigations. Additional details are offered later in the section titled “Major Scene Logistics”

The first officer is not concerned with “administrative or investigative organizational issues” when responding to an emergency call. However, once the first responder notifies supervisory staff of the circumstances encountered in the field, additional support personnel are likely to respond. This transition between the first responder and the “investigative team” is the first critical step in the approach to and organization of the investigation.

Frequently, the responding officer has information which no one else in the investigation will ever be able to recover. The initial officer probably has viewed the perimeter of the scene or has had contact with reporting parties and medical staff. Chances are that he has also encountered other, intangible “clues” at the scene such as odors, lighting, sounds and the like. This information may prove vital to the investigation. The officer in charge of the investigation should always consider the responding officer as an active member of the investigative team.

#### *ORGANIZATION WHO IS IN CHARGE*

Departmental procedures vary throughout law enforcement; however, someone will be in charge of the “event response” (administrative) and address the demand for people, departmental resources, overtime, transportation, communications and the like. In smaller cases, the demands of this function may not be that great, and the same person may be in charge of conducting the criminal investigation. As case complexity increases, hopefully, a “lead detective” (with no administrative responsibilities) will be placed in charge of setting the direction of the investigative processes while someone else assumes responsibility for administrative support.

The investigation will likely involve a team of people who will organize under the “lead detective.” These people require logistical support (transportation, communications, food, sanitation, equipment and eventually rest!). Do not forget the possibility of emergency medical support for investigative staff, especially under adverse conditions or long duration investigations.

## ***PROCESSING THE SCENE***

### ***IMPLEMENTING THE SCENE PROCESSING***

#### **ORGANIZATION (continued)**

In smaller investigations, the issues of organization and coordination are more manageable since most of the staff on site report to a single “authority.” Knowledge of the staff capabilities may be well known to all on site since they have worked together before. In these instances, known talents and resources are easily deployed to benefit the investigation. As case demands exceed the departments resources, other agencies may be called upon to assist. These “mutual aide” responses often create a team of individuals with little or no prior knowledge of each other’s skills or resources. In these cases the problems of team organization and coordination of diverse skills become more complex. There are many viable solutions to cope with this, but most begin with identifying who is in charge of the scene and of the investigation.

The lead investigator may designate someone within the scene to serve as a “scene lead” and insure that the mechanical processes of search, document, evaluate, preserve and transport are effectively accomplished. That person may also provide the communication conduit for information developed at the scene and staff conducting interviews or interrogations.

The lead investigator and scene lead are responsible for establishing the approach to the scene processing, specific talents and resources to be used as well as what the processed scene’s final “paperwork”, “evidence packaging” and “overall documentation” will look like.

Further considerations in the organization of the crime scene that may involve multiple scenes, a mix of contributing agencies, long duration investigations, those which are highly publicized or the serial crime are offered in section “Complex Scene Logistics” of this text.

## *PROCESSING THE SCENE*

### *SEARCH AND SEIZURE*

All investigations must be based upon a legitimate right to enter into the location of the crime. Each country has different laws affecting entry into private residences, whether in the course of an arrest, during a general search for illegal activities or at “scenes of crime” such as homicide. In the United States, the 4<sup>th</sup> Amendment of the Bill of Rights to the Constitution guarantees protection from unreasonable search and seizure. This amendment, as well as United States Supreme Court decisions, dictates that the officer ascertain his legal standing within that “property” or “location.”

#### The 4<sup>th</sup> Amendment

*The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.*

Common law and “case law” further define the implementation of this Amendment. Searches of mobile objects such as cars, planes, boats and even the ability to “seize” evidence directly from the body of the suspect continue to evolve as the Supreme Court provides its guidance. Full discussion of these is beyond the scope of this text.

However, in the United States, failure to adhere to the Supreme Court decisions regarding access to “private areas” (and the influences of the 5<sup>th</sup> amendment “non-incrimination”) may result in evidence being “excluded” and the officer being subject to civil and criminal penalty.

The United States Supreme Court in Mapp versus Ohio ruled that “exclusion of evidence seized in violation of the 4<sup>th</sup> Amendment is reasonable in order to protect the most important constitutional privilege” of the right to be free from unreasonable searches and seizures. The Supreme Court believed this “exclusionary rule” to be the only viable alternative to compel respect for the Constitutional authority of the 4<sup>th</sup> Amendment. This position has been further defined by such decisions as United States v. Leon and many others since, wherein the Court created an exception to the “exclusionary rule” for evidence obtained as a result of officers' objective, good-faith reliance on a warrant issued by a neutral magistrate which was later found to be defective.

The investigator should **refer to specific legal sources** within their jurisdiction to become familiar with prevailing search and seizure guidelines.

## *PROCESSING THE SCENE*

### *SEARCH AND SEIZURE*

#### *WARRANTS OR NOT*

Investigators at crime scenes have tremendous powers to secure the area of the crime. In these instances “reasonable cause” is established when the corpus of the crime is found by or reported to the police. In order to protect the evidence of the crime and to insure an investigation sufficient to meet the needs of the courts, police have the ability to take control of the immediate scene. This may include the control access to the area or movement of people within the area of the crime. Police must take action to prevent contamination or alteration of the crime scene. Administrative procedures should be in place to guide the actions of the officers at the scene.

Court direction has shown that evidence may even be collected in limited instances prior to the issuance of a search warrant. Exigent circumstances which require immediate collection of an item to preserve it from loss are supported by legal opinion and court decisions. This was initially permitted when a danger to life existed or when the danger of escape was present; however, it is generally considered when there is an immediate need to preserve and collect evidence which would otherwise be lost in the typical time frames experienced when obtaining a search warrant. This does not waive the warrant requirement for other items nor enable the investigator to extend “reasonable cause” to areas beyond the crime scene. This and other search warrant requirements (such as suspect hair and blood standards at the time of arrest) must be discussed with the local prosecutor **in advance**. The legal requirements of search and seizure are affected by the same Supreme Court decisions throughout the United States; however, various jurisdictions interpret and implement these decisions in many different ways. **Check with your prosecutor** to be certain of the interpretations in your area.

The investigator should always know the legal foundation and circumstances which permit entry into the crime scene as well as the collection of evidence from a specific crime scene location. When in doubt, contact the prosecutor with jurisdiction. That legal advisor must be equipped with the most current information available and the proper qualifications to provide this guidance which is essential to every investigation.

## ***PROCESSING THE SCENE***

### ***SEARCHING THE SCENE***

The crime scene is searched in order to locate evidence which will apprehend and convict the perpetrator or exonerate the falsely accused. This evidence will also help to describe the actions performed by the perpetrator and the victim during the course of the crime.

### ***STYLES OF SEARCH***

The styles of searching generally considered at the scene include:

- 1) Circular pattern (principally for use in underwater searches and rarely else!)
- 2) Assigned blocks (a checker board or grid)
- 3) Lane search
- 4) Evidence Trail (logical association)

These search methods, which begin when the officer steps into the scene, form an integral part of scene processing. Whatever method is used, the search should examine the area around the scene before the investigation gets focused into what may be too small a part of a larger scene.

Each of these methods can be used to some degree at an interior or exterior scene, depending on manpower availability and the likely destruction of evidence that the pattern will incur. All search techniques are subject to the same weaknesses. If multiple people are assigned to the search, then the problem of co-ordination and communication prevail. Those factors are negated if only one person undertakes; however, they will likely physically and mentally fatigue during the long time frame necessary to complete the search. The answer comes in a slow, methodical search which involves a well organized team that regularly communicates their findings to a central coordinator.

It is possible for the officer and his teammates to effectively use the lane, checker board or a combination of these methods at a crime scene, especially one which is out-of-doors. To do so, they must avoid the distractions which pull them from their position in the pattern, or else the entire search may miss critical facts. All of the methods demand that the pattern not be broken by one team member anxious to see another's findings. To avoid this temptation, clearly identify the search areas, assignments and plan regular "evidence update" sessions to inform all personnel of evidence findings which may affect their portion of the search.

## *PROCESSING THE SCENE*

### *SEARCHING THE SCENE*

#### *PATTERNS EXPLAINED*

1) **CIRCULAR PATTERN** relies on the investigator's ability to follow a circle of fixed diameter. Each time the circle is completed, the diameter is increased and the search goes on. This pattern is easily complicated by physical barriers at the scene, and the difficulty of integrating photos, sketches and measurements and is rarely used except in underwater recovery scenarios in murky water. Investigators should not expect to use this technique unless under unusual conditions.

2) **GRID** (also known as zone, area or checkerboard) is a method which can use one or a dozen searchers on almost any scale: yards to acres. This method is most effective with smaller areas. The method works well indoors as well as outside. Consider the "house" as a series of larger (room-sized) grids. The initial cursory overview of the house (walk-through) is then completed with a methodical detailed search of each room. Once a key element of evidence has been located, the remaining searchers should be made aware of the item so that they can look for related objects in their assigned area.

3) **LANE SEARCHES** (also may be an accumulation of area searches) may be performed by one person or by dozens. Each team member is restricted in his search to a specific width (arm's reach is a good start). Anything which is in this path is his sole responsibility to find. One person should serve as coordinator to help regulate the pace of the search and the collection of samples and standards. The difficulties in obtaining the scene measurements without contamination of the search lanes remain a problem, but can be minimized by flagging evidence locations for later processing. This method can be used to search large areas with more people, but be sure to organize it well and to pass on significant findings to all searchers to keep them oriented as to what to look for.

## *PROCESSING THE SCENE*

### *SEARCHING THE SCENE*

4) **EVIDENCE TRAIL or LOGICAL ASSOCIATION** is the method most used by investigators in small scenes, especially the less complex. It is performed slowly; and with patient thought, logical progression leads the investigator, much like the fictional Sherlock Holmes, from one item to another. The key is to keep extraneous personnel from entering the scene, take ample time, carefully document and discuss all alternatives while at the scene. This method relies on investigator experience and instinct as well as the logical evaluation of each piece of evidence and its relationship to the entire scene. The investigative team must seek every alternative “reconstruction” while actively involved in the scene investigation. It is usually combined with a form of “checker board” search focusing upon one room within the crime scene at a time.

### *WHICH IS BEST?*

Indoors, the “grid” method is best; considering each room one of the “squares” to be searched. Within each room, the lane method is easiest. Outdoor scenes also benefit most from the lane search; however, grave-site excavations are better suited to the grid approach. All methods require the use of logic and communications to relate one piece of evidence to another. Awareness of what is found in one “grid” (room) of a house educates the searcher as to what may have greater value as evidence in another “grid.” By applying “logic” to evidence discovered through methodical searching more details can be learned about the crime. These intangible “clues” cannot be collected, rather must be developed through evaluation of the evidence at the scene and documented through observation and notes.

### *WHERE TO START*

Whichever scene search-method is employed, it is imperative that the evidence officer's thought processes begin working beyond the outermost perimeter of the scene and work towards its center. The searcher must refrain from the impulsive dash to the body. In such a rush, it is likely that evidence will be lost to hurried feet guided by unseeing eyes. These will likely clash with the investigators need to learn the identity of the homicide victim (the wallet/purse and identifying papers). Controlled access to the body for this purpose should be considered and incorporated into the processing plan. It is unnecessary to deny the investigator the identity of the victim until the outer boundaries are processed.

## *PROCESSING THE SCENE*

### *SEARCHING THE SCENE*

#### *PRELIMINARY VIEW*

The investigator should complete a preliminary walk-through and constantly search for evidence as he enters the scene. The entire team will be more likely to recognize items left behind by the perpetrator once the investigator has informed them of the key elements of the crime. A preliminary walk-through will also give ideas as to what may have occurred during the commission of the crime and aid in setting the plan for processing the scene (including the search pattern or patterns to be used).

#### *CHANGING PATTERNS*

The investigative team must carefully consider the particular search pattern in use at the various stages in the scene processing. This may occur when: 1) there arises some form of evidence which alters the concept of the crime: a firearm rather than a knife as the murder weapon or, 2) when, despite every effort, a key item of evidence has not been located: a casing or article of clothing. Changing patterns and the areas for which each person is responsible allows fresh eyes to scan an area.

#### *A SEARCH TIP*

When unable to find small objects in irregular terrain, the officer should place a similar (but marked) object into the area to help visualize the item and "tune" the eyes of the searchers. This is particularly helpful when using less experienced searchers in outdoor scenes. Additionally, a search for these small items in difficult terrains cannot be conducted from normal eye level. A search for a bullet or cartridge casing on a lawn conducted by a line of persons may look good for the media, but is likely to miss evidence. If a visual search must be performed, get close to the ground and feel as well as look for the object.

#### *PRECAUTIONS*

There are many disadvantages for those who rush to the body and hastily initiate an expanding search from where the body is. It is probable that in the effort to obtain adequate photographs, establish reference points, and take measurements, critical small evidence will be lost or destroyed. The several trips to and from the collection supplies will probably destroy evidence.

The lead investigator should initially become familiar with the core of the scene; however, the actual processing should begin on the "outside" and work toward the "inside." As an additional benefit, recording the scene will be much easier.



## *PROCESSING THE SCENE*

### *RECORDING THE SCENE*

It is essential to the success of any crime scene reconstruction effort and its ultimate presentation in court that the location of evidence and its spatial relationship to other items be thoroughly documented. These details are recorded by one or more of the following methods.

### *RECORDING METHODS*

Four methods commonly used to capture the details of a crime scene include sketching (with relevant critical measurements); photography (both as still and as moving); and three-dimensional media (such as castings). All of these methods are augmented by case notes which provide specific details and key observations.

### *FOR USE, NOT ART*

The most artistically rendered sketch, professional-quality photograph, or detailed cast will lose much of its value unless it is completed by someone who knows how it will later be used. Each step must be considered as a part of the entire process of scene processing and performed with imagination and thought to complete the thorough evaluation of the crime scene.

Remember, photographs are to record the entire scene and the relationships of all items within the scene; a sketch serves to record only those features which the investigators feel are relevant to the rebuilding of the crime scene or the reconstruction of the activities during the crime. Casting documents a small piece of the scene that the investigator believes is important as physical evidence.

No great technical skill is required to perform any of these methods. With the existence of so many convenient and "user friendly" cameras and distance measuring devices, good quality work is within almost everyone's grasp.

### *APPLICATIONS*

Each method of recording is intended to be used for a different purpose and to convey varying degrees of information:

1) **Sketches** show locations and relationships of important details and eliminate unnecessary items. They portray the degree of detail captured by the image which is in the mind's eye: that which has been the focus of the investigator's attention. These sketches may be hand drawn (include measurements) or scene diagrams prepared with laser mapping.

2) **Notes** that may be written or dictated at the time of the scene investigation. These should include factual observations of the evidence for future use. Consider including WHY an item has value as evidence (visual detailed observations regarding the item).

## *PROCESSING THE SCENE*

### *RECORDING THE SCENE*

### *APPLICATIONS*

2) **Still photographs** capture all the field of view, often losing critical details in the background. Still photos record the equivalent of the "casual glance" which includes particulars as well as the irrelevant. Overview, approach, and close-up photos are essential for complete documentation. These steps will be discussed in greater detail later.

3) **Videos** can possess the same degree of detail as still photographs if the image is properly framed. They have the advantage of being able to link each of the separate "stills" so as to convey the spatial relationships of all items critical and incidental to the crime. Here, too, a series of views is best to document any single item in the scene and to show its relationship to all other items relating to the crime. Digital cameras typically include a high definition video capability. Combined with the ability to "frame grab" video digital images, a multitude of "still views" become readily available which may prove helpful to all aspects of investigation and court presentations.

4) **Casting** will record critical information about a specific item, but will not convey its relationship to other items at the scene. That is best accomplished by sketches and photographs. All castings, regardless of the media used should include a means of not only establishing where in the scene the object was, but how it was oriented. (E.g. establish the direction in which a part of the cast was pointed in relationship to landmarks within the scene).

### *SKETCHES*

#### **WHY SKETCH?**

Scenes of crimes are sketched to document the "size and feel" of the location as well as the approximate position of evidence within the scene. All major crime scenes should have some form of sketch to accompany the photographic documentation. The basic purposes of a sketch are to:

- 1) Make note of those things within the scene that are important to the investigators at the time of processing.
- 2) Serve as a backdrop for the measurements of the scene and the approximate position of evidence within the scene.
- 3) Associate items numbers and descriptions to their relative position in the scene.
- 4) Help interpret photographs and video documentation of the scene.

## *PROCESSING THE SCENE*

### *RECORDING THE SCENE*

#### *SKETCHES (cont)*

Sketches should be created in all major scenes, whether evidence is collected or not. However, there are many “simple scenes” of crime such as an automobile theft that may not require a sketch. If one is created, it may be very simple, emphasizing one or two elements of the crime.

There are several degrees of refinement and many different styles in sketching. The initial sketch may be “rough” but include all the relevant measurements. No one is expected to be a draftsman at the scene, just thorough. The initial sketch is often started during or immediately after the initial walk through by the investigator. This rough sketch can be used to orient other team members as to the location of evidence, the scope of scene processing and the limits of the physical scene.

The sketch which is included in the case file should be neatly made and be intelligible to anyone who reads it. The investigator rarely draws a sketch to scale. Most investigators will sketch objects in proportion to their relative sizes to give a sense of scale to the overall sketch. It is strongly recommended that the investigator **never throw away the initial sketch**.

The final court diagram should be of high quality, to scale, and contain only relevant information. It should not include unnecessary clutter which might confuse the jury. If additional information is needed, then the original case-file sketch can be used to add details taken from the scene.

#### *Laser Mapping and Total Station*

Many agencies utilize “total station” or “laser mapping” devices to provide a detailed three dimensional diagram of the crime scene, often integrated with scene photos creating data suitable for dimensional animation. All categories of laser measurement and mapping devices flourish in large open areas, but may be used in environments with interfering walls that block the laser beam. If the laser cannot contact the item, the total station has a “rod” that is used to access the item. Both types of devices have the ability to add details to the raw field obtained data. The experienced user will assess each scene and decide whether the laser or conventional measuring methods is appropriate,

Both methods require establishing known references to position the laser as well as a known distance to establish scale. The equipment is relatively easy to use in the field (once trained); however, creation of animations is best performed by someone who regularly uses the specialized software to process the field generated data.

## *PROCESSING THE SCENE*

### *SKETCHES*

#### *SKETCH CONTENTS*

Certain components must be found in the drawing at each stage of sketching. There must be directional orientation to the overall sketch. Usually, north is used for orientation; however, a street, an intersection, or any other identifiable reference point such as a prominent landmark is acceptable. The officer's identity, date of the scene processing, case number, and the location of the site should be included on the sketch, as well as the sketch's scale, if one is used.

#### *LEGEND*

The investigator should follow architectural conventions when sketching structural components of a building and its contents (furniture). Though not required to be used, tracing templates are readily available for such household items as sinks, bathtubs and the like and may be helpful. Essential elements of the scene which are not collected as evidence should be drawn on the sketch in an identifiable shape or listed by *letter* code in a key or legend. Most symbols used within the sketch are so common that a legend becomes unnecessary.

Some choose to include in the legend a *numbered* list of the items of evidence collected with shortened descriptions of each item. If this is done, the legend must coincide with the separate, more descriptive evidence list.

#### *EXPRESSING MEASUREMENTS*

Though discussed separately later in this text, measurements are so fundamental to sketches that they must be briefly mentioned here. There are three basic approaches to correlating measurements to the sketch, evidence and the scene. Some investigators place lines and numbers on the face of the sketch. While this is fine for those sketches with just a few measurements, it doesn't take long for the sketch to become obscured by the numerous lines required for a major investigation with lots of evidence and measurements. When that happens, the purpose of the sketch, to document clearly the relationships of items at the scene to the premises and to each other, is lost.

Other investigators place their measurements into the body of the report in a narrative textual fashion. Often these sentences are very confusing to read. For example: "Item 1 is 4'3" SE of the NW corner of the eastern most bedroom and 9'3" SW of the NE corner at a height of 3'2" from the floor." These take some concentration to interpret and the reader quickly tires of the effort.

## *PROCESSING THE SCENE*

### *SKETCHES*

#### *MEASUREMENT TABLE*

There is an easier and clearer alternative available through the use of a “measurement table associated to the sketch. Measurement lines need not be present on the face of the sketch, either in rough or final form. This information can be provided through labeled references and a measurement table which will aid in the reconstruction of the scene and the placement of evidence. It is possible to very precisely list the measurements in the table which can also serve as a legend and evidence list. (See example). Begin this table by first making sure that the points of reference for all the measurements are clearly identified. In the list, begin with the victim’s body (V1, V2, etc.) then list the items collected at the scene (property sheet). Place the value of the measurement in the column for the appropriate reference point. For every item, be sure to include the height of the object above the floor or other reference elevation.

The descriptions used in the property sheet should also be factual and clear observations that are made at the scene. The description should capture the observations made that answer the question “what is important about this item? The descriptions listed here may be the only easy means for others to understand what the item adds to the investigation.

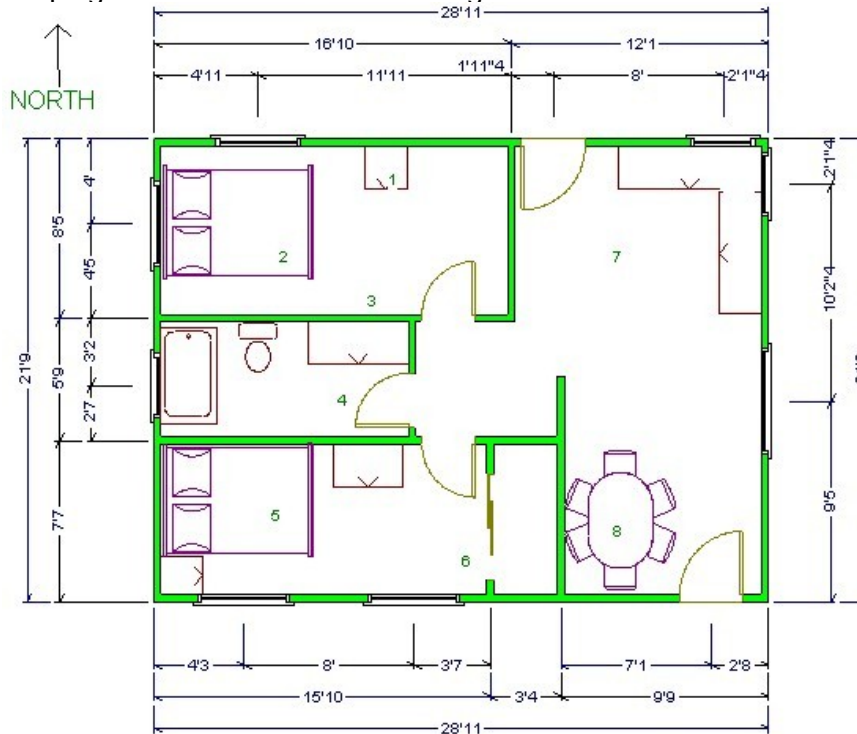
#### *PUTTING IT TOGETHER*

A simple measurement table integrated with the property sheet has been designed to help clarify the sketch and insure that the investigator has considered the relationship of all the evidence at the scene. This table (see example opposite) contains a column-oriented listing of reference points, items collected and the distances to identified reference points. In addition, its design may be integrated with existing “property sheets” and save the investigator time and unnecessary duplication of effort.

This table may also be used as a “checklist” to more subtle measurements and evidence relationships. The investigator may wish to add into the top row any of the items of evidence collected at the scene or landmark evidence too large or awkward to be collected. Placing an item across the top row, the investigator asks the question: “How far was this object from the other item of evidence?” If the answer to the question is valued by the investigator, it is placed in the intersection of the rows and columns for the item in question. This creates a checklist unique to each case, which forces the investigator to consider the inter-relationship of the items of evidence. If a relationship is worth noting, it merits actually taking the measurement and the item being added to the top row of the table. (EXAMPLE FOLLOWS)

## PROCESSING THE SCENE

An example of a method to coordinate item and package numbering, approximate location in the scene and (important) details for each item while keeping the sketch clear of confusing lines.



The attending “legend” also serves as a list of evidence with details intended to capture perishable observations of what is important about the items.

Item	Description	North wall	West wall	Ht.
1	Ruger, Security Six, Stainless, SN123456, (5 live, 1 spent case under hammer, possible blood on grip)	1' 2"	11' 3"	3' 2"
2	12 oz Budlight beer can (cold, half full)	6' 4"	5' 11"	1' 8"
3	Ammo box, (RP, .357, lead 158 grain 18 count)	7' 9"	9' 8"	0
4	Possible blood on floor (aprox 2'x3')	3' 3"	9' 6"	0

## *PROCESSING THE SCENE*

### *SKETCHES*

#### *PROCESS REVIEWED*

First, identify the reference points and place their description on a line in the "Item Description" column of the measurement table, which may also serve "double duty" as a property sheet and as a "legend" for the sketch. Clearly label these references within the sketch. Next, place the victim into the sketch on a line under "description". Measure its location from the references and add the values to the table in the same row, but in the appropriate column. Then comes the list of all items collected at the scene. Each is added to a new line in the table and measured from the appropriate references.

Once the positions of items are documented, the investigator can consider their relationships by asking the question "how far is item number 'X' from item number 'Y'." Use of this "table" will assist the investigator in capturing the importance of item relationships at the crime scene. The relationship of items to each other provides insight as to how the crime occurred.

#### *SKETCH TYPES*

The content and vantage point to be depicted in the sketching can include:

**General Sketches** typically include broad-view renderings such as

    "Overview" (floor plan or bird's-eye view) and

    "Side views" that depict elevation or sectional renderings

    Perspective Drawings (3-D effect)

    Exploded Sketches (Combined overview and elevation renderings)

**Detailed Sketches** (close ups of anything!)

The method of sketching should be selected which best depicts the measurements necessary to establish the item's relative position within the crime scene. It is also important that the method provides a clear impression of the spatial relationship of the depicted items to each other. Years after the crime, these documents may be viewed to recapture the dimensions and relationships of items within the crime scene.

#### *SKETCH TYPES*

**"Overview drawings"** are the most common form of sketching. This method is the one most overworked, often used to record scenes best done with other styles of sketching. Appropriate applications include house floor plans or the "bird's-eye view" of exterior scenes. This sketch can accurately record flat or horizontal surfaces with great accuracy and detail. It cannot record accurately the true relationship of vertically oriented evidence such as the relationship of a car at the bottom of a cliff to the roadway from which it fell. Trying to do so cannot show the true proportions of the distances involved and may even misrepresent the crime scene.

***SKETCHES (continued)***

**Side Views** (Elevation views) are used to depict the height of object of interest within the crime scene, be it a structure or terrain.. For example, a side view sketch may be used to depict a grave site's position (elevation) relative to the slope of a hill. These views depict vertical measurements of objects on exterior surfaces in the scene typically relative to an arbitrary reference base, such as "the bottom of the hill" or "the side of the building." Similarly, a side view may be used to show vertical details and accurate vertical spatial relationships of items which are interior to the scene. The inside of automobiles, walls of a house or cut-away interior views of a structure are examples of this type of sketch. They are often used in conjunction with overview sketches to provide a comprehensive view of walls, cabinetry and the like in conjunction with room layouts.

**"Perspective drawings"** are rarely used at crime scenes. They require drafting or artistic ability, but are worth the effort in some instances to make a more understandable scene sketch. They can effectively supplement photographs by pinpointing important details otherwise lost in the picture. Illustrating a witness's view of a crime scene or depicting the path of a sniper's bullet to the victim are just some uses for the perspective sketch. The sectional sketch when combined with overview sketches are more frequently used than perspective drawings and are typically more accurate for crime scene reconstruction.

**"Exploded sketches"** should be used in place of overview sketches far more often than they are. Every interior crime scene which has evidence on the walls or windows should use the exploded sketch. It is simply a combination of overview and sectional sketching placed on the same page, with a common edge to allow one sketch to be easily related to the other. A little more time consuming, this method contains much more information than the overview sketch and is a clearer way to depict the origin of evidence. Caution is the byword when trying to derive measurements from exploded sketches. It is always preferable to measure critical distances at the scene rather than try to extrapolate those distances from a sketch.



## *PROCESSING THE SCENE*

### *DETAILED SKETCHES*

“Detailed” sketches are simply “close up” views of a portion of the crime scene. They are used when there is too much information to show in a larger scale sketch without losing it in the “clutter” of small lines and numbers. These are helpful when the investigator is trying to depict a location which is obscured by other objects or when there are many items of evidence in a confined area. For example, an “overview” sketch of an entire house would include the den, might include desk and chair, as well as the windows, walls, cabinetry and lighting. If there are numerous items on the desk that are important to collect, then these should be “sketched and measured.” The officer who tries to depict all of the table contents in the larger “overview” sketch will be at a disadvantage unless it is augmented by a “detailed sketch”. This close up (detailed) sketch provides the opportunity to place clearer, more detailed information into the documentation.

The investigator who adds “exploded, sectional or detailed” sketching to their crime scene documentation will have an advantage over the one who uses only the floor plan (over view) sketch. In combination, all can be used to show heights on walls, a cluster of items or views that are otherwise obscured by large objects in the scene. The investigator who documents the scene using several forms of sketching will be more aware of the relationships of one item of evidence to another and be able to evaluate their meaning at the scene at a much later date.

### *REMEMBER*

The most frequently used form of sketching is the “top view” or floor plan sketch familiar to all of us. These are commonly used in non-investigative applications to depict the interior of a home, apartment or even in public settings to illustrate where a business is located or the emergency evacuation route. Familiarity with this form of sketching often results in it being exclusively used to document a crime scene. This may result in incomplete or inadequate documentation.

It is frequently better to use more than one form of sketching to fully record the crime scene details. As an example, the location of a bullet hole in a kitchen table top can be clearly recorded if two or more sketches are used in different scales to establish the precise location; first the kitchen, then the table, and finally the hole. Use the floor plan sketch to depict how the detail and side view sketches are related to the scene. In the example above, the desk’s “detail sketch” could easily be referenced in the floor plan view with a simple notation of “see detail sketch (alpha or numeric identifier).”

## *PROCESSING THE SCENE*

### *MEASUREMENTS and REFERENCE METHODS*

No crime scene can be accurately documented without taking at least some measurements. Whether it's a burglary through a window (height of the opening); a body in the forest (overall location of the scene); or a rape (location of any bruising or trauma), the officer should collect information which will locate the position of the evidence at the scene.

#### *WHY MEASURE*

Measurements taken at crime scenes satisfy two equally important needs. Combined with accurate sketching of the evidence in its found position, measurements address the question: "Where was item A?" This permits the replacement of evidence within the scene.

The second reason is to determine distances between objects to show relationships. "How far was A from B?" These measurements will address questions raised as the investigation discovers items that may require inference (trajectories) or special value (gun from suicide victims' hand).

#### *MEASURING DEVICES*

Vehicle odometers, optical range-finders, fifty-foot and one-hundred-foot tapes, twenty-foot pocket tapes and rulers are just a few of the tools used at scenes to measure distances. Technology has proliferated infra-red, laser and sonic rulers as well as satellite based geographic positioning systems and laser mapping devices. Each electronic measuring device comes in various levels of cost that make them available to most crime scene investigators. Each has inherent limitations which the investigator should explore prior to relying upon them as a tool of choice.

#### *WHICH RULER?*

Each device has a different inherent accuracy; however, the measurements should be reproducible or else the wrong tool was used. Selection of the proper measuring tool is based upon the length of the overall distance in question. A general guideline would be to use a tape which will span the distance without being moved. For indoor scenes, a pocket tape capable of spanning 30 feet will be most useful. At outdoor crime scene locations, a tape 200 feet long will meet most needs. A six-inch ruler should also be carried when it becomes necessary to include a scale within a photograph to capture an object's relative size. **Caution** must be exercised with the chosen measuring device not to inadvertently transfer evidence between scene locations. This could occur with trace evidence or very low levels of biological materials. The laser measuring device eliminates contact with floors and other surfaces and the possibility of cross contamination. Disposable scales should be considered for use with photographs.

## *PROCESSING THE SCENE*

### *MEASUREMENTS and REFERENCE POINTS*

#### *ACCURACY OF MEASUREMENT*

It is also not reasonable to expect the same degree of precision from each of these devices. Where a twenty-foot tape may be precise to 1/4 inch at forty feet, a ten-foot tape may only be good to one inch because of the greater number of "moves" required to span the distance. The degree of "precision" should also consider the nature of the evidence item as well as its size. For example, a jacket or other large article of clothing may be lying in a "lump" on the floor and an arbitrary "visual center" used as the point from which to measure to the reference. This measurement is clearly an estimate and not likely used for critical reconstruction interpretation. Conversely, an item with well-defined shape, is easier to reproduce the visual center and measure the location with greater precision.

With larger items measurements to the nearest inch are appropriate within a home. For small, well-defined objects such as a bullet, measurements may be recorded to the nearest "½ inch." All measurements, regardless of the device used (including lasers) are "best estimates." Whenever a measurement is critical (as with trajectories), the degree of accuracy should be considered as the measurement is applied to address the investigative question, (as in "where was the shooter"?).

Hand-held electronic devices can be very accurate when regularly checked against a known standard measurement. Geographic positioning systems based upon satellites may be accurate only to yards rather than inches or feet (twenty feet accuracy is excellent with this satellite based system while thirty feet is more to be expected). Any electronic device has the advantage that it is less likely to move trace evidence or very low level DNA from place to place within the scene (or between scenes!). Remember that traditional measuring tapes are often placed on floors or other surfaces that may contain evidence. Caution and cleanliness should always be exercised to prevent inadvertent migration of evidence.

#### *ESTIMATIONS?*

Measurements taken at the scene are always estimates, regardless of the device used to obtain it. Though they are estimates, they may prove critical to a reconstruction of the crime; the more critical, the more careful the measurement. For the purpose of reconstruction, "off site" approximations of the relative positions of items are not acceptable substitutes for carefully obtained measurements recorded on scene. If the investigator lacks time, resources or the scene has difficult terrain, consider the use of additional staff, or perhaps a surveyor.

## *PROCESSING THE SCENE*

### *FORMS OF MEASUREMENT*

### *HOW TO MEASURE*

There are four different methods which can be used to obtain measurements from given reference points.

- A) Line of sight
- B) Horizontal projection
- C) Topographical or contour
- D) Height or elevation

### *MEASURING METHODS*

A) **LINE OF SIGHT** is the simple equivalent of stretching a tape between two points without regard to height or surface irregularities between those points. This is the equivalent of measuring the distance between a bullet hole in the wall and the firearm on the floor.

B) **HORIZONTAL PROJECTION** is an accurate method in determining distances over flat or horizontal surfaces where there is no relative elevation or height change, as in football fields or the interior of buildings. This method ignores topographic variables and measures only horizontal differences. This is the **most common method** of measuring that can be used. However, for scenes with terrain involving contours, it may not be the method that is easiest to use or should be used.

C) **TOPOGRAPHICAL OR CONTOUR** consists of laying a tape over irregularities in the terrain between two points, including all variations in height or elevation. Examples include ravines, hillocks, stairways or the contours on the front and hood of a car. For example, for those who count paces walked as an approximation of the distance from the roadway to the crime scene, the irregularities of the outdoor terrain will be included in their final measurement.

D) **HEIGHT** is merely the measurement of the elevation differences between two points. It ignores horizontal distances and is not affected by contours- as in, how **high** was the roadway from the canyon floor, and how **far** from the roadway was the canyon.

### *REMEMBER*

If the method of measuring is something other than the typical horizontal and elevation common to interior scenes, the documentation should include how the measurements were made to avoid misinterpretation in the future.

## *PROCESSING THE SCENE*

### *REFERENCE POINTS*

When possible, measurements must be made from two distinct and durable but not necessarily permanent landmarks to the item of evidence. Often this is misunderstood as requiring “permanent” reference points. This is incorrect (what is permanent in this world?). References must be something whose positions are likely to remain fixed for the duration of the investigation and trial unless overt and altering actions are taken by others. Examples include: corners or walls of a room, edges of sidewalks, “bottom - dead-center” of automobile tires (for objects in relation to the vehicle) and power outlets in a structure all qualify as “reference points” for measurements. Some think “large (permanent) trees” are required outdoors and forget that they too are “impermanent.” Recall too that those large trees (perhaps several feet in diameter) are not in themselves the reference point! They simply aid the investigator in locating the single spot (on the tree) that IS the reference spot.

### *POINTS ON THE ITEM*

If the evidence item has a particular orientation which is valuable to note, then two points on that object must be measured to at least two reference locations. On a firearm for example, the front and rear sites or front site and base of the frame must be measured to two reference points.

### *ARTIFICIAL REFERENCE POINTS*

Though almost any reference point can be destroyed, reasonable references need to be established to aid reconstruction and interpretation. In the event there are no reference points available, they can be created. These artificial reference points must have their positions documented relative to durable landmarks. Once they have been established by the investigator, these artificial reference points can be used to document items of evidence collected at the scene. Their position from more durable references can be recorded by the investigator or perhaps a surveyor after the scene is processed.

The selection of such well-documented, **artificial reference points** can simplify measurements, especially in cases where there are few “natural reference points” readily available or where those which are may be quite a distance away. Efficiency sometimes requires simplicity and common sense to aid the investigator in the “mechanical processes” at the scene in order to have more time for the “thinking” processes at the scene.

## *PROCESSING THE SCENE*

### *REFERENCE METHODS*

Reference points and landmarks may be selected to enable the use of each of the following reference methods:

- 1) Triangulation (from two points)
- 2) Transect (or baseline)
- 3) Rectangular (from walls or the like)
- 4) Polar Coordinates (from an established point)

Once it is determined which reference method will be used to document the specific site of the crime or the relative positions of items within the scene, the selection of reference points and measuring devices may be made. Reference points should be selected which will easily and accurately document the scene with a minimum of confusion and time lost. As mentioned previously, some would suggest that reference points be permanent, however all that is really required is that they can be relocated later to permit the rebuilding of the crime scene for the court.

The accuracy required to record spatial relationships may determine which of the following reference-point styles is used. The reference point style, combined with the actual tools used to measure distances will provide an overall degree of accuracy in rebuilding the crime scene. In dealing with the total crime scene, it is rarely necessary to measure an object to units less than one inch.

### *TRIANGULATION*

**Triangulation** may be performed in any setting as long as two reference points and a relative direction can be located. The angle from the reference point to the item is not critical, being determined only by the item's relative position within the scene. The reference points selected may be very precisely defined and be kept constant throughout the measuring and sketching processes, or, for convenience, the reference points may be varied, provided their relationship to previous reference points is documented. These "points" may really be "lines", such as the corner of the room. No need to use the "corner" on the floor, use the entire corner's edge from floor to ceiling and simply include the height of the object, which is always a good thing to note.

Some like to use the same reference as they move from room to room within a structure. For example, the consistent use of the northwest corner or south wall.

## *PROCESSING THE SCENE*

### *REFERENCE METHODS*

#### *TRANSECT*

2) **Transect** (baseline) requires the creation of a line between two reference points, then measuring along that line to a distance where a perpendicular angle is drawn to the item. The distance to that point from the line is measured and a compass direction from the reference line is used to orient the position of the object. This method is frequently used in traffic scene documentation and is referred to as the “baseline method.” It is a valuable tool; however, it relies upon the officer’s ability to measure “right angles” in the crime scene. In outdoor cases with large objects, the inaccuracies inherent in this method are not a problem. However, if precise measurements are necessary, especially to small objects, then triangulation would be a more suitable method than transect or baseline.

#### *RECTANGULAR*

3) **Rectangular coordinates** are an indoor version of the transect method using the walls of the room as forms of reference lines bound to each other by the room. Commonly used for the quick measurement, particularly at indoor sites, this is a **poor** method of accurately measuring over long distances. The 90 degree angle casually measured by eye can cause significant variances. The variables of 1) just how perpendicular to the wall is the tape; and 2) how high on the wall is the tape held usually result in inaccuracies. This is the most commonly used method of measuring at the crime scene. If the measurements are not critical to the reconstruction this method may be used without adverse consequences.

#### *POLAR COORDINATES*

4) **Polar coordinates** require a central reference point and a precise direction and distance from that point to the item in question. The direction may be found by compass or by a simple orientation from an artificial landmark or traces on a sheet of paper placed on the central point of reference. This method is rarely used, but does have application in crime scenes located on beaches, in the desert or other sites devoid of suitable reference points. In these instances, the use of “GPS” devices reading satellite coordinates of latitude and longitude can be useful to establish the approximate location of the scene, as well as the approximate location of “artificial reference points” that will permit more conventional measurements to be taken.

## *PROCESSING THE SCENE*

### *MEASUREMENTS and TYPE OF SKETCH*

Each of the following four styles of measuring is best recorded with a particular type of sketch. If the wrong measuring style is used, the sketch can grossly mislead the reader by improperly depicting the relative positions or dimensions within the scene. This becomes more critical with outdoor location having irregular terrain. (e.g., a contour measurement shown on an overview sketch would be misleading unless clear notations are made. A side view sketch would be clearer.)

### *PUTTING IT TOGETHER*

1. **HORIZONTAL PROJECTION** measurements (such as those along the floor of a structure) are effectively used with any reference method on an overview or exploded sketch. The entire scene can be easily recorded and the relative positions of important details clearly portrayed, so long as the measurements depicted are all in the horizontal plane.

2. **LINE OF SIGHT** measurements may be carefully applied to any of the sketching techniques, as long as the measurements are taken from the same height. Should that not be possible, a combination overview and side view sketches should be used. Additional documentation should be made as to the relative heights between the reference and the item.

3. **TOPOGRAPHIC OR CONTOUR** measurements work well with references placed on an elevation or other form of “side view” sketch. An overview sketch can be used in conjunction with these other sketch techniques to convey a total image of the scene from a bird's-eye view. Topographic measurements placed on an overview sketch having “horizontal measurements” will result in inaccurate proportions.

4. **HEIGHT OR ELEVATION** measurements should be placed on elevation, sectional or other form of side view sketches. Their use in any other form of sketching should be carefully annotated to show where they were used to prevent misinterpretation by the viewer of the sketch.

In most instances, the investigator is inclined to use flat, horizontal projection measurements in conjunction with the overview sketch. Though these styles are compatible with each other, the officer must always evaluate other styles of measuring and sketching as clearer forms of documentation. Not everything is “flat” and seen looking “straight down” from the overhead perspective. Be resourceful in the gathering of measurements and in the style of documentation. Never disregard the measurement of height of the object within the crime scene.



## *PROCESSING THE SCENE*

### *PHOTOGRAPHING THE SCENE*

The camera is at the scene to record the appearance of objects and their relative positions so that others not present at the scene can obtain knowledge of evidence and the crime setting including the physical objects and intangible clues.

#### *DUPLICATE THE EYE*

To do the photographic job properly, the camera must take pictures which provide the person looking at them the ability to orient any object to its surroundings. The photographer should use the camera to mimic the process used by each of us to orient an object to our surroundings. First we get the widest view possible, then move in closer. The investigator who examines the crime scene performs the simple operation of looking at all objects and building a “roadmap” of relationships. Those of greater interest to the investigator loom larger in his mind. This is the same process that the jury must be able to perform; however they will usually use the photographs to get sense of the real “three dimensional” crime scene.

The camera, like the eye, should scan an area to show the relative positions of objects in an “overview” photograph. This perspective information is used to orient subsequent viewers to the overall scene. Then the photographer’s eye and camera select a reduced field of view providing an “approach” picture that provides more subject detail. As an object is evaluated at nearer distances, the camera captures “close-up photographs.” If any of these steps in photography are eliminated, the viewer of the pictures is more likely to become disoriented perhaps not recognizing what or where an object really is, especially in relationship to other items within the scene. Photography, regardless of the media used, must follow this technique to keep the subsequent viewer oriented to the scene, without a narrative explanation.

#### *GENERAL CONSIDERATIONS*

Photography is a complex interaction of subject matter, light, lenses, shutter speeds and recording media. Photographs are taken to preserve the details of the subject matter as observed by the investigator and serve as an aid to present their observations to others. However, as with all things, the devices used to record the image have an effect upon how the content of that image will later be interpreted by the viewer.

This text is not intended to provide an exhaustive discussion of photography, however, some aspects and how they effect “scene documentation” need to be mentioned. Among the concerns are the influences of lens selection, flash (or not) and the height from which the photograph is taken.

## *PROCESSING THE SCENE*

### *PHOTOGRAPHING THE SCENE (continued)*

The camera detector is intended to accurately capture the information focused upon it within the entire field of view of the lens. The maximum amount of information regarding an object is obtained when it occupies the entire field of view of the lens and the entire surface of the recording media. Common experiences tell us that (regardless of the recording media), it is not possible to enlarge an object occupying a small portion of the view screen to the same resolution and clarity as the same object occupying the entire view screen. For example, taking a picture of a fingerprint on a door from across the room does not capture the fingerprint details needed for comparison. We cannot enlarge the tiny image of the print, it must be originally photographed “up close” in “macro mode” to capture the necessary details.

### *CLOSE OR FAR?*

The distance of the camera from the subject is the most common problem with scene documentation photography. If we get close enough to see everything about the item of evidence, we lose the “where is it in the room” information. If we stand back and capture only the “**overview**” image, we lack the detail to see everything we need to know about the single item. The answer is simple; take multiple pictures of the item. In addition to the “general documentation” pictures of the entire crime scene which show very little detail of any single item, we must take another series of evidence documentation pictures. In these series, photos are taken as the investigator **approaches** the item; this captures a bit more detail about the item, and also serves to show its relationship to other nearby items. Another set of photos are taken **close-up** prior to collecting the item; a ruler is placed next to it, the camera brought directly “overhead” and the properly illuminated photograph is taken.

Unfortunately, as we take “overview and approach” photographs, the effects of the lens, lighting and the height of the camera have great influence. Many investigators use multiple focal length lenses such as “35-85mm” lenses. While most convenient to the photographer, they harbor potential problems too. Focal lengths that vary from the “normal” lens of about 50 mm, can alter the appearance of the objects in the “field of view.” Wide angle lenses tend to elongate objects and make things in the background look smaller. Telephoto lenses tend to shorten objects and make things in the background look larger. Extreme wide angle lenses can cause obvious distortions, but even the 35mm end of that “35-85mm range” lens can create distortions especially when combined with a camera height “low” relative to the “field of view.” For example, place a rifle on the floor and “crouch down” to take a picture of it from the muzzle end using that 35mm setting. It will look VERY long. Stand and take another picture from “eye level” using the 50mm setting on the lens. Compare the two pictures and the effects become obvious.

## ***PROCESSING THE SCENE***

### ***PHOTOGRAPHING THE SCENE (continued)***

#### ***STANDING BACK***

And as we stand back to take our pictures, the amount of available light influences the length of time the recording media must be exposed in order to capture the details of the item. We have four choices; leave the media exposed longer (slower shutter speed), let more light get to the recording media (change the *f/stop*), find a more sensitive media (more sensitive setting on the detector) or add more light (wait for daylight or get out the artificial lighting!). Both still and video photography are subject to these influences.

#### ***SHUTTER SPEEDS***

Slower shutter speeds have two drawbacks. Moving objects may blur and slow shutter speed may capture the “twitches” of the photographer holding the camera. Since crime scene photography deals with dead or inanimate objects, the former should pose no problem. The latter poses little problem until the shutter speed drops to less than 1/30 of a second (with a normal lens). Tripods or similar stabilizing devices should be used at or below those speeds.

#### ***THE IRIS OF THE LENS***

The lens contains an “iris” much in the same way as the eye does. In bright lighting, the iris is smaller and in dim lighting it opens to permit more light to enter the eye. A side effect of opening the iris to permit more light to enter is that the degree of focus is reduced (less depth of field). For those who suffer from the need for reading glasses, this parallel is very obvious... we don't need glasses, simply more light! The end result is the same. More light means a smaller “iris” opening and therefore a “greater depth of field.” and things are easier to focus!

#### ***THE RECORDING MEDIA***

More sensitive detectors ease the problem of low lighting, provided the clarity and color are maintained. Film cameras were limited by the fixed light sensitivity of the film used. Today's digital cameras utilize very sensitive detectors that are capable of high resolution images with very low lighting levels; particularly if the image subject is not moving. Variable ISO” detectors are available which provide greater latitude of lighting sensitivities for the crime scene photographer.

#### ***ARTIFICIAL LIGHTING***

Artificial lighting seems to be an easy solution to low light levels. However, all too often the method selected is inadequate to capture the color and detail of the items. The “internal flash” on some cameras (still or video) is only sufficient for a few feet (typically less than 12 feet). The purpose of additional lighting is to illuminate the farthest reaches of the “field of view” and these built-in flashes are inadequate. They will have to be augmented by suitable flashes, floodlights or simply waiting for the sun to rise!

## ***PROCESSING THE SCENE***

### ***PHOTOGRAPHING THE SCENE (continued)***

#### ***WHERE TO START***

Photography at the crime scene should begin on the outside and work its way in. It is part of every step of scene investigation. Some photographs may be taken by the responding officer; others during the “walk through” of the scene by the investigator or evidence officer. More photographs will be taken of a specific item just as it is being collected in the field and others not until the object is in the forensic laboratory.

At the crime scene, it is unlikely that a single set of pictures will be taken and the camera put away. Most commonly photographs will be taken, then, after additional searching, still more pictures taken. Eventually number stands will be placed near the evidence items and another series of pictures will be taken. As individual areas of the scene are evaluated and searched, this process of searching and photographic documentation will be repeated.

Crime scene photography should be closely integrated with the scene search methodology and always proceed by taking overview, approach, and then close-up photographs prior to collecting an item. The completed package should permit the viewer to get a sense of the item as if they were there. Keep in mind that the scene should be photographed by standing back and taking overview photos to show total spatial relationships and perspectives and include ceilings and floors (as applicable). As an item becomes the focus of interest, an approach photo should then be taken to illustrate finer details of the object and its surroundings, being sure to include landmarks which were visible in the overview photographs. Ultimately a close up photo of the numbered item is taken with the lens perpendicular to the object.

#### ***BASIC CAMERA TOOLS***

A digital camera with detachable flash, interchangeable lenses (including a macro), a polarizing filter, additional power sources and a sturdy tripod define the minimal equipment for a crime scene camera.

Technology has solved some of the most problematic situations confronted by the scene photographer however digital devices have become far more complex to use than the predecessor “35 mm reflex camera”. The digital camera user must dismiss the thought of a single “lighting sensitivity” as was found in film (remember ISO400?). Digital cameras have the ability to vary detector sensitivity “on the fly” as lighting conditions require IF the user has the camera set to do so. This diminishes (but does not eliminate) the need for specialty lighting techniques such as “paint with light” or slave flash.

## ***PROCESSING THE SCENE***

### ***PHOTOGRAPHING THE SCENE (continued)***

#### ***LEARNING HOW TO USE THE CAMERA***

Any mid to professional level digital camera will be able to record the scene. The features of this type camera will simplify its use and allow more thought to be given to the product rather than to the process. Substituting a macro-zoom lens for the normal lens gives the photographer a greater range of “lenses” built into one. Be cautious of the previously mentioned dangers of image distortion. The macro lens is necessary to take those close-ups of toolmarks and fingerprints. The addition of a detachable flash linked to the camera computer simplifies almost all flash photography problems. The amount of light from the flash must be controlled by the camera’s computer. This is particularly true when the flash is held away from the camera as in oblique lighting of tire tracks or in fire scenes.

The photographer must become familiar with the specific camera that will be used. However, learning the following points will greatly improve overall quality of the product. Note that this may mean that the user will actually have to read the owner’s manual and practice!

- A) How to manually control the output of the detachable flash. This will be helpful to reduce shadows in “mottled light” conditions as found under trees in bright light. Also useful for macro photo conditions and oblique lighting as with impression evidence.
- B) How to set the sensitivity of the detector. There is an “ISO sensitivity setting” for the detector and likely an “auto ISO” setting. This will interact with the need for flash in very low or very high lighting conditions. Don’t think of the detector as a fixed ISO.
- C) How to select the format of light metering on the detector. Some cameras use “center weighted”, average, or programmable points within the field of view.
- D) How to manually focus the lens. This will be important for those instances when the scene is in forested areas, (especially in dim lighting) and when photographs are to be taken through windows (as with automobiles).
- E) How to control aperture versus shutter priorities.
- F) The photographer should also acquire a tripod capable of inverting the mounting head downward to capture shoe and tire track impressions.

The trick to photography is to learn the equipment through practice. Don’t wait until the next scene to find that camera and flash. Learn the “buttons” and menus and then take a lot of pictures of non-critical things. After you have conquered your “apprehensions” the practice will lead to expertise!

## ***PROCESSING THE SCENE***

### ***PHOTOGRAPHING THE SCENE (continued)***

#### ***ISO? PIXELS?***

Color negative film has disappeared from the world of photography except for very specialized segments of industry. Instead of the fixed ISO sensitivity inherent in emulsion film, digital cameras are capable of various sensitivities programmable by the user. Resolution and size of the detector have replaced concerns over the sensitivity of film and the “graininess” of the negative. Decisions regarding resolution and “how many pixels” are enough, must take into account the manner in which the photo will be used or viewed. Photos that document evidence that is no longer available (such as a latent print that could not be lifted) should capture all the details needed for forensic comparison. However, high resolution images viewed in court are limited by the ability of the projector to display all the information captured by a high resolution camera.

In either instance, follow the simple rules of good photography and you will capture excellent photographs with any digital camera above 5 megapixels.

- 1) Take photographs that fully represent the scene (overview, approach and close-up). Don't forget the ceilings and floors.
- 2) Use balanced lighting to avoid under or over exposed areas of the field of view. Indoors, try “bounce flash” off of the ceiling to avoid bright spots. Outdoors consider forced flash to remove shadows.
- 3) Include a scale or an object of known size to provide the subject matter a sense of size and dimension.
- 4) Fill the field of view with the subject of a close-up photo.
- 5) Be sure to include number stands in at least the approach and close up photos.
- 6) Consider attaching colored “Post-it” sheets to the top of number stands to help show the distribution of specific types of evidence throughout the scene. (Various calibers, each a different color).

#### ***PHOTO LOGS***

Photo logs have historically been used by some agencies to track camera settings or to manually list the sequence of photos to make it easier for the detective to locate desired images. Given the ease of viewing for most scene digital photos and the built-in record maintained by the digital camera, the need of the photo log is reduced.

Every photograph taken with a digital camera has a companion file that includes virtually every setting, time and (with some cameras) even the latitude and longitude of the camera! With modern digital cameras available today, the photographer may not know the specific settings which were used, but the camera's computer automatically tracks all this information.

## ***PROCESSING THE SCENE***

### ***PHOTOGRAPHING THE SCENE (continued)***

#### ***VIDEO AT THE SCENE***

Video cameras have advantages over still photographs in that they provide a continuous progression of images which convey to the viewer time and spatial relationships of the subject. Still photos must be used to augment motion pictures or video to record fine details and provide court displays. Never rely upon the video recording alone. However, with the increasing resolution of high definition video cameras, frame-grab software may soon be able to deliver court useable images comparable to those from a camera designed for still photography.

#### ***VIDEO CAMERAS***

Digital video cameras with “stabilization” and even infra-red or low level light capabilities are now prevalent in the market place for under \$1,000. These through-the-lens viewing, low-level lighting abilities and close-up macro lenses make the video camera as easy to use as the still camera. They have the advantage of usually including an adjustable angle playback screen complete with sound. An adjustable focal length lens enables the photographer to take overview, approach and close-up pictures with continuity, thereby documenting the scene in a manner augmenting not replacing still photography. The trick is to slowly scan the area and not move the camera too rapidly from one view to another. Give the viewer time to recognize the objects of interest.

There are some who use video to first take a broad overview of the scene with a normal to wide angle lens setting, then zoom in closer to the object(s) of interest and then frame a close up of the evidence item. Excessive “zooming in and out” can distract the viewer from the subject matter. Caution should be exercised to always include within each frame or view, a recognizable landmark to aid the viewer in mentally picturing where the object is in relationship to other items within the crime scene. Pre-planning the progression of the video will greatly enhance the clarity of the overall production.

Other scene investigators may use video only to generate an overview of the scene. They leave the full documentation of the scene to the still camera and a series of approach, overview and close up images. This investigator uses the video to create a brief walk-through “orientation” of the entire crime scene from the “overview” perspective. This video should be short enough to retain the attention of the viewer and informative enough to quickly provide a sense of the scene and the crime to other investigators or administrative staff.

## ***PROCESSING THE SCENE***

### ***PHOTOGRAPHING THE SCENE (continued)***

#### ***NIGHT VIDEO AT THE SCENE***

Video at night still has problems for the crime scene investigator. Some will settle for the small camera mounted light to illuminate their scene. Other investigators will bring in a powerful flood light and generator to brighten the scene. Each of these creates "hot spots" against black backdrops. There may even be distracting movement in each scene as the camera mounted light throws shadows against the lighter backgrounds. For these reasons, it is best to wait until daylight to video. The alternative is to bring in at least two powerful flood lamps plus the camera mounted auxiliary source to provide a bright background without shadows. Be careful to avoid moving the field of view into the darker edges of lighting where color and details will fade.

#### ***VIDEO AND SOUND***

Whatever dialogue or background noise occurs while the video is running will be recorded unless the microphone has been turned off. It is suggested that no sound be recorded while at the scene. If narration is desired, the original video should be copied and to that copy, sound can be added in a sound-free room and read from a prepared script. Wind and traffic noise or the "fish story" offered by an unknowing bystander are thereby eliminated from the video recording.

#### ***REMEMBER***

Prior to video recording a crime scene, it is suggested that the evidence investigator prepare a rough list of key objects to be included in either the orientation video, or in the more thorough documentation video. This will give the photographer an awareness of the investigator's needs as well as the scene. The result will be a more thorough and professional appearing product.

If any narration is added to the tape at the scene, it should be brief and factual. If used, it is suggested that the narration be used to lead or prepare the viewer for the next view they will see, rather than describe a self explanatory image in view at the time. For example, a view of a vehicle license plate does not need a narrator reading the plate number!



## *PROCESSING THE SCENE*

### *CASTING OF IMPRESSIONS*

Of the methods of recording available to the investigator, only casting can capture three-dimensional surfaces with the detail needed for analysis. As an additional benefit, trace evidence may adhere to the surface of the casting material. In this respect, casting often collects evidence which would otherwise go unpreserved -- soil on the plaster cast of the footprint or metal adhering to the "plastic" cast of a toolmark.

#### *CASTING MATERIALS*

The methods of casting are very simple and require only a little practice and a few "tricks of the trade" to make them efficient for use at any scene.

The most frequently used materials for casting fall into two categories:

- 1) Those which require the addition of water to plaster-like substances such as PLASTER OF PARIS, DUROC and the like.
- 2) Synthetic materials such as MIKROSIL which harden with the addition of a catalyst.

#### *PLASTER CASTING*

Most plaster of Paris casts are capable of providing an excellent three-dimensional record of tire or shoe-track evidence when properly mixed with water. In addition, this process also retains a sample of the soil which can be used as a standard for comparison with residues found on the suspected shoe.

#### *GETTING READY*

Before mixing the plaster, some supplies should be acquired. For example, to pour a footprint, five pounds of plaster (from a local hardware store will do) and a two-pound coffee can are needed. To reinforce the cast, twigs, sticks or coffee stir-sticks should be located. Water, stored in a plastic one gallon milk container or obtained at the scene, will be needed to mix 5 pounds of plaster. A sheet of paper should be placed on top of the officer's clipboard. This paper will form a palette which will diffuse the stream of plaster as it is poured from the can, down the clipboard, and into the imprint.

## *PROCESSING THE SCENE*

### *CASTING*

#### *PREPARING THE IMPRINT*

The soil around the edges of the imprint should be mounded up slightly to contain the poured plaster. This is usually unnecessary, since the plaster will naturally thicken and seek its own perimeter. Frames are helpful on steep terrain when the earth cannot be built up on the down-hill side. Avoid creating an edge higher than two inches, since it will interfere with the pouring process. Photograph the imprint from directly above with scale and oblique lighting from several angles before casting. Block direct sunlight with an umbrella and find the best light angle with a flashlight... the substitute your flash or reflector in that best angle position at about three feet from the imprint. Closer flash may “wash-out” details in the photograph.

#### *MIXING PLASTER*

To prepare the plaster mix, a two-pound coffee container should be filled with three inches of water and the plaster added as rapidly as necessary so long as lumps of unmixed plaster are not introduced. Avoid lumps or bubbles. As the mix reaches the consistency of pancake batter, the side of the can may be tapped to free bubbles which might obscure details in the cast. These materials should be mixed very near the imprint site. A mix too thick will harden quickly, often in the container! For those who do not want to get their hands soiled, place the plaster into a plastic bag and add water mixing by manipulation from the outside of the bag. Some commercial forensic casting materials are pre-packaged in plastic bags for convenience of the user. Such kits are not required in order to create a cast suitable for forensic examination and comparison.

#### *POURING*

Regardless if the casting mix is from a “commercial kit” or improvised from the local hardware store, the casting material **should not be poured directly** onto the impression. A palette should be created using a clip board or piece of cardboard. It should be placed about two inches above the imprint and tipped to a shallow angle. The plaster is then poured onto the top of the palette to provide a uniform cascade slowly flowing into the imprint. As the plaster flows, the palette should be drawn down the length of the imprint avoiding any irregularities or waves in the plaster. Once the first pour is firm, twigs should be laid onto its surface to serve as reinforcement for the plaster. A second batch of plaster should then be prepared. This second batch can be hastily mixed without regard for bubbles in the mixture, then directly poured onto the first hardening layer to provide the cast added strength. A typical footprint cast will consume 4 pounds of plaster, a quart of water and 20 minutes of time.

## *PROCESSING THE SCENE*

### *CASTING*

#### *SNOW, WATER & DUST*

By using the previously outlined process, it is possible to collect casts from dust, from underwater (although quality will be poor), and from snow (with excellent results by first applying a specialty product called "Snowprint"). Prints in a puddle of water require that the water be drained away prior to adding the plaster mix. A more useable cast will be obtained if the water is first drained off the imprint and then the casting material poured into the soil. Rarely do casts poured under water have sufficient detail to identify the type of shoe or tire responsible for making the original impression. If at all possible, drain water away from the imprint.

#### *SYNTHETIC CASTS*

Many plastic materials can be used for the collection of impression evidence having very fine microscopic details. These materials range from waxes and dental casting products to special mixes designed just for this purpose. In this case, the specialty products are the easiest to use and give the best results. Several colors are available such as white, grey, red, brown and black.

These simple catalytic materials are inexpensive, yet capable of recording fine micro-stria in toolmarks, contact striations such as vehicle collisions, bitemarks or even fingerprints.

The instructions for use are straightforward:

A small amount of the base material is placed on a card, and the catalyst is added according to manufactures directions. It is thoroughly mixed. The amount of catalyst controls the rate of cast set and the thoroughness of mixing determines the uniformity of the casting material. For toolmarks and bitemarks, a small amount of the casting medium should be rubbed into the surface of the mark to eliminate air pockets. The cast may then be built up with more material and allowed to set for five minutes. The direction of the mark should be clearly indicated and the cast labeled.

With tool marks the catalytic casting material is aggressively rubbed into the impression in order to make contact with the three dimensional mark and to remove any air pockets that may form as the material is pressed into the impression. Conversely, when applied to powdered fingerprints, the catalytic material must be gently rolled onto the surface, being careful not to obliterate the fragile impression.

## *PROCESSING THE SCENE*

### *CASTING*

These synthetic products may be used to lift fingerprints from irregular surfaces such as wood, textured or curved surfaces and difficult to reach locations such as exterior car door handles. It is important to stress that these materials do not develop print images, rather they simply lift those already developed with materials such as magna-powder or conventional powders. Once the print is developed, the "Mikrosil-like" material should be gently rolled over the print, allowed to set and then lifted. The latent print will then be quite durable. In addition, prints collected in this manner will be complete and free of extraneous textured inclusions. These casting materials can also be used to lift "powder developed" prints from curved surfaces such as concave door knobs. Prints have even been collected from dry rocks previously worn smooth in a river.

### *OTHER USES*

The lifts collected when using a casting material will be a mirror-image of the standard tape lifts; therefore, the method of collection should be clearly noted for the benefit of the latent comparison expert. Extra caution should be exercised when comparing the "lift" to the subject cards to prevent mirror-image disorientation. Photography of the imprint can be used to reverse the lift and return the image to a normal orientation.

### *CAUTION!*

As with all other imprint evidence, the impression should be photographed by using oblique lighting cast from several points of the compass and with a close-up lens before any attempt to cast it. A ruler must be included in the picture to provide a scale for later comparison purposes. Without a scale, the photograph loses most of its value as identifying evidence. The ruler should run the long axis of the impression so the lab can accurately print a 1:1 scale enlargement from the officer's negatives. Do not remove debris which is trapped in the imprint (such as roots in a soil imprint or paint flakes in a tool mark). The effort to "clean" the impression may well destroy the fragile details in the impressed material. It is best to leave anything adhering to the imprint and merely apply the casting material over it.

### *REMEMBER*

## ***PROCESSING THE SCENE***

### ***COLLECTING THE EVIDENCE***

The techniques of collecting evidence are as varied as the forms of evidence are varied but usually require only the most common devices. Investigators can collect evidence at most crime scenes if they use imagination, resourcefulness and little else but a first-aid kit, note pad, pen knife and paper bags.

### ***CHAIN OF POSSESSION***

Whatever the devices used to collect evidence; the legality of its seizure or the adequacy of the container it is placed into, EVERY item of evidence must have a chain of possession from the point of its origin to its last point of value as evidence. This chain is only effective in protecting evidence if the evidence container is sealed at the crime scene

### ***REMEMBER***

A chain of evidence requires that:

- 1) The item be securely sealed to prevent addition or loss of contents.
- 2) The method of sealing should be such that any entry into the package would be obvious to the next examiner and ultimately the courts.
- 3) The container has sufficient labeling and identification to associate it to its case specific chain of possession.
- 4) There be a specific chain of possession for each item in order to track where the item has been and who has had control of it.
- 5) The above criteria being met must be clearly documented and demonstrable in court.

### ***SEALING***

Evidence should be evaluated on scene, initially processed (see page 70), then collected and packaged in a sealed container. The seals applied to protect evidence from accidental contamination or loss will also insure the integrity of the chain of evidence. The officer's initials or other identifier across the tape makes intrusion into the package more visible and supports the chain of possession for court.

If the evidence is to be submitted to a crime laboratory, the investigator should be aware that most will require that every package of evidence be sealed with evidence tape and bear the agency name, case number, officer's name and date of collection. These are not all court requirements, rather ones which stem from the crime labs accreditation process.

## ***PROCESSING THE SCENE***

### ***THE PACKAGE AS EVIDENCE***

#### ***LABELING***

The identifying information which appears on the sealed container is important to the chain of evidence. Each package should clearly bear the agency name, case number, item number, and a "key-word" identifier for the contents. There should also be the name or initials of the officer who collected the item, as well as a chain of possession to establish the route which the package has taken. Tags stapled to the container are not suitable for identification; they become loose, causing unidentified containers and confusion. It is suggested that the labeling information be placed directly onto the evidence container.

The use of a property sheet which correlates the item description, location at the scene and item number is part of the chain process. This property sheet may also indicate who collected the item and when that occurred. Some agencies combine computer bar code tracking with manual signatures. There are hundreds of alternative forms and methods used to maintain the signatures, locations and times required for a chain of custody. Most strive to meet the needs of the courts and of property management. Often, the simpler the process, the easier it is to insure compliance.

#### ***COLLECTION GUIDELINES***

When applying the contents of the crime scene kit to the evidence at the scene there are a few critical collection steps for the officer to remember:

- 1) A container should be selected which will secure and preserve all the information which is in the evidence. Though often a seemingly simple task, the importance of this step is frequently overlooked. Remember, the convenient availability of a package does not necessarily make it the most appropriate one to use.
- 2) Evidence may have components which should be subsamped and packaged separately to better protect them. For example, a wine bottle which contains gasoline and the fingerprints of the suspect should have the fluid removed to an airtight container and the dried bottle kept in a separate box. Gasoline may otherwise dissolve the fingerprints.
- 3) Every effort should be made to minimize evidence alteration during collection. Large or small items must be handled with extreme caution. Each time an item is collected, the question must be asked: "How can this be collected in order to preserve all of its value as evidence; all of the clues it holds to the reconstruction of the crime." Great care must be given to prevent contamination from other items.

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

3) Every effort should be made to minimize evidence alteration during collection. Large or small items must be handled with extreme caution. Each time an item is collected, the question must be asked: "How can this be collected in order to preserve all of its value as evidence; all of the clues it holds to the reconstruction of the crime." Great care must be given to prevent contamination from another object at the scene.

4) As much as is practical should be collected from important items, remembering that there is no need to submit unnecessary bulk. Whenever possible collect the entire object, however, if it creates a transportation and storage problem, sub-sample it. Sub-sampling evidence requires a thoughtful evaluation of the larger item and its importance to the investigation. Don't just collect the object and hope that someone else will decide what is important.

5) The effects of the surface upon which the evidence was found must be considered. Background control samples should be collected to eliminate false results from the background surface. Contamination may be present that could affect blood grouping, chemical analysis, or add trace evidence which could confuse the results of laboratory analysis. A non-reactive control helps validate evidence test results.

6) The investigator must collect standards of known materials for comparison purpose. For example, hair from the deceased victim to compare with trace evidence found on the suspect's clothes; soil from the yard to compare with the suspect's shoes, or blood from the victim to compare with that found throughout the crime scene.

### *HOW IS IT ATTACHED?*

With these essential evidence concepts described, let's consider the four ways items may be attached to each other and then deal with specific problem areas.

1) Freestanding. As an isolated or non-attached entity not bound to other items, such as a bullet on a floor.

2) Adhering. As an item loosely held by mechanical or electrostatic force, such as transfer fibers on a garment or soil on shoes.

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

#### *HOW IS IT ATTACHED? (Continued)*

3) Bonded. As samples which have been placed into intimate surface contact either by absorption, force, or by chemical means such as drying. For example, paint on the bumper of a car or blood soaked into the pores of a concrete walkway meet this definition.

4) Integral. As portions of a large object which may not convey any meaning as evidence in itself. For example, an entire wall need not be removed to collect a bullet hole; just the nearby area will suffice.

#### *FREE-STANDING EVIDENCE*

For free-standing items such as a firearm, cartridge case or knife, the process of collection is straightforward, requiring only that attention be given to documentation, evaluation on scene, packaging, minimizing possible contamination; and properly packaging the item to protect it from tampering. No special mechanical devices or techniques are necessary. Because it is so easy to gather, almost anyone can (and does) pick up this type of evidence at a scene. Unless these items are fully evaluated for "clues" at the scene, the result is contaminated and improperly packaged evidence lacking proper documentation. The officer should avoid the hasty "tag and bag" approach and consider the value of every item collected.

#### *ADHERING EVIDENCE*

Adhering evidence, such as hair found on carpeting or plant debris in the trunk of a car, is loosely attached to the object upon which it rests. Only very light mechanical force is typically necessary to dislodge the object from the host surface. Frequently, adhering evidence is some type of trace evidence and may well be very small in size. This stability of this form of evidence should be carefully evaluated for the proper course of action.

In some instances, it may be best not to remove the evidence but leave it adhering and collect the entire object. This decision requires protection from disturbance after collection. Wrapping or layering an item in clean newsprint or butcher paper is critical and will minimize adhering evidence migrating to other areas on the host item.



## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

Because adhering evidence is easily separated from its host, the usual process is to evaluate carefully at scene and while on scene to intentionally remove it and package separately. Devices such as tweezers, adhesive tape, or even the use of gloved fingers are used collect the material. This small evidence should be protected by a container such as a "drug bindle" made of note paper or put into a small pill box. The numbering used from this separate package can follow the pattern of "parent-child". E.g. when the host item is labeled as "Item 1", the subsample package would be labeled as "Item 1a".

**Documentation** of the location of adhering evidence is critical to interpreting it in light of the investigation; therefore, it must be as **specific as possible**. E.g., hair near left sleeve cuff button" is preferred to "hair on shirt". The position may change in shipping thereby changing its interpretation as evidence. For example, a hair at the bloody end of a crowbar may have greater significance than hair on the opposite end (the association of the victim's blood, hair and injury to the shape of the tool).

### *BONDED EVIDENCE*

Evidence that is bonded into the material of a host surface (blood into a drapery) presents the problem of removing what you want from the underlying layers and minimizing the hosts effects upon lab testing. Because of this background control samples should be collected, clearly labeled and made available when requested by the crime lab. Bonding created by force (paint on a bumper) usually requires scraping the item into a paper bindle or small metal tin; however, the shape of the evidence will be lost. Alternatively, soaking the sample onto a damp swab may prove the best method (as with biological materials on an item of evidence. Documentation should include photographs and sketches to record details of shape and relationship to the substructure on which the evidence is fixed.

### *INTEGRAL EVIDENCE*

Integral evidence presents the problem of either removing an area of interest from a larger item or deciding to collect the entire object intact. Cutting tools ranging from razor blades to circular saws are used as needed to remove evidence which is an integral portion of a much larger surface. (E.g. tool marks on doorjamb and bullet holes in walls).

As with all forms of evidence, photographs should be taken before and after the removal of the evidence to establish the orientation of the removed portion.

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

#### *THE TOOLS FOR COLLECTION*

There are many devices available to the crime scene investigator. Police supply vendors are more than anxious to create a product line which will become popular in law enforcement agencies. However, most of the tools for evidence collection can be found at a hardware store, supermarket and/or pharmacy.

#### *THE CRIME SCENE KIT*

Though the kit may be large or small, there are certain items to be included:

- 1) Personal safety gear: gloves (both surgical and work type), particle mask, anti-putrefaction mask, eye protection, coveralls and footwear protection.
- 2) Basic fingerprinting materials (fiberglass brush, Magna brush, black or bi-chromatic powders, 3x5 white cards, lift tape and Mikrosil).
- 3) Eyedroppers, cotton swabs, filter papers, blood collection kit or lab acceptable swabs for DNA collection, dissection kit (scalpel, tweezers, etc.), magnifying lens, distilled water and toothpicks.
- 4) Small hand tools such as needle-nose pliers, pocket knife and scissors.
- 5) Impression casting supplies such as "Plaster of Paris" and Mikrosil.
- 6) Shovels, hammer, chisel, saws, etc. (Depending on the case).
- 7) Recording materials: camera, flash, digital storage media, batteries, tripod, sketch pad, drawing supplies, video recording device.
- 8) General items such as number stands, 3x5 cards, "Post it" adhesive pads in various colors.
- 9) Packaging devices: paper bags of assorted sizes, coin envelopes, paper to make a drug fold bundle, plastic vials, labels, tape, stapler, pens, and waterproof markers.
- 10) Measuring equipment: thirty-, fifty-, one hundred-foot tapes, small hand level, ruler, string. If available, laser measuring device is very handy at the scene and may improve overall efficiency while limiting possible contamination from the conventional tapes. A "total station" or laser mapping device with computer interface is often helpful, sometimes a requirement due to complexity and extent of the scene.

A kit may occupy a briefcase, the trunk of a car, a van or even a mobile home. In most instances, the appearance of the kit is secondary to who will use it and how it will be used! **The most important item to be sure to place into the kit is the resourcefulness and intelligence of the investigator.**

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

*EVALUATE!  
NOT "TAG AND BAG"*

Some scene investigators consider that scene processing consists of taking photographs and measurements, creating sketches, packaging evidence and perhaps some effort to locate impression evidence (fingerprints). To some, evidence collection becomes a repetitive process of almost ritualistic "tag and bag" for each item. However, this may overlook much of the information that can be learned from each item while at the crime scene. This "tag and bag" mentality can lead to lost information relative to the commission of the crime. The antidote for "tag and bag" syndrome can be countered by the concerted effort of figuring out what happened during the commission of the crime. That is the goal of scene investigation... and often rewarding to the investigation.

The investigator, before handling an item, should apply the following steps to every type of evidence. They will reveal subtle clues otherwise missed.

- 1) How did the item get there? What happened before? After?
- 2) Carefully observe the item. Is there something added or removed? Consider functional condition and temporal information (hot/cold, wet/dry, etc.). Does the item provide information about "position, action, direction, duration, sequence, origin? How does it fit with other items in the tentative story of the crime?
- 3) Does the items position in the scene and relationship to other items or location within the scene communicate valuable information?
- 4) Does the orientation of the object and things on it provide any investigative information? For all of the above, document with detail sketching, macro photography or notes to preserve long term.
- 5) Consider what forensic testing is applicable to the item?
- 6) What forensic testing should be done to the item on scene? If there is more than one process that can be performed, then in what order? (E.g. swabbing, preliminary screening, fingerprinting?)
- 7) Should small items adhering to an object be removed from it prior to packaging on scene or left on to suffer the hazards of transport?
- 8) How should the item be collected, packaged, transported and stored to preserve it full evidence content and forensic testing?
- 9) Are there references or controls that should be collected that will help in the forensic testing that may later be conducted?
- 10) Is there an absence of evidence that can be useful as evidence?

The above is not a check list, rather a guide to help you extract the most information from every item within a crime scene and discover the true story.

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

#### *COLLECTION PROBLEMS*

There are four areas in which it is necessary to offer specific collection suggestions. Additional guidelines are offered in the "Addendum" at the rear of this text. The areas for immediate discussion include:

- 1) Trace Evidence
- 2) Human Biological Evidence
- 3) Firearms Discharge Residues
- 4) Fingerprints

#### *TRACE EVIDENCE*

Trace evidence is significant in its ability to eliminate a potential origin or to refute a possible crime scene reconstruction. Conversely, it is infrequent that the laboratory can conclusively identify the specific origin of an item of trace evidence. The chance for success, either as an elimination or identification, exists only if adequate comparison standards are collected from any of the suspected sources. Comparison standards may show that a piece of trace evidence is not "native" to a particular place, or may point to a possible area from which the trace evidence originated.

When an item of trace evidence is analyzed in the lab, results of chemical testing really don't provide the kind of specific "signature" information that firearms, fingerprint or DNA analyses do. Trace evidence will typically result in a report of the general chemical nature of the item, the type of material it is or a possible origin. From this information, the investigator may develop an idea as to the area from which the material may have originated.

#### *CONTROL STANDARDS*

Tests performed on the trace evidence are also conducted on the control standards, and the range of test results compared to determine whether they came from similar or different origins. These variations are plotted over the surfaces of the source in question to determine if they are the same as the evidence item tested. **The lab results, therefore, are only as successful as the collection of standards is thorough.** The on-scene investigator is the only person who can evaluate the location and take steps to acquire the range of standards of known origin. This is true with all forms of trace be it soil, glass, paint, vegetation, hair, fibers or items commonly found around the household, yard or commercial enterprise. Failure to collect standards minimizes the ability of the lab to test the trace evidence and provide results of value to the investigation.

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

### *TRACE STANDARDS*

The standard collection process requires the investigator to obtain a range of samples as standards to enable thorough mapping of variations in the likely origin of the evidence item. This does not mean that dozens of standards must be collected. It is most efficient if the samples are collected from likely points of contact or origin and then from the surrounding areas in order to gain more information about the variations likely to be expected. The investigator should be careful when collecting standards not to mix or contaminate them. It is imperative that the different standards be packaged separately and that the specific location from which they were collected be documented.

Examples of trace evidence include:

- a) Glass
- b) Soil
- c) Paint
- d) Human hair
- e) Animal hair
- f) Fiber evidence

a) Broken glass chips recovered from a suspect require the officer to collect standards from the suspected origin. For example: from a window. Glass should be removed from the 12, 3, 6 and 9 o'clock positions around the edges of the break to permit the lab to develop a chemical and physical profile of the glass. The above standards should be packaged separately. With a smaller object such as a bottle, as much as possible of the original glass should be collected and packaged in a single container.

b) Soil within a footprint near a crime should be used as a comparison standard to soil on the suspect's shoes, but only after photographs have been taken and casting of the imprint considered. Samples should also be collected from entry and exit paths likely to provide soil to the suspect's shoes. A tablespoon quantity is all that is needed from each area sampled. The standard may be packaged in a "bindle" or other suitable container.

Soil samples generally collected from the scene, are best taken from the surface samples by simply scooping with a spoon. Minimal samples include the likely point of entrance, exit and near the center of activity for the crime. These three samples will indicate the variations in the soil. If there is indication that a specific area within the scene was involved, include that as an additional sample.

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

### *TRACE EVIDENCE*

c) Paint smears or transfers should be collected from the points of contact (and labeled as "transfer paint") and from an area very close to the transfer smear, but not touching it (and labeled as standard color "X"). Without adequate paint standards, it is likely that the lab will be unable to fully characterize the paint evidence submitted to them.

It is possible to analyze a transferred paint sample and provide a possible manufacturer; however, few crime labs continue to perform this service...Automotive paints are the most frequent types of paints that lead to this type of request for analysis.

At crime scenes involving vehicles, the standards should be collected from the damaged body part as near to the "transfer damage" as possible, but not in the immediate area of the possible contact point. If standards are collected from other body parts, it is possible that the paint may be from a replacement body part or touch-up paint job on previous damage. Analysis of improperly selected standards might falsely eliminate the automobile actually involved in the incident.

d) Particularly in sexual assault cases, the officer must rely upon forensically trained medical staff to collect transferred as well as standard hair samples from the victim. Prior to the collection of standards, the region should be combed or brushed to recover loosely adhering transfer hairs exchanged at the time of contact between the perpetrator and victim. A dozen head hair samples from each of five locations must be obtained from the front, crown, nape, left and right sides of the suspect's and victim's heads. These may be pulled or cut as close as possible to the scalp, then separately packaged. Pubic hairs should also be collected from the suspect and victim, preferably from each point of the pubic triangle. As it is not possible to identify the source of evidence hair by microscopic examination, it is not necessary to inflict additional discomfort upon a living victim by pulling the standard hairs. Cutting these hairs close to the flesh should be adequate. Some criminalists believe that the roots should be collected for DNA analysis; however, a blood sample would be the better sample for DNA analysis. Loose hairs may contain root structures and enough DNA for analysis.

The sampling of the hair should be performed by medical personnel regardless of the sex of the subject. Non-trained staff may not recognize medical conditions hazardous to the subject as well as the officer.

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

#### *TRACE EVIDENCE (cont.)*

If the assault resulted in contact with facial or other body hairs, or if there was any scratching or wounding which might have captured body hairs, these areas should be sampled, recovering three to six hairs from each area. Each area should be packaged into a separate container and documented as to the location from which it was collected. The time lapsed since the occurrence and the activity of the individuals should be considered when deciding the worth of collecting hair samples. The longer the time, or the possibility of cleansing, the less likely it is that trace evidence transfers will remain.

#### *ANIMAL HAIRS*

e) Animal hairs present special problems because most animals have short as well as long hairs which vary over the entire body of the animal. Hairs should be cut close to the skin of the animal. Twelve to eighteen hairs should be collected from at least four areas of the body to map the variations in the animal's coat. The samples should include the short body hairs and the longer top coat hairs. This form of evidence can lead to the breed of the animal, but not to "identification" of the specific hair source unless DNA is performed by a specialized lab.

#### *FIBERS*

f) Fiber evidence is frequently encountered in violent crimes against persons where contact is made between the victim and the perpetrator. These materials are usually quite small and difficult to locate. If the investigator tries to predict the actions of the perpetrator and the victim and then focuses there, fiber evidence which may otherwise be overlooked may be found.

These very small bits of thread may be removed from the surfaces to which they adhere by means of tweezers, masking tape, or by a special vacuum canister placed at the front nozzle of a conventional vacuum cleaner. Fiber standards may be removed from carpeting, drapery, bedding, and the like by pulling out small bits, by cutting out a portion of the material, or by collecting the complete item. The very small samples should be carefully packaged into a well sealed container to prevent loss or cross contamination from other evidence or from the standards collected at the crime scene. The use of a paper bindle as an initial evidence container is adequate to protect the small items or even the standards. The bindle should be placed into a larger envelope with the administrative information required by the agency.

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

#### *HUMAN BIOLOGICAL MATERIALS*

The investigator should always collect the samples while wearing gloves and avoid any contact or breathing directly over the sample. With the increased sensitivity of DNA analysis, contact with the cells or body fluids of the investigator can easily complicate DNA testing. It is all together possible that the investigator will need to wear a surgical mask especially when collecting or handling evidence with trace or very low levels of DNA. It may even be necessary for the collector of the sample to provide a voluntary DNA reference to insure he/she has not added their cells through handling or breathing on it!

#### *ON CLOTHING*

Human biological stains encountered on clothing will likely be partially air-dried in place at the scene as the investigator processes the scene. When it is decided to collect the partially dry item, it should be wrapped or layered with clean paper, packaged in a paper container (sealed on scene) and stored under refrigeration. The practice of transporting the item “unsealed” in a container and then drying it out in an open environment such as “clothes line”, locker or even a “drying chamber” is an unnecessary step which will expose the item to potential contamination or loss of trace evidence.

#### *DNA SWABS*

If the blood is on a larger surface which will not be collected, then a portion of the stain should be absorbed onto a swab moistened with water to soak up the residue. Caution must be used to prevent the damp swab from contacting the outer packaging since it may literally soak through and contaminate another neighboring package. There are several commercially designed products available to protect the swab, almost all of which are acceptable so long as they provide some degree of air circulation to allow continued drying of the damp swab. If a commercial product is not available, an alternative is to staple the moist swab to a 3x5 fingerprint card rolled into the shape of a tube with the sample protected inside. However protected, each sample must be individually packaged to prevent cross contamination or loss.

#### *BACKGROUND CONTROLS*

If an item is too large to collect or submit for lab analysis, then be sure that a background sample of a neighboring unstained surface is collected and stored separately from the related stained area. This sample can be used as necessary by the lab to verify that the test result from the suspected stain is truly from the stain and not found over the entire surface of the larger host item. If the entire item of evidence will be submitted and the stain is absorbed into it, there is little need for the stained area to be swabbed and no need for a background sample to be collected.



## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

#### *HUMAN BIOLOGICAL MATERIALS KEY PRINCIPLES*

There are five principles to remember for the handling, packaging, and storage of biological materials:

- 1) If the sample is a damp stain, then allow it to dry out at room temperature while packaged and sealed in a paper container. Do not use a fan unless in a special device designed for sample drying! The fan may cause cross contamination of trace evidence on larger objects. The use of commercial drying chambers requires documentation of the cleaning processes before or after each use. If a sealed package is placed into the drying chamber, the possibility of cross contamination is reduced to zero.
- 2) Dry samples should be packaged into a paper container which will allow for the free circulation of air. Once dry, fabric items should be layered with paper to prevent the cross contamination of stains on the same item. For example, a bloody shirt should be folded with clean paper laid between each layer and within the sleeves to prevent the blood stains from transferring from one surface to another.
- 3) For very small samples (fingernails, hair, fibers), collect adequate standards for comparison. All samples must be packaged separately and labeled as to origin.
- 4) If fluid samples are to be retained as such (test tube samples), then they must be maintained under refrigeration. Do not freeze tube of liquid blood as it is likely that the test tube will crack or that the blood sample will itself be compromised.
- 5) Items should be taken to the laboratory as soon as possible or they should be stored at appropriate temperatures. Dried stains should be frozen and fluids in glass containers should be refrigerated.

#### *STANDARDS TO COLLECT*

The laboratory requires standards or "knowns" of the suspect's and victim's genetic profile in order to perform DNA analysis. The easiest sample to collect is by scraping of the interior of the cheek to gather cells onto a stick referred to as a "buccal" swab. These cells are perfect for DNA analysis.

## *PROCESSING THE SCENE*

### *COLLECTING THE EVIDENCE*

#### *HUMAN BIOLOGICAL MATERIALS STANDARDS*

Samples of DNA should be collected from all of the subjects involved in a criminal incident. In property crimes, this may mean it may be necessary to obtain a reference (known) sample from a victim to exclude their DNA from consideration. A sample destined for a database search should be from a likely perpetrator and not the victim.

This should also include those persons who might have legally contributed samples in person crimes. For example, in a sexual assault, samples of any consensual partners DNA should be obtained in order to eliminate their DNA profile from consideration.

#### *POSSIBLE CONTAMINATIONS*

**Blood** standards, when collected from transfused victims, may present a mixture of DNA. As a minimally acceptable alternative in this instance, blood standards may be in the form of tissue samples, bloody garments or from the blood under the body at the crime scene.

A buccal swab obtained from the oral cavity of a sexual assault victim may contain more than the victims DNA and be unacceptable as a standard. This buccal swab scraping of the cheek is not to be confused with the gum line swab that was completed to gather residues of the assailant that may remain in the crevasses within the sexual assault victim's mouth.

#### *SHAPE vs CHEMICAL*

Most forms of biological evidence which have potential for DNA testing have physical characteristics of shape and form as well. For example, bloodstains, fingernails, pieces of flesh, and bones may prove to be of greater value as physical "matches" or general trace evidence rather than through DNA analysis. When collecting these items, consideration should be given to their value beyond DNA and every effort made to protect the item from inadvertent alteration or damage during storage and shipping to the laboratory. Document them thoroughly at scene by photography with a scale. The investigator bears the responsibility of evaluating the evidence at the crime scene; in a sense, actually beginning lab analysis before the evidence is collected.

## *PROCESSING THE SCENE*

### *PACKAGING THE EVIDENCE*

The selection of the wrong type of container can destroy or alter almost every form of evidence encountered. Inadequate packaging combined with improper temperatures of storage can render evidence totally worthless. Attorneys become excited and judges irate at these forms of carelessness. Some simple guidelines will help protect the evidence and the officer.

#### *PACKAGING VOLATILES*

Volatile evidence (gasoline, glue vapors, etc.), must be sealed in air-tight containers. Unused paint cans are one of the best forms of packaging for this purpose, but there are forms of aluminized bags which will do. Coffee cans with plastic lids over foil wrapping are acceptable only as temporary measures if the proper containers are not available. Plastic or rubber lids will soften from exposure to volatile fumes, and the vapor is easily lost. Paper bags, evidence envelopes, and plastic bags will not preserve this type of evidence.

#### *PACKAGING BIOLOGICALS*

Biological evidence must be stored under quite different conditions than volatile items. Moist stains (including blood, urine, and seminal fluid) may be dried at room temperatures prior to packaging. If the stain is on an article of clothing, then the damp garment may be layered with paper to prevent cross contamination and packaged in a paper container. The paper container allows the passage of air to prevent the buildup of moisture. The stain should be stored at freezing temperatures. It may be acceptable, if the investigator's DNA lab approves, to store the biological evidence in paper containers that prevent moisture accumulation or to transport the item(s) to the DNA lab as soon as possible.

If a firearm has a bloody print on it, the weapon should not be frozen. Returning the object to room temperature causes moisture in the air to condense on the cold metal, thereby dissolving the ridge details in the bloody print. The result is that fingerprint evidence which could identify the individual would be lost while trying to save the blood evidence. With an object bearing blood and a bloody print, it is best to sub-sample the blood. After sub-sampling, freeze the blood sub-sample and store the weapon at room temperature.

## *PROCESSING THE SCENE*

### *PACKAGING THE EVIDENCE (continued)*

#### *FLUID SAMPLES*

Fluid biological samples, usually collected as standards from subjects, must include a preservative. Once sealed, they should be stored at refrigerator temperatures, but not frozen. If the medical technician or pathologist uses a lavender-colored or yellow-stopper test tube to collect the sample, it will be properly preserved for most blood grouping purposes. When such tubes are not available, such as at the crime scene or occasionally at autopsies, a gauze pad may be used to soak up a sample and then air-dried. It is not acceptable to simply scoop a sample up from an abdominal pool of blood or from a pool of blood at the scene, and then place it into a plain tube or vial. The wet sample will already be contaminated by airborne bacteria which will deteriorate the sample and threaten the chemistry of the blood.

#### *PACKAGING PLANTS ETC.*

Moist biological materials, including marijuana, should not be stored in air-tight containers such as plastic bags, cans, or jars. Mold may develop and cause severe deterioration of the physical form and even the chemical composition of the item (marijuana "soup"). Store this type of evidence in a "breathing" container such as a paper bag or envelope, and then only after it has had the opportunity to dry. It may be necessary to use one packaging container to initially dry out the material and then to repackage it in a second container once the evidence has completely dried out.

Avoid using any kind of air-sealed package which will retain the moisture inherent in all plant materials.

#### *PACKAGING FIREARMS*

Firearms evidence creates curiosity, leading to inappropriate handling by personnel who should know better. To protect against this, opaque packages are preferable to transparent, plastic bags. What can't be seen won't stimulate curiosity. Weapons should be affixed to a cardboard box with cable ties.

The weapon itself has many parts which relate to the overall, functional condition of the weapon and its most recent sequence of operation. Though the condition of the weapon at the scene can contribute greatly to the reconstruction of the crime, it must be rendered safe prior to its packaging.

The position of the hammer, cylinder, chamber alignment, safety setting, bolt orientation, and the engagement of any magazines or clips should be noted. The position of the cylinder must be marked prior to opening a revolver. Photography captures most of these details. It must be remembered that the

## ***PROCESSING THE SCENE***

### ***PACKAGING THE EVIDENCE (continued)***

### ***PACKAGING FIREARMS (continued)***

trace and biological evidence often on a weapon can easily be lost when the gun is packaged in a paper sack. That same sack may rub against the metal of the weapon, and, in so doing, obliterate the evidence. Consideration should be given as to whether the weapon should be processed for fingerprints, trace and biological at the scene, or packaged and transported for processing.

### ***SAFETY***

Package the weapon in a safe condition with no possibility of discharge. This can be accomplished by placing a "cable tie" through the open port and down the grip of a semi-automatic handgun. For revolvers, placing a Styrofoam coffee cup over the cylinder can retain the cartridges in place and prevent the cylinder from closing. Use a cable tie behind the cup and through the frame to hold the cup in place and the weapon onto the cardboard box.

### ***CARTRIDGES***

Projectiles and casings once recovered should be wrapped in tissue, not cotton. This tissue will protect the critical surfaces from extraneous scratching, yet not contaminate the evidence with cotton fuzz so noticeable under microscopic examination. A container should be selected which will reduce the possibility of mechanical damage to the cartridge casing or projectile. Careful consideration must be given as to whether it is even necessary to remove expended casings from a revolver or leave them in their respective chamber, thereby preserving their relative position within the weapon.

### ***MARKING FIREARMS***

Firearms and projectile evidence should not be directly marked. There are many investigators who parrot the concept of always marking all evidence. This is not acceptable with this type of evidence. Vital information can be found on virtually every location on bullets, from the nose to the base. Casings are just as informative over every surface, including the inside, and should not be marked. However, if absolutely required by administrative order, the only place to mark the casing would be on the inside of the mouth and on the base of the bullet. It is preferable that this evidence be photographed, described in notes, and placed in a sealed, marked container. The officer must resist adding initials or the all-identifying "X" which will alter the evidence and which may restrict laboratory examination.

## ***PROCESSING THE SCENE***

### ***PACKAGING THE EVIDENCE (continued)***

#### ***PACKAGING TRACE***

Trace evidence (hairs, fibers, soil, paint, glass, and the like), does not require specialized containers, only a little imagination on the part of the investigators.

The druggist fold (drug bindle) provides an excellent storage device for most items of trace evidence which are not mechanically fragile. Standards for comparison, as well as the evidence item itself, can be conveniently packaged, sealed, and labeled in this type of improvised container. The location from which the item was collected must be noted, and each item separately packaged, sealed, and identified. A small amount of tape serves to seal the container. The container should be carefully marked to reflect whether the contents are standards for comparison or transferred trace evidence to be examined. If adhesive tape (latent lift tape, lint roller, the sticky edge of "POST IT" notes) or the like are used to collect trace materials, they should be packaged to protect the exposed adhesive surface and the evidence it holds.

#### ***FRAGILE PACKAGING***

In collecting fragile evidence such as headlamp filaments, one must not only consider the effects of storage, but must also anticipate the worst in handling and in transportation problems. The typical packaging devices include boxes lined with tissue paper and metal tins or pill boxes with tissue. Mason jars can also be used to hold and protect fragile items, with the obvious weakness inherent in a glass container. Always consider the extremes of handling to which the items may be exposed.

If the fragile materials are affected by temperature variations, particular care must be given to alerting the laboratory and transporting the materials to them as soon as is possible. For example, a bite from an apple may well have sufficient details to compare with the dentition of a suspect. However, as the apple dries out, or the temperature increases, the apple will lose detail and information. Ultimately, the value of the evidence bite (as well as saliva) will be lost.

## *PROCESSING THE SCENE*

### *COLLECTION OF FIREARM DISCHARGE RESIDUES*

#### *THE BASIC TERMS*

Deposits resulting from a firearm discharge are referred to as firearm discharge residues. These may be loosely grouped as to those which are visible and those which are invisible.

A) Gun powder patterns are usually visible and are durable unless washed or rubbed.

Powder particles

Lead or fouling

Smoke or soot

B) Gunshot residues (GSR) are the invisible components and may dissipate with time or be lost to washing.

Primer residues, lead residues

Each of these forms may be found on hands or other body parts, clothing, or on structural items such as walls and windows.

#### *TO RECONSTRUCT THE CRIME*

The analysis of firearm discharge residues may place the shooter in a given location; infer that the person fired a weapon or even be of value in determining the type of powder or ammunition used in the shooting.

These residues have their most significant meaning in their pattern and distribution. From these patterns the relative position and distance between the weapon and the target can be determined. Heavier residues travel farther and can be useful in distance determinations. Sooting and partially burned powder residues (lighter than powder and lead fragments) prove useful in determining close distances and often the relative position of the weapon to the garments or outstretched arms and hands of the participants.

An investigator may also be concerned whether or not gunshot residues (GSR) are present on a person's hands thereby indicating that the person discharged a firearm. Great caution must be used in interpreting any "GSR" test results as they are not conclusive evidence. This will be discussed later in this section.

## *PROCESSING THE SCENE*

### *COLLECTION OF FIREARM DISCHARGE RESIDUES*

#### *GUN POWDER PATTERNS*

Gun powder patterns are usually visible; however, the powder, lead, and soot are easily lost if washed or subject to rubbing away. For example, the clothing worn by a perpetrator may lose some of this trace debris during his flight from apprehension; or the pattern of a shot fired over the top of a car may fade by the passage of air over the speeding vehicle. In most cases, some of the pattern will remain for analysis. The problem becomes one of its collection and documentation.

#### *PATTERN COLLECTION*

The easiest technique to use in the collection of complete patterns of a firearm discharge is to collect the entire object and package it to prevent loss. The laboratory will then collect the pattern off the host evidence item using an extraction method, and test the resulting sample for reactive components of the powder or projectile residues.

A practical alternative to objects not easily transported to the laboratory is to call the crime lab and ask them to collect the residues "on site". The preferred methods use acetic acid and water, best handled by trained chemists. If the lab is not available, the investigator may use blotter paper or laboratory filter paper moistened with either water, or, preferably, dilute vinegar-water (1 vinegar to 5 water) to "lift" the pattern from a surface. The moistened blotter paper is placed on the suspected surface and allowed to sit for five to ten minutes. The officer should indicate the orientation of the paper in relation to landmark areas in the scene. This paper is then sandwiched between two other dry papers to prevent cross contamination, and, if possible, allowed to air-dry prior to final packaging. It may be rolled into a tube- shape or stored flat for transportation either to the laboratory or to the investigator's agency for testing with sodium rhodizonate or similar chemicals.

If copper jacketing material is encountered, first apply a 1:5 ammonia to water solution prepared as above. Once the paper overlay moistened with that solution is collected, then the vinegar and water solution may be used on a fresh piece of paper.

This form of collection will preserve not only the chemical nature of the residue, but also the pattern associated with the actual discharge of the weapon. The test results can then be used to establish the orientation of the weapon, the direction of the discharge, and the weapon's distance from the target surface.



## *PROCESSING THE SCENE*

### *COLLECTION OF FIREARM DISCHARGE RESIDUES*

#### *PATTERN COLLECTION*

A pattern may also be scattered on several surfaces, which, if moved, would disturb the residues. A discharge pattern from a gun fired through a closed curtain and open window would be altered by opening the curtains and closing the window. If the residues are properly collected and documented, lab analysis may well help to re-establish the original position of these structural items by reconstructing the original pattern. The investigator must be aware that these residues are fragile and easily covered by blood or lost by abrasive actions such as washing or wiping.

If the target surface remains immobile and protected from mechanical damage, the metallic components, soot, and powder can be retained on the item for long periods of time, if due care is exercised in the handling of evidence.

#### *INVISIBLE COMPONENTS*

The term **gunshot residues** refer to the invisible components of firearm discharges. They will have a relatively short lifespan but can be protected by proper and timely evidence collection. Immediate collection at the scene is preferred over transporting the suspect and victim to a nearby "holding facility" to collect the residues.

Before discussing the collection techniques it is important to note that with even the most thorough of methods, it is possible for a negative result to occur even if the subject did fire a weapon. Great caution must be exercised in interpreting these results. Gunshot residues have greatest evidence value when the individual being tested denies being in the vicinity of a firearm discharge and subsequently tests "positive" for gunshot residues. False positives from non-firearm sources can be reduced if the investigator learns as much information as possible from the subject, as to their activities immediately prior to the sampling of their hands. Information as to contaminants from employment, hobbies, materials handled as well as any washing of the subject's hands should be learned during the field interview.

The investigator must remember that these residues may be transferred from the shooter to other surfaces, from surfaces in the scene to the hands of a non-shooter. Results must be very carefully interpreted in light of the case circumstances.

## *PROCESSING THE SCENE*

### *COLLECTION OF FIREARM DISCHARGE RESIDUES*

#### *RESIDUES ON HANDS*

Specific details as to the collection process will vary with the laboratory's analytical abilities; however, their points of similarity are as follows:

#### *COLLECTION BY STICKY DISKS*

The preferred method, "sticky disks," can be utilized on any caliber of ammunition including rim fire .22 caliber. These disks collect the firearm discharge residues on an adhesive service on top of a short cylindrical platform suitable for placement into a Scanning Electron Microscope. The officer, wearing gloves, dabs one of the disks over one of the subject's hands in the same areas as described for the "swab technique." The process is then repeated with the other hand using the second disk. As with the swabs, commercial kits are available. The officer should check with the laboratory as to its preference.

#### *NOTE*

During the early 90's many forensic laboratories ceased the analysis of gunshot residues for a variety of reasons. It may be difficult for the officer to locate a government laboratory which will test the kits collected. The officer may have to resort to private laboratory testing with the accompanying costs.

#### *REMEMBER*

The methods of collecting gunshot residues from hands have several common elements for their successful completion:

- 1) The movements of the subject must be restricted to avoid loss of residues.
- 2) The officer must use gloves to avoid contaminating the subject's hands with his own hands.
- 3) The samples must be collected as soon as possible.
- 4) Background information about the subject's activities prior to the collection must be obtained.
- 5) Samples of both hands must be collected.

## *PROCESSING THE SCENE*

### *COLLECTION OF FIREARM DISCHARGE RESIDUES*

6) Once the decision is made to collect the residues, all subjects at the scene, whether living or dead, suspected of discharging a weapon should be sampled.

7) In the event of a possible suicide, the investigator should carefully evaluate the need to collect samples. If a firearm is present in the immediate vicinity of the subject's hands, or if the room is small, it is likely that the hands and most other nearby surfaces will accumulate enough residues to give a positive result, even if someone else fired the weapon.

#### *REMEMBER*

It is essential that the interpretive value and limitation of these residues be recognized. In those cases where the investigator believes the collection is warranted, they must be properly collected as soon as they are found.

#### *A CASE EXAMPLE*

Consider the case of a suspected suicide, with the gun at the victim's side. Residue analysis of the hands will be of little use since the gunpowder and residues left in the air at the time of discharge will eventually settle onto the victim and his/her hands. In either a suicide or homicide made to look like a suicide, the test results will be positive to some degree on the exposed areas of the hands. The gunshot residue tests will merely indicate that the subject was in the vicinity of a firearm discharge; a conclusion readily drawn at the scene without testing.

#### *RELEVANT SAMPLES TO COLLECT*

Far more relevant to the case is the sampling of the hands of suspects claiming to have not fired a gun. A positive test on the hands of those subjects can provide investigative leads which may not be available to the officer by any other source. For that reason, the subjects' statements as to their activities immediately prior to the sampling must be obtained to eliminate any false positive results.

#### *REMEMBER*

GSR residues may be transferred from one person to another or from an object to a person handling that object. Use great caution when interpreting laboratory test results.

## *PROCESSING THE SCENE*

### *COLLECTION OF FINGERPRINT AT THE SCENE*

Many techniques are available to develop the two fundamental forms of fingerprint evidence:

- 1) Latents are invisible deposits of oil, salt, water, protein, carbohydrates, and contaminants deposited onto a surface from the fingertips and palms of the hand;
- 2) Patents are visible patterns deposited onto a surface or impressed into an object. For example, these may be in grease, oil, soft surfaces or even in butter.

Methods used for developing latent prints react mechanically or chemically to the various oils and components within body secretions. Some of these processes also react with extraneous debris (such as greases and oils) accumulated on the fingers and then deposited onto evidence. Techniques which, on the other hand, capture patent imprints usually record the existing surface texture to capture the visible details of the print. It is suggested that photography precede the collection of any fingerprint evidence, especially on surfaces which may be difficult to mechanically or chemically process. Specifics of the various techniques follow.

### *LATENT PRINTS*

Though lasers, chemistry and high technology devices can all be used to develop fingerprints, it is unlikely that many agencies will have access to these complicated and costly methods for use at crime scenes. Some of the chemical forms of development do not lend themselves to field application because of the hazards associated with them. This need not be thought of as a drawback, provided the officer processes a scene or evidence promptly while fingerprints relative to the crime are fresh.

The investigator who responds to the crime soon after its occurrence can take advantage of the fresh oils and moisture present in recently deposited fingerprints. Almost all fingerprints will be detected by conventional methods using powders on fresh prints. Therefore, mechanical and chemical procedures will be emphasized which have realistic daily application.

## *PROCESSING THE SCENE*

### *COLLECTION OF FINGERPRINT AT THE SCENE*

#### *MECHANICAL METHODS*

Mechanical methods used in the field to develop latent imprints typically utilize powders applied with a brush. White, green, dragons blood, gold, silver and orange powders were once common in the fingerprint kit. Today there is no need for these out-dated colored powders to be used at the crime scene. Originally intended to improve the contrast and visibility of the latent print, these powders have since been replaced by improved lighting devices and alternative processing techniques. Today, all that is necessary is a fine black powder. If available, a mixture of black and silver (commercially referred to as "bi-chromatic powder") can often be useful and may be substituted for, or augment the use of black powder.

Orange and green colored powders may be found in a modern kit for the purpose of luminescing under special lighting conditions to enhance the details of a faint fingerprint. This requires the use of a special light source to excite the powders to luminescence and a filter to view the light given off. These powders will be clearly marked as being luminescent chemicals. The collection of prints visualized by these powders requires photography using a similarly colored filter over the lens.

#### *IMPROVING CONTRAST*

Those who select silver powders on dark surfaces to "increase contrast" should consider the use of oblique illumination and/or bichromatic powders as a reasonable and convenient alternative. The use of silver powders should be avoided as they are somewhat "oily" and are difficult to apply. One should also consider the disadvantage during the comparison phase of examination after the lift has been processed. Silver-powdered prints would usually be lifted onto dark-colored cards. These lifts are compared with the usual black ink on a white background. Eye strain and confusion become problems for the examiner which can be easily avoided with the black or bi-colored powders onto white cards. In the event the investigator is processing a dark object and has only black powders, a flashlight held at a shallow angle to the surface being "dusted" will make the developed prints more visible and speed the processing.

## *PROCESSING THE SCENE*

### *COLLECTION OF FINGERPRINT AT THE SCENE*

#### *BRUSHES*

Conventional development powders are applied with fiber or hair brushes or the rarely used feather duster. One of the best and simplest devices to use is a fiberglass brush with individual fibers which allow even application of the powders. The brush is moved in a gentle "painting" motion without unnecessary swirling or spinning of the brush. Very light contact with the surface to be fingerprinted will provide the best results. The bristles of the brush should be uniform and without errant strands which will drag across the dusted print and damage details.

#### *CAUTION!*

The investigator should avoid using a fingerprint brush which has accumulated oils (small beads in the jar?) or other debris from evidence surfaces. These contaminants can make the use of the brush increasingly difficult and ultimately render the brush useless.

NOTE: The use of black fingerprint powders has been shown not to interfere with DNA testing; caution should be exercised to keep the brush out of DNA containing materials. Disposable brushes are available when there is a concern of migrating DNA from one surface to another as with "trace levels" of DNA where visible biological materials are not present.

#### *LIFT TAPES*

There are many types and sizes of devices used to lift fingerprints developed with powder. Almost all are some form of adhesive tape which is applied to the print in order to pick up the adhering powder pattern. Of all of the "lift tape" products available, the most frequently used is the simple roll of clear or frosted tape, usually measuring one to two inches in width. Stiff rectangular pieces of clear Mylar with adhesive on one face are called "lifters." The more flexible "rubber lifters" are intended for curved surfaces where rigid tapes wrinkle and obscure the fingerprint. Though personal experience will eventually dictate which types of "lifters" each person uses, the simple roll of frosted tape will satisfy almost every need to lift the powdered print.

The use of synthetic casting materials to lift prints has been in use for over 30 years (as of this printing). These materials (such as Mikrosil) have replaced the need for many of the specialized lifting tapes designed to collect developed prints from curved, textured or otherwise difficult surfaces. These products should be a standard component of the fingerprint kit.

## *PROCESSING THE SCENE*

### *COLLECTION OF FINGERPRINT AT THE SCENE*

#### *MAGNETIC POWDERS*

An alternative mechanical method, and one which should always be available, is magnetic powder and its applicators. These react in much the same manner as do conventional powders but do not suffer from mechanical wiping of the print by the brush. The powders are held to the special wand-like applicator by a small magnetic field and are captured on the print by the light adhesive action of the oils in the latent impression. Cleanup of excess powder is as simple as bringing the applicator close to the spilled powders and allowing the magnetic field to capture the powder.

#### *LIKELY SURFACES*

It is often suggested that prints suitable for powder development exist only on hard, non-porous surfaces such as doorknobs, guns, automobiles, and the like. This is simply not true. Fresh fingerprints may be developed on porous surfaces such as paper or rough surfaces such as rocks and even plant material, depending upon the degree of absorption and diffusion caused by the surface. Often, magnetic powders are more effective on such surfaces.. However, older prints which have had the opportunity to soak into the porous surfaces, or in which the oils have been able to dry, will not develop with magnetic powders. In these situations chemical processing must be used.

#### *CHEMICAL METHODS*

Chemical processes such as iodine vapors, ninhydrin, silver nitrate, crystal violet, cadmium chloride, "Super Glue" cyano-acrylate vapors (and other, more dated methods) react with fats, salts, and amino acids from body secretions of the oil, perspiration and sebaceous glands of the body.

These methods are designed to react with the more durable chemical components of a fingerprint after the oils and water (which let brush and powder work so well) have evaporated. They are also more mechanically durable since the oils and water have either evaporated or soaked into the item of evidence and the remaining materials remain "bonded" to the evidence item.

## *PROCESSING THE SCENE*

### *COLLECTION OF FINGERPRINT AT THE SCENE*

#### *CHEMICAL GUIDELINES*

“Kits” for these chemicals are available which also contain specific instructions for their use. Whichever kit or supplies are selected, there are a few general guidelines for use which they have in common:

- 1) When considering very fresh prints, do not dismiss the value of powders and brush on either porous or non-porous surfaces. The use of a Magna brush prior to chemical processing can often develop the more recent fingerprints of the perpetrator rather than the background fingerprints of those legitimately handling the items. Great success has been achieved using the Magna brush in concert with chemical processes.
- 2) Ninhydrin works best when allowed to react at 50 to 60 degrees Centigrade and 80% humidity for 2 hours. An over-spray with cadmium chloride may greatly enhance ninhydrin prints. Remember that ninhydrin reacts with prints only after there has been an amino acid - protein breakdown. This takes time and heat to occur. Ninhydrin does not work well with fresh prints, whereas mechanical processes do. If iodine is used, apply it prior to ninhydrin for best results with fresh prints. The iodine will actually assist the breakdown process necessary for ninhydrin to work. With documents, care should be taken not to use a ninhydrin solvent that will dissolve ink. Ninhydrin and iodine prints are transitory and require photo documentation in order to preserve them for presentation in court.
- 3) Silver nitrate is permanent and will react with the salts of body fluids. An immersion method should be used to apply silver nitrate. A high-intensity ultraviolet lamp will develop strong, black prints and not turn the background dark. Immersion in standard darkroom fixer stops silver nitrate reactions and keeps the background light.
- 4) Crystal violet will work very well on sticky surfaces such as tape adhesive.. If the tape is light colored, ninhydrin may be used before crystal violet. With these as well as all other chemical development processes, caution must be used to avoid contact or inhalation by the investigator. See comments to follow.



## ***PROCESSING THE SCENE***

### ***COLLECTION OF FINGERPRINT AT THE SCENE***

#### ***CHEMICAL GUIDELINES (Continued)***

5) Camphor fuming is best applied to glossy surfaces, but will react with body oils on any non-sticky surfaces. After fuming, the object is brushed clear to leave the final print: fine, black particles. This "brushing away" can be accomplished with a ball of cotton or with an older brush. Camphor is an oily material which will eventually ruin a fingerprint's ability to be effective.

6) "Super Glue" method usually requires from 30 minutes to 2 hours for the cyano-acrylate to react with the prints. If the sealed chamber is kept at a 75% to 80% humidity range, the prints will become white and visible. This humidity is critical to the successful development of visible fingerprints using the "Super Glue" methods.

7) Sudan Black will work well on sticky surfaces such as soda cans which have otherwise dried out.

8) Amido Black reacts with blood residues making fragmentary blood prints into comparable prints.

#### ***CHEMICAL CAUTIONS***

The application of these methods to items of evidence carries certain dangers for the technician or crime scene officer:

1) Iodine vapors are absorbed by body oils until sufficient iodine is present to become visible. It is an extremely corrosive material, especially to the eyes and mucous membranes. This material should always be used in a fume-hood or at least out-of-doors.

2) Ninhydrin reacts with amino acids to produce a purple color. No solid proof has surfaced that ninhydrin is in itself harmful, but caution should be used so that inhalation or contact is minimized. The solvents used are highly flammable, making the use of a totally spark-proof, fume-hood motor imperative. The use of spray cans of ninhydrin in open air will result in its inhalation by the investigator and co-workers. Even in a contained fume-hood, the sprayed air-borne materials will be deposited upon the interior surfaces of the chamber and ventilation ducting. Therefore it is recommended that ninhydrin be used in a fume-hood as a dip process into a solution which can then be safely destroyed.

## *PROCESSING THE SCENE*

### *COLLECTION OF FINGERPRINT AT THE SCENE*

#### *CHEMICAL CAUTIONS*

3) Silver nitrate reacts with the salts in perspiration. Since these salts are not soluble in the carriers used in the other development methods, silver nitrate can be used after they have been tried. Waterproof gloves should be worn when handling this chemical. Contact with silver nitrate followed by exposure to sun light will result in blackening of the flesh. Though silver nitrate is relatively safe as compared to other chemicals used in fingerprinting, the officer should always be watchful for unnecessary exposures to chemicals.

4) Crystal violet requires great care in handling. For many years it has been used as a theft detection material due to its bright purple color when attempts are made to wash it from the flesh with water. The amount of crystal violet which would fit in this figure "o" is sufficient to turn hands, face, or any other body part purple for days. Always wear waterproof gloves when handling this material and then dispose of the gloves to prevent inadvertent spread of this very active chemical stain.

5) Camphor fumes are produced by igniting camphor. These fumes are fine, black particles which will adhere to the oils of the fingerprint. Often, when the excess is brushed away, a perfect print remains behind. Burning camphor can cause serious burns. Other than the obvious hazard of inhalation, this material is otherwise relatively innocuous.

6) Cyano-acrylate is a hazardous chemical requiring careful handling and limited human exposure. Adequate ventilation must be provided to reduce the amount of material inhaled or absorbed. A fume-hood and gloves are minimum safety features. These chemicals should not be applied in the field unless absolutely necessary. Chemical contact with skin and inhalation of the vapors must be avoided.

#### *LASERS*

Laser examinations usually use a fluorescent dye such as Rhodamine 6G which reacts with the fingerprint and then glows when struck by laser light. This chemical and others related to it may be hazardous to the health of the officer and to others exposed to evidence items processed with it. Some agencies actually mark the item with a special warning sticker to alert the courts, property clerks and others of the potential hazards.

## *PROCESSING THE SCENE*

### *COLLECTION OF FINGERPRINT AT THE SCENE*

#### *CAUTION!*

Rhodamine 6G has been classified as a cancer causing agent by at least one manufacturer. There is some controversy as to whether this chemical is a cancer causing agent; however, as always, safety should err on the side of caution.

With lasers, photography is used to "lift" the print image developed by the florescent dye. Given the high-quality photo gear which accompanies the laser, laser light can be used in conjunction with other forms of print development. Consider using it as a high-intensity light source which can enhance the contrast of almost any fingerprint and improve its "readability" through photography.

#### *PATENT PRINTS*

Patent prints which are created as the result of distortion of oils, as on a gun, should have any of the chemical, powder, or casting methods used on it only as a last resort. It is most likely that prints will be visible by oblique illumination; be it conventional lighting, mono-chromatic light or laser light.

If powders are applied to firearms, it is probable that they will adhere to the lubricated surfaces. The chances of success are far outweighed by the likelihood of destroying any details present. To record these prints, photography should be used in conjunction with carefully controlled oblique illumination.

Those patent fingerprints which are actually impressed into a surface can be treated with a casting material (after photography) and captured for later direct examination. It may be necessary to lower the temperature of the patent print prior to casting. For example, heavy grease on the undercarriage of a car may have imprint details which will have to be frozen prior to casting with a synthetic material to preserve it.

Patent prints must always be photographed prior to subsequent mechanical or chemical processing. Using photographic techniques similar to those used in footprint impressions, the contrast of the detail is enhanced by shadows created from oblique lighting. A series of photographs should be taken with lighting from each quadrant to insure the full development of all details. If possible, the officer should get a full frame image of the imprint to insure adequate detail upon photographic enlargement. The use of specialized lighting sources can improve the contrast of the patent print. If a variable wavelength light source is available to the investigator, it should be used to enhance contrast and detail during the photographic documentation.

## ***PROCESSING THE SCENE***

### ***COLLECTION OF FINGERPRINT AT THE SCENE***

#### ***PATENT PRINTS (Continued)***

These same forms of specialized lighting can be combined with luminescent powders to enhance contrast and detect ability of very light fingerprint residues. The investigator should first practice the application of these powders and use of specialized lighting on test surfaces before applying them to case materials. Luminescent powders are very sensitive to fingerprint materials.

#### ***REMEMBER***

No processing of a fingerprint or any other imprint evidence is complete until the exact location and direction have been noted. This information can prove to be very instrumental in the reconstruction of the crime sequence. A sketch or photograph of the print should always be used.

It is important that the investigator realize that existing fingerprints are not protected by the investigator's use of gloves. The fresh prints which still have oils and moisture present on the surface of the object can be smeared and their ridge details destroyed by any abrasive wiping action. The only purpose gloves accomplish is to protect the hands from chemical contact and the oils on the analyst's hands from contaminating the evidence. However, when wearing very thin surgical gloves, it is possible for the investigator's fingerprints to be left on evidence from oils and debris accumulated on the exterior of the glove. Those who wear gloves to protect prints or prevent adding their own prints to the evidence do so mistakenly.

#### ***CAUTION!***

The principle purpose of gloves at the crime scene is to protect the hands of the investigator from biohazard exposures from blood or other human body fluids. For this reason, they should be worn whenever blood or other body fluids are present at the crime scene. Remember they do not prevent the wearers fingerprints from being deposited at the scene!

#### ***COLD WEATHER TRICK***

On very cold, metal surfaces a "camphor-like" technique can be used to warm the surface and re-moisten oils. Twist a length of masking tape upon itself like a wick and light the end. Hold the burning wick beneath the object to be examined and expose the fingerprints to the heat, soot and oils generated as the wick burns. The black "sooty" fumes created will coat the object and restore the oils to the fingerprint thereby capturing the soot. The excess soot must then be brushed away with a fingerprint brush or cotton ball and the area visually examined for prints. Useable quality prints developed in this manner may then be photographed for documentation purposes and lifted with tape or a synthetic casting material.

## *PROCESSING THE SCENE*

### *SPECIAL FINGERPRINT PROBLEM AREAS*

#### *FLESH*

The nature of a crime may lead the officer to suspect that certain areas of the victim's flesh have been forcefully handled by the perpetrator. The print processing should concentrate on those areas of the victim's flesh most likely to have been gripped by the suspect. Fingerprinting a subject's skin should only be performed after careful examination for trace evidence, extraneous body fluids (semen and saliva) and after photography.

#### *NOTE*

Always evaluate the body for evidence of the crime as though the autopsy were beginning at the crime scene. The loosely adhering evidence such as hair and fibers, bite marks, saliva or latent fingerprints may be lost if they are not collected before the body is transported to the morgue for medical autopsy. If the law requires, obtain permission of the coroner or medical examiner before processing the body on scene.

#### *PRINTS OFF A BODY*

Fingerprints of an assailant may remain on the skin of the victim for several hours. Depending on the case, surfaces such as the wrists, ankles, neck, thighs, breasts should be considered. Several technically sophisticated methods for removing fingerprints from the flesh of a victim are available; however, most are expensive or beyond the ability of the investigator to complete. There is, however, one method which has worked well and is very simple and inexpensive to use, requiring only routine materials.

- 1) The glossy surface of a fingerprint card is gently applied to the flesh, being careful not to smear the print. In approximately half a minute, the excess oil is transferred to the card. The glossy surface of the card is then dusted with a magnetic brush or bi-chromatic powder.
- 2) If a print does not readily appear on the card, the flesh should be dusted directly, using the Magna brush. If nothing is then visible, a cotton ball or clean fiberglass brush can be used to gently brush away the excess powder. This may improve the contrast to the point that a print will appear on the card or the flesh.

The processing may then be continued on other segments of the same area of the body, taking care not to destroy prints yet to be developed.

## ***PROCESSING THE SCENE***

### ***SPECIAL FINGERPRINT PROBLEM AREAS (continued)***

3) During the late 1990's it was believed possible to preserve fingerprints of the assailant on the victim's body by the use of "Super Glue." The body area should be isolated from general ventilation by use of a large plastic sack and fumed for 30 minutes in the fashion previously described. This method has not been useful for many agencies and is rarely used in field locations.

One or more of the steps of this simple method of body printing could provide a fingerprint which could establish the identity of the suspect.

***REMEMBER***

The body-print process will probably not succeed if either the cadaver or the living victim has been washed or been subjected to abrasive wiping. For example, a living victim rubbing a hurt shoulder previously grabbed by the suspect will probably have smeared the suspect's fingerprints. The prints will be viable for a period of 12 to 24 hours after deposition.

***CASTING  
FINGERPRINTS***

Another problem area is on rough-textured, porous surfaces such as aged redwood railings. Here, magnetic applicators and powders can develop excellent quality prints. The prints should first be photographed, then cast using Mikrosil or a similar catalytic casting material. The print will be totally collected, and the wood surface cleanly left behind. This will eliminate the problem of wood chips found in the tape lifts. This also works on curved surfaces such as doorknobs. Refer to the section on casting for additional details regarding this technique.

***REMEMBER***

The prints collected by this method will be mirror images of the standard lift using transparent tapes. Caution should be exercised in comparison.

***SPECIAL NOTE***

The use of tune able light sources is a way to enhance latent print visibility. These light sources, as well as the higher cost lasers; also prove to be very useful tools in helping the investigator locate fibers and some biological residues such as semen. Remember that the light emitted from the evidence item is visible only with the appropriate colored filter. Without the filter, the print may not be enhanced or seen by the investigator or the camera.

## *PROCESSING THE SCENE*

### *COMMUNICATING WITH THE LABORATORY*

One of the greatest scene investigation weaknesses among officers, evidence technicians and criminalists results from the laboratory examiner rarely being at the crime scene. Therefore, lab personnel lack the background awareness of the scene known by the technician-investigator who has collected the evidence. It is essential that there be communication with the laboratory examiner who will perform the analysis of the items collected. It is the responsibility of the laboratory to demand information relevant to their analysis and its interpretation. It is the responsibility of the investigator to provide that information and to discuss the case circumstances with the laboratory.

The investigator can use the information derived by the laboratory regarding key elements of the crime to assist in interviews or interrogations. The laboratory and scene team must be able to rapidly update each other for this analysis-to-interview feedback process to work. In so doing, details alleged by witnesses can be corroborated or refuted, and evidence with special psychological significance can be offered the interrogator to which only the perpetrator would react.

Administrative procedures require some basic identifying information in order to maintain case file accuracy. The following should always be included:

- 1) Agency name, case number, investigating officer, and a telephone number where he can be reached.
- 2) Known subject's names, and relevant descriptors.
- 3) The general type of offense.

While important, this information is not sufficient to familiarize the lab examiner with the complex crime scene setting. Additional information required in complex cases includes:

- 4) A brief summary of the circumstances of the crime.
- 5) Sketches and photographs should be submitted to aid in the reconstruction. This will give the analyst a much better perception of the elements of the crime and generally how the analysis might best be directed.
- 6) A copy of the autopsy report and photographs as soon as possible.
- 7) In major cases, it is always preferable that the investigator, analyst, and, if feasible, the actual prosecuting attorney, freely discuss the case to establish what is valuable evidence and what is peripheral to the case.

## *PROCESSING THE SCENE*

### *COMMUNICATING WITH THE LABORATORY*

There are two additional elements which comprise the communication: a list of the items which are being submitted to the laboratory (along with a comment as to the purpose of the examination), and a chain of possession, signed each time the evidence leaves the control of a specific section or department. If a sketch is included in the case, the numbers for each item should be the same as indicated in the sketch. This helps the lab understand the item's significance within the scene and simplifies the court presentation. The container for each item of evidence should also indicate the name of the person collecting the sample, when it was collected and a key word describing the contents.

### *REMEMBER*

There are many submission forms available which can serve as a source document for the officer to capture the necessary information for the chain as well as the administrative information. Any of these will be suitable as long as they contain the above specified minimum information. It is important, however, that the officer not forget that the same information could be noted on the exterior of a plain, brown, paper bag available from any grocery store. The absence of a departmental form or container is never an excuse for a poor chain or an inadequate description of the evidence.

In addition to the above listed administrative and legal requirements for evidence submission to the crime laboratory, there is other information which can help expedite analysis of the case. Remember to communicate the importance of the evidence to the investigation and the time frames desired for the analysis. The laboratory will likely assign a higher priority to cases leading to the identification of a suspect, an arrest, or a court presentation. Every crime laboratory seeks to work cases which will result in a reduction of future criminal activity.

The investigator should maintain contact with the laboratory administration prior to the assignment of the case and once assigned, maintain communication with the analyst. The limited resources of the crime laboratory cannot "overlook" the officer who makes sure they are aware of the continued investigative needs and the requirement for analysis.



## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***INTRODUCTION TO INVESTIGATION AND RECONSTRUCTION***

A homicide may contain dozens of items of evidence and hundreds of pieces of information acquired from many sources. How these come together in an investigation to produce the “story of the crime” (crime reconstruction) may seem a mystery. However, the difference between a guilty or not guilty verdict often rests with the prosecutor’s ability to present a credible reconstruction before the court. Sometimes accusations of police incompetency or prejudice are made to cast doubt upon the impartiality of the investigation and the credibility of the investigation. A well organized investigation which clearly demonstrates impartiality and accuracy of the reconstruction serves as a safeguard against such accusations.

The following pages present an approach which integrates this “telling of the story” (reconstruction) with every aspect of the investigation. Hopefully, this process will simplify complex scenes; give order to the seeming randomness of scene evidence; and organize the information generated in the investigation. A simple, ordered and organized presentation to the court should help keep the focus upon the defendant’s guilt or innocence.

### ***RECONSTRUCTION: A DEFINITION***

Webster’s Unabridged Dictionary defines reconstruction as:

*To build up, from remaining parts and other evidence, an image of what something was in its original and complete form.*

The common definition of “reconstruction” conveys an image of the rebuilding of an object such as a broken vase or even the surgical reconstruction of an accident victim’s face. While these impressions are accurate in a general sense, they are inadequate in law enforcement investigations. The general definition does not include the full meaning of a crime reconstruction, which is to add the details of “*how, why, where, when and what*” to the “*who* did it” of the crime investigation.

### ***COMMON SENSE REASONING***

*Crime reconstruction* is the application of “common sense reasoning” in conjunction with *forensic science* to interpret evidence as it resides at the scene. These are then *combined* with knowledge of the *likely behaviors* of participants under known conditions. As “reason, forensic science and likely behaviors” interact, the investigator develops a reconstruction which depicts position, movement, sequence and timing to the participants in a crime and sometimes infers the motive of the crime. Evidence viewed in this fashion ultimately describes the actions of the participants who created them; much in the same manner that “props” in a movie depict the behavior of the actors.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

#### ***AN ANALOGY***

The commission of a crime can be likened to a movie or a play. There are actors, the stage, backdrops, acts and scenes, as well as dialog and actions revolving around a script which has a defined plot. Each scene also includes "stage directions," which give additional information as to where actors should stand, move, and how they should act. If we understand the stage (the crime scene) and find all of the props (evidence), then we have a chance to learn what actions may coincide with them.

A crime scene reconstruction may portray specific actions and perhaps even place them in sequence; however, it is unlikely that a continuous "flow of actions" (like the script of the play) can ever be achieved. Though some investigators would represent a crime reconstruction as a continuous portrayal of the entire "plot and script of the play," this is not possible. The very best that can actually be achieved is to develop the separate (and brief) actions for each scene of the play and offer ALL of the logical alternatives to connect them together.

#### ***INVESTIGATOR AND THE EVIDENCE***

There are many approaches the investigator may use to interpret evidence at a crime scene and to reconstruct the actions, positions, and perhaps even infer the motives of the perpetrator and victim. Some investigators rely upon testimonial statements of eyewitnesses and minimize the value of physical evidence. Others may follow their "gut instincts" and reasoning to guide an investigation. There are a few who rely upon a check list to conduct an investigation "by the book."

Regardless of the investigative approaches used those that are most successful *integrate* information developed from all resources into the ever accumulating and evolving investigation. They also realize that what may not be important early in the investigation may prove to be a critical part of the case later, (and vice versa). The goal of this text is to provide scene investigation approaches that will develop more factual information to the investigator earlier in the overall process.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### **RECONSTRUCTION**

Though many other approaches have solved cases, this text emphasizes the importance of the trained and experienced investigator attacking a well defined (and documented) “initial theory” with a “common sense” form of the scientific method. Armed with “*common sense*” and *objectivity*, he is able to observe and document the information conveyed by evidence and form the most reasonable theories of the crime.

The investigator formulates initial theories as to how a crime was committed when he **objectively evaluates** the crime scene and its evidence by recognizing *individual objects, relationships between objects, or environmental observations* essential to solving the crime. The investigator then applies unbiased “**common sense reasoning**” to the evidence and observational clues and compares them to prior common life experiences, prior specialized training or prior casework. This “common sense reasoning,” is simply the reversal of known “cause and effect” relationships. Everyday an individual observes actions, and witnesses the effects of those actions. When the effects (the evidence) are observed and the “causes” (actions) are reasoned, reconstruction is occurring. The cautious investigator will be watchful for the subconscious “Hollywood version” of cause and effect which often lacks credibility and can lead to false assumptions. E.g. a bullet will not cause the victim to be hurled backwards (as in the old westerns!)

In addition to these forms of evidence, the investigator receives information from witnesses, informants and various record or database checks. These interact with other efforts in the criminal investigation to provide a greater “picture” of the activity which occurred prior to, during, and after the crime. Combining this information with knowledge of the forensic analytical results, this properly trained crime scene investigator may develop clues that witnesses may not remember nor any lab test ever conclude.

Given time and resources, the investigator can use his theory of the crime to search for evidence and observational clues, and then assimilate that information with their initial “guess” and evolve a reconstruction with foundation. Repeating this process of search and assimilation should raise every question which might arise to challenge a reconstruction, and answer them “in the field.” Information should be passed from scene processors to investigators conducting interviews, and vice versa. This interaction between the scene processors and the interviewers may develop additional physical evidence, clarify interview statements, or point out discrepancies in the known “facts.”

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

#### ***THE SCIENTIFIC METHOD***

This “common sense, cause and effect” reasoning is a fundamental part of the “scientific method,” the objective heart of scientific inquiry. The scientific method can be paraphrased and applied to crime reconstruction as follows:

*“A theory which is refuted by evidence must be altered until it incorporates all observational clues and physical evidence encountered.”*

Any relevant evidence which doesn't fit the initial reconstruction theory must be explained. It cannot be ignored. If the reconstruction cannot explain the evidence, the theory must be altered to include it. After several cycles of this process of formulating theories, a plausible reconstruction will be achieved based upon substantiating physical evidence and observational clues. Using this process of scientific inquiry and common sense reasoning creates an investigation which has survived objective challenge from within. It is therefore better prepared to withstand critical challenge in the courtroom.

#### ***STRENGTHS AND WEAKNESSES***

The strength of a reconstruction can be undermined in several ways. One problem is the investigator who lacks sufficient experience or training to interpret the clues of the crime. Most departments “rotate” staff to broaden officer perspective. Often the investigator is “rotated out” just when his investigative experience is most needed. For this reason, the investigator must have access to specialists who can address specific reconstruction questions. Care must be used to select *qualified specialists having expertise relevant to the reconstruction question*.

Even with this expertise, problems arise if the investigator focuses upon proving his initial theory correct even though there may be evidence which refutes it. This “non-objective” scene processing often lacks sufficient documentation, and usually fails to collect evidence which would counter the initial theory. This effort never addresses alternative reconstructions, but rather awaits the “adversarial process” to test a theory before the jury, a hazardous proposition indeed.

#### ***RECONSTRUCTION – THE ALTERED SCENE***

Another commonly encountered reconstruction weakness occurs when the investigator assumes that the scene he finds is in the same condition as when the perpetrator left. This failure to account for alterations which may have occurred prior to his arrival provides the investigator with a false “starting point.”

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

#### ***EMERGENCY RESPONSE: EFFECT ON EVIDENCE***

The major steps in a crime reconstruction must not be limited to determining the actions of *only* the perpetrator and victim. The investigator must also be attentive to the actions of emergency personnel whose efforts may change the evidence and clues as left by the perpetrator. Without a clear understanding of how evidence has been affected, it is impossible to separate the actions of the emergency responders from the actions of the crime participants.

There are at least three phases in the emergency response to a “9-1-1 call.” During the initial and second phases, which focus upon the protection of life and property, it is anticipated that responders will *alter, destroy, or create evidence and clues* as they enter the crime location. Only in the third phase, when the investigation is initiated, should the “justice system” reasonably expect that evidence relative to the crime will be the *primary* concern of the emergency personnel present. In that third phase any alteration of the evidence or clues of the case can and must be avoided.

### ***THE PHASES OF EMERGENCY RESPONSE***

PHASE 1: Officers enter the scene in order to protect life and property. Procedures used will focus upon *threat assessment, officer safety and the suppression of aggression*. The officer, distracted by a misplaced concern for the evidence, may place his own life and the lives of others in harm's way. The phrase “security at the crime scene” in this phase means the control of the aggressor and the preservation of life; it has little to do with protection of evidence. Greater attention can be placed upon physical evidence in scenes lacking threat to life or safety. But the question remains, did the process of determining that the scene is “safe” change the scene?

PHASE 2: If life is in jeopardy and medical assistance is required, certainly it is anticipated that the first concern of medical personnel is with the *preservation of life and the control of injuries*. Movement of the body, alteration of the clothing, blood patterns, trace evidence, and weapons are tolerated because of the priority to save life. If life has already been forfeited, then it is reasonable to expect a minimal alteration of evidence. But here again, one has to ask just what process was used to determine that life support efforts were not needed and how it affected the scene.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### **RECONSTRUCTION**

#### ***EMERGENCY RESPONSE: (continued)***

PHASE 3: After the initial threat and medical assistance phases have concluded, the investigative phase begins. The objective is the *isolation of the scene; the location, documentation and evaluation of the evidence; and the extraction of all possible information*. The phrase “crime scene security” now has the meaning of protecting the scene itself and the evidence contained within it. Investigators and other participants in this phase must not alter, create or destroy evidence by their actions. Doing so could create credibility issues and impede the ability to investigate or reconstruct the crime.

The crime scene is never “as it was” when the perpetrator left the scene. In addition to these predictable effects of the emergency response, there are other factors to consider. For example:

- 1) What did the victim do after the perpetrator left the scene? Was there an attempt to restore “normal” within the scene? Recall the burglary victim who sweeps broken glass from the floor while waiting for police response... or wipes blood from the windowsill at the point of entry.
- 2) Did the person who discovered the crime enter the scene? What was done to gain access? Lights turned on, doors opened, objects in their hands at entry, innocently dropped or left in the scene.
- 3) Animal predation with obvious signs..
- 4) Environmental effects such as air conditioning, irrigation, external exposure to the elements are examples that effect decomposition or the drying of blood or fingerprints and many other evidence factors.
- 5) Are there items in the scene that may be left over from a prior incident? Bloodstains in the bar scene may well be from the fight last week rather than the stabbing under investigation!

It is up to the investigation team to consider each of these factors as they evaluate an object within the scene for its value as an item of evidence.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

There are several definitions of crime scene evidence which exist in the criminal justice system and in common usage. In reconstruction, there is yet another:

*Evidence is any observation, relationship or object which supports or refutes anyone's theory of the "who, how, why, what, when, and where" of a crime, or which addresses the critical elements of the crime.*

Everything is evidence of some event. The key is to identify and then capture evidence relative to the incident in question. Often, it is the information developed through the investigator's powers of observation which separate evidence of the current crime from the *residuals* of prior activities. For example:

Accumulated bruises on a body or the accumulation of pry marks on the door jamb of a commercial building: In order to extract the relevant information from these items, the investigator must be able to discern marks showing signs of age from more recent marks associated to the crime.

*A reconstruction is impossible to complete without the ability to discern evidence relevant to the crime, or an appreciation of the information that evidence contains.*

### ***PHYSICAL EVIDENCE AND OBSERVATIONAL CLUES***

We have used the terms "physical evidence" and "observational clues" without defining their meaning.

*Physical evidence* consists of tangible objects which, when *analyzed*, reveal chemical or structural details of blood, trace, firearms, fingerprints, toxicology, and the like. The scene investigator must be aware of forensic capabilities in order to identify physical evidence, carefully evaluate it, protect it from alteration and see to its long term preservation. Forensic awareness combined with scene processing skills are essential in dealing with physical evidence; however, in themselves, they do not establish the intangible *observational* clues which come from the relationships of evidence at the scene.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

*Observational clues* are intangible bits of information based upon an interpretation of the *context and relationships* of evidence within the scene. They result from the interaction of *what* an item is, its *relationship* to other items and the *predictable effects of time and the environment*. They cannot be collected by packaging, but must be preserved by various forms of documentation. Once an item is collected the “observational clues” it contains may well be lost if they are not recognized at the scene and preserved through documentation.

### ***EXPLORING OBSERVATIONAL CLUES***

The fundamental inter-relationships between an item and the scene, time or the environment can be categorized into three primary forms of observational clues.

*Relational clues*-- significance of where an object is or its relative orientation, rather than its chemical or structural identity.

*Functional clues*-- the operational condition of an object which is indicative of how it was used or what it was used for.

*Temporal clues*-- are based upon the interaction of time and environment upon the evidence. For example, a *transitory* state of an object (body temperature or a foggy window) indicates time or duration (when).

These intangible clues can be unpredictably altered by the actions of others. Fragile as they are, they can be easily altered by inadvertent actions of those in the crime scene during the *initial phases of the emergency response*.

Intangible clues as well as physical evidence are also susceptible to unpredictable effects of time and the environment (such as weather changes or the effects of passing traffic). These “unpredictable factors” randomly introduce chaos to an otherwise orderly interpretation of the observational clues and evidence which remain behind after the criminal activity has concluded.



## ***EVIDENCE AND CRIME RECONSTRUCTION***

### **RECONSTRUCTION**

#### **MINDFUL OF "CHAOS"**

Chaotic, unpredictable effects in evidence are the result of unexpected changes, which can often be disastrous unless the *original condition* of the item is noted and then carefully documented. Accurate documentation of the evidence at the scene should minimize the impact of unexpected and unpredictable changes which might occur and give "false-lead" information to the investigative effort. Many of these unpredictable effects are the result of the transitions which occur during an investigation from the first officer response to the medical attendants, ultimately to the person documenting and collecting the evidence at the crime scene. *Interviews with personnel involved in phases I and II of emergency response are essential to understanding their impact on the evidence's original condition.* For example:

Opening a revolver's cylinder without noting chamber position relative to the hammer might change a suicide to a homicide. Or alteration of bloodstain evidence on the deceased's clothing by transportation in a body bag might render patterns useless for reconstruction purposes.

#### **OTHER CLUES**

Reconstruction information does not depend on the physical form of an item, indeed, it may be intangible and without form. The investigator must remember that "evidence is *any observation, relationship or object* which supports or refutes anyone's theory of the who, how, why, what, when, and where of a crime, or which addresses the critical elements of the crime. But be watchful for the impact of unpredictable effects.

The ability to recognize information and apply it to a reconstruction can be developed further if traditional classifications of physical evidence (impressions, trace, serological, etc.) are set aside. The field investigator will view the physical evidence and observational clues in a different manner if he concentrates on *how* they contribute information to reconstruction. The wary investigator relies on these concepts as he performs pattern matching with currently viewed "effects" to previously experienced "causes." The clues learned from cause and effect observations or from physical evidence which help us reconstruct the "scenes of the play" include the ability to:

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### **RECONSTRUCTION CLUES**

- 1) Determine the sequence of events-- information which establishes the relative order of events in the commission of the crime. For example, a wet bloodspot disturbed by a *subsequent* muzzle blast of a gunshot.
- 2) Establish direction-- components of an item which aid in determining the path or motion of an object or participant. For example, the *direction* a shoe print is pointed relative to the scene.
- 3) Describe actions or positions-- factors which provide information to reveal the motion or the actions of the parties involved may also serve as an indication of the relative positions of the participants. For example, the *position* and *orientation* of a bloodstain pattern relative to the point of attack.
- 4) Identify ownership or origin-- items of evidence which establish the origin of an object or identify persons. For example, the determination that a bullet *originated* from a specific firearm.
- 5) Limit the scene-- that which restricts or expands the boundaries of the search, but which must remain flexible enough to be modified as new information arises. For example, a bullet breaking a window as it enters the home will *expand the scene boundaries* to out of doors.
- 6) Establish time or duration-- This is literally the time line of our "play," into which the "actors" must limit their actions. These may be established in many ways, not the least of which are *temporal observational clues*. The investigator will coordinate this information with the alibis of suspects and the statements of witnesses to establish the relative time and duration of events surrounding the crime.

The information in these categories can be combined with "cause and effect role playing," by the investigator to guide the scene search or the field interview to additional evidence. Often, they will give the investigator the ability to observe and interpret the fact that evidence is not where it "could be."

This will provide information which may be useful as evidence. The absence of evidence is, in itself, information which can become useful as evidence.

*For example: A well-defined break in the misted bloodstain on the wall in front of a shotgun victim infers that the position of the shooter was at a particular point and that there should be blood on the suspect's clothing.*

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

Caution should be exercised in documenting all details which support these "absence of evidence" conclusions. Often this documentation includes the relationships between items, their position in the crime scene and details as to when these items were deposited or removed. Deduced details usually build upon these and other evidence or clues found within the scene. Documentation, including photographs and sketches, are very important to support inferences drawn from evidence at the scene and will help establish foundation for the reconstruction.

### ***STARTING A RECONSTRUCTION AT THE SCENE***

In the course of investigating and reconstructing a crime, an investigator usually begins with an overview of the crime as it has been related to him from a variety of sources. This builds an image of the crime based upon a "preponderance of obvious clues," the statements of witnesses, and assumptions made by trusted others at the scene. It is critical that the crime scene investigator realizes that, though helpful as a starting point for the investigation, over-reliance upon this initial premise or theory may actually mis-direct an investigation.

Though instinct and experience can create first-class investigators, the best investigators are always wary of the possibility of a wrong "initial impression" and use their developed powers of observation to re-verify opinions. The investigative team has the responsibility to seek all forms of information, whether it supports or refutes their initial premise or theory. Doing so will evolve a more detailed reconstruction based upon supportive demonstrable evidence. Often, the reasoning process includes a form of mental "role playing" as to how the crime might have occurred, which in turn leads to additional evidence which supports or refutes that theory. Simply, the investigator is trying to correlate the "effects" (property and clues) at the scene with previously experienced "causes" (actions leading to the evidence) in order to understand how the crime occurred. *If evidence contradicts the theory, or raises new questions, the investigator must alter the reconstruction to incorporate all the evidence and clues.*

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

The investigators should rely upon experience and their first impressions only to pinpoint key elements which form a starting point. This start leads to numerous questions which lead to several alternate answers. By using experience, developed powers of observation, “scientific” thinking and objective reasoning, choices are made as to which alternatives to pursue. Ultimately, the accumulation of many such logical decisions refutes dozens of possible reconstruction theories, and leads to a short list of possible solutions.

One way of achieving that open style of logical thinking is to list the most critical components of a crime, and build a reconstruction correlating each of the elements of the crime with the respective physical evidence or observational clue. The analogy of the “play” will help explain a way to sort all the investigative information. To do this, we must first identify the critical parts of our “play.”

### ***THE ELEMENTS OF A CRIME***

Within the play analogy, there is the underlying plot, which is composed of a series of scenes or vignettes built by behaviors of the actors who use props to accentuate their actions. In the real world, virtually every crime against persons (such as murder) has specific stages of behavior. The evidence at the scene (the props) can be correlated to one or more of these stages of behavior. Every effort should be made to find evidence to satisfy these stages of behavior.

- 1) *The perpetrator's preparation for the incident:*  
This may include mentally acting out the approach and aggression of the crime, selecting a certain “profile” of victim, finding a location to the advantage of the aggressor, selecting a weapon and even planning for the disposal of the deceased. Many criminals also prepare their alibi in advance and anticipate their “after crime” behavior.
- 2) *The approach to the victim:*  
In this phase the aggressor and the victim make initial contact. This may be a subtle contact with an unsuspecting victim or a forceful contact which blends with the next phase, control.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

#### ***ELEMENTS (cont.)***

- 3) ***Control of the victim:***  
Violent behavior is not always necessary in this phase, however, it is commonly present. The control may be one in which the victim believes that he is participating in a harmless undertaking and, as such, is unaware that his freedom of choice is being compromised. If violence is used, it will be scaled to deprive the victim of his freedom.
- 4) ***Containment or "detention"***  
If the mechanism of control does not permit the assailant the degree of motion and time necessary to accomplish his crime, he may resort to some other mechanism to detain or restrain the victim. Obvious examples include ligatures, "cages", blunt trauma or drugs.
- 5) ***Aggression:***  
This is the actual act of the perpetrator against the victim. With repetition (practice), the aggressor may alter the style of aggression to become more effective.
- 6) ***Response:***  
The victim will exhibit two major forms of response: voluntary and involuntary. The voluntary response may have a subconscious component, (grab an injury) as well as a conscious response to control the aggression, counter the aggression, and flee the assailant or panic. Involuntary responses stem from the autonomic nervous system and include such factors as hormonal responses, blood pressure, and shock. Responses include efforts to control the attacker, counter the attack, flee from the location or when all else has failed, to undergo "panic". Many responses can be better understood by knowing the location of the attack and the barriers to escape.
- 7) ***Disposal/ display: (or Staging)***  
After the aggression/ response cycles have ceased, the victim is abandoned, concealed or perhaps positioned in a form of "display" for others to find. Occasionally, assailants continue their aggression after the victim's death (necrophilia, dismemberment, decapitation, disfigurement or incineration). Some assailants display the victim or evidence for others to find. This display can convey a wealth of information regarding the perpetrator if properly documented and evaluated by qualified personnel. In rare instances, the crime may be staged to give false appearance as to what actually occurred.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### **RECONSTRUCTION**

8) *Flight/ alibi:*

The perpetrator will typically disassociate himself from the crime, perhaps by departing the crime location or simply by disavowing knowledge of the incident. He may leave items in the scene, or have in his possession evidence, which can be used to associate him to the scene or the crime. The collection of physical evidence standards from the scene by the investigative team is critical to this association of the perpetrator to the crime. A descriptive listing of the evidence found at the scene (or which may be missing from the scene) will help the investigator when the alibi of the perpetrator becomes known during the interview process. A very descriptive evidence list and effective communication between the scene and the interview, will help separate truth from deception as the subject provides his statement.

9) *Post incident behavior:*

There may be an alteration of the normal schedules of the perpetrator after the commission of the crime. This may result from the “flight” from the crime, from the response of the victim (injuries to the aggressor) or from the perpetrator’s inability to cope with the reality of his actions. It may also include the victim’s efforts for first aid, the behavior of the person who found the crime or inadvertent alterations that can occur by pets (predators) or the weather.

Keeping these fundamental stages of criminal behavior in mind as the scene is searched, interviews are conducted and results are evaluated, will lead to a more thorough investigation and reconstruction. The more detail these nine stages contain, the easier it will be for the investigator and prosecutor to not only prove who committed the crime, but reconstruct how it was done.

The key elements of a crime and their details build the theorized reconstruction. Each of these key elements may have a number of possible explanations. It is critical that the investigator considers all the explanations or theories. Each possible explanation must be logically evaluated, dismissing one only after proof has been found among the evidence or clues which eliminate it. That proof may be a result of on-scene evidence evaluation by the investigator, combined with eventual laboratory analysis of evidence. In either instance, the proof must be documented to refresh the investigator’s recollection at a later date.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

The investigator will follow one alternative or another as a theory is developed, and the reconstruction evolves much like the story line of a play. If, in the process of reasoning through the alternatives and evidence, there is a contradiction, the investigator should back up to the last series of decisions and re-evaluate the possibilities. An alternative may have been overlooked or eliminated without adequate proof, or because of a "blind spot" in logic. It is often helpful to discuss alternatives with a fellow investigator in a form of constructive argument, which considers every possibility, no matter how trivial or absurd it might seem.

### ***THE FOUNDATION FOR RECONSTRUCTION***

To help the investigator establish the foundation for reasoning and sorting through the alternatives in a case reconstruction, it is suggested that information acquired from all sources (physical evidence, observational clues, witnesses or records) be evaluated in light of the following areas.

- 1) Learn the **backgrounds** of all the participants and the history of the crime scene. In addition to the usual background checks, consider the age, sex, infirmities or special talents of the victim, location of the crime scene (remote, public view, concealment) and the mobility of the perpetrator. In addition, determine the extent of the crime scene and prior responses to the location.
- 2) Learn as much as possible about the **tools or weapons** and the extent of force employed. Consider the type of weapon or tool used and its ability to associate a suspect with the crime. Consider objects, such as knives, bludgeons, firearms, ligatures and the like, and the extent of force used. What degree of control was used by the perpetrator towards the victim (excessive bindings) and, in an assault, whether the weapon required the assailant to closely approach the victim or remain at some distance (stabbing a victim as opposed to shooting from a remote vantage point).
- 3) Be informed as to the **wounding or damage** to inanimate objects involved in the crime. Wounds will be only superficially visible on scene. The pathologist or emergency medical physician must be consulted to learn the full extent of damage. Be sure to include damage to the circulatory system, as well as central and peripheral nervous system.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### **RECONSTRUCTION**

### **FOUNDATION (continued)**

- 4) Detect, document and adequately sample **the patterns** at the scene be they impressions, stains or the distribution of material evidence. This will prove useful to establish the potential paths of motion or relative positions of individuals at select instances during the commission of the crime.
- 5) Evaluate the **crime scene** dimensions and layout for likely locations for entry, exit, deposition of transfers and the like.

Once the investigator has knowledge of the above factors, the team should consider the **motive** of the crime. Was the crime for monetary gain (or power), sexual gratification (or love), revenge (or a re-directed hatred), irrational (an insane act) or was it a random occurrence (perhaps accidental and without motive). Did the apparent crime serve as a cover for another offense? What was the likely or perceived relationship of the victim to the perpetrator? The motive may be elusive based upon information available at the time, however, insight to the motive may help the experienced investigator develop possible reconstructions. These reconstructions will be evaluated in light of the evidence and information developed in the course of the investigation.

### ***EVOLVING A RECONSTRUCTION THEORY***

The investigator should develop reconstruction theories with as much detail as he reasonably feels comfortable in presenting, be it a reconstruction for field use or for court proceeding. The alternative reconstructions are then compared against the information contained in each item of collected evidence, observed clues, laboratory findings, or witness statements. For each item, there will likely be more than one concept of information. That information is then tested against each of the alternate theories as “refute” or “support.” Any observation which refutes a theory must be explained, or the theory dismissed or altered to fit the evidence. To help visualize the theory the investigator may assume the roles of the victim and perpetrator as the crime is *mentally acted out* relying upon known “cause and effect” relationships. Reconstruction theories, which are supported by the items of evidence, remain on the list of probable reconstructions. *As the reconstruction develops, secondary factors supportive of the reconstruction will be implied.* These small details are then investigated to either refute or support the theory of that reconstruction. Nothing can be more satisfying to a reconstruction than to have “cause and effect role playing” predict evidence, and then find it was there all along.



## ***EVIDENCE AND CRIME RECONSTRUCTION***

### **EVOLVING A RECONSTRUCTION**

#### ***EXPERTS WITHIN RECONSTRUCTION***

Reconstruction relies upon “common” sense (or common experience) reasoning to interpret evidence. However, frequently, an item of evidence will generate a question which requires knowledge beyond “common experience” to answer. It is then that experts with specialized training and knowledge are required to examine and interpret the evidence. Professional expertise is a combination of training, case experience and professional accomplishments. The investigator must be watchful for “expertise” based upon out-of-date training or inaccurate information. Inaccurate, non-reproducible interpretations based solely upon the opinions offered by the “most famous” experts, can only mislead an investigation.

#### **AVOID BIAS**

Science and objectivity require all conclusions to be demonstrable to (or reproducible by) others. The expert must be held to this standard. There is nothing in forensic science which condones the statement “Only expert ‘X’ can see or know this.” Whatever the scope of the reconstruction, it must be presented in such a fashion as to enable others to experience for themselves the foundation for the expert’s interpretation. The professional burden remains: not only must *qualified* expertise be *relevant* to the crime reconstruction; it must ultimately be *demonstrable* to the jury. The more complex the issue, the more critical is this need.

#### **CHALLENGE INFORMATION**

Once the preceding areas have been addressed, it is time for the investigator to integrate the findings with tentative reasonable reconstructions as to how the crime occurred. Statements by a surviving victim, eyewitnesses, or the suspect; inferences drawn from evidence at the scene; or a pattern of circumstances which seem to match a prior case, can all contribute to this list of possible reconstructions of the critical elements of the crime. Each of these has inherent limitations and the potential for inaccuracy. It is sometimes awkward, but the investigator must be able to challenge the sources of information that will be relied upon even if it comes from a “reliable source”. Witness statements may be filled with errors in recollections; lab test may be confusing or incorrect, pathology reports incomplete and police reports inadequate. It is the responsibility of the investigator or reconstructionist to keep an objective and unbiased perspective in the evaluation of these contributing products.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### **RECONSTRUCTION – SIMPLE OR COMPLEX**

Some reconstructions are so limited in scope they rely only on a single specialized form of evidence and the appropriate specialist. Other reconstructions may involve several specialized forms of evidence in conjunction with crime scene “observational clues.” Just as in the crime scene, no single item of evidence can ever stand alone in a reconstruction, but must incorporate all relevant evidence at the scene. So too must the findings of specialists be *correlated* to each other and *integrated* into the complete reconstruction if it is to withstand scrutiny and challenge.

### ***CHARTING THE “STORY”***

When reconstruction theories are being developed, the investigator will theorize actions of the perpetrator and the victim’s response. This process correlates major theories to tangible evidence, observational clues and verified information from any source. All information must be correlated to the alternative reconstructions and be available for others to evaluate.

To develop the most detailed reconstruction a simple approach is used. It requires the investigator to reconstruct very small moments of time, justify each and then place them into a sequence. Techniques such as timelines, via charting, link analysis or flow diagramming are available to demonstrate or document relationships and sequence. Regardless of the documentation technique, the problem begins with where to start and how much to tackle at one time. Critical thinking combined with logical reasoning is essential.

State the “story” of the crime in short phrases representing positions, actions, duration, motion, direction or sequence. Connect these phrases with conjunctions such as “and, or, if, then, until” (and many others)! Each conjunction ends a very short portion of the reconstruction and requires documented justification (or further investigation). Each conjunction can be numbered and the supportive evidence (analytical result, observational clue, factual record etc) referenced using that number to support or refute the statement.

The short phrases and their numbered conjunctions may be listed in a column of a table or spread sheet and related evidence or observational clues listed in a neighboring column, each in a separate row (as with a spreadsheet). The information reasoned from each item is listed in the next column using as many rows as necessary for photographs, links to reports and the like, (since an item has more than one piece of information to contribute to the story). The information is then tested against the theory and notations made as to whether the information “supports” or “refutes” the theory and include alterations to the reconstruction to fit all the verified information.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### **INTEGRATED DOCUMENTATION**

This “story board” utilizing a spreadsheet to track information becomes an integrated document which tracks all of the evidence and information gathered, as well as the hundreds of questions and answers encountered during an investigation. All the possible reconstructions may then be evaluated and objectively documented in the story board. The most viable reconstructions are those which are *supported* by the greatest number of evidence items, observational clues and relevant information.

### **THE “STORY” WHERE TO START!**

To evaluate case information in light of the potential reconstructions, many investigators use a form of flow charting to demonstrate and document the various elements (events) of the criminal activity. To help us decide what forms of evidence to rely upon to start our flow diagram, consider that:

1. The participants need a position in the flow diagram where they may stay for some time (duration) and perform actions which affect the location. (An actor on stage, a perpetrator in the scene).
2. They may interact with objects or people leaving portions of themselves behind or removing items from one location to another, (ownership and origin).
3. They then change position to another location (motion and direction) where they will again remain for a period of time (duration).
4. This creates a sequence which will traverse the crime scene and may reduce the importance of some portions of the scene (limit the scene).

These behaviors are revealed by the evidence; but they are also influenced by the structure of the crime scene as well as the participant backgrounds.

It may prove helpful to begin the theory of a reconstruction by seeking those evidence concepts that establish where a participant is (and what they did in that position) and then look for evidence to show movement (to a new position). Seek information that reveals duration at that position.

### **TIMELINE BACKBONE**

The critical elements of the crime may provide a “backbone” to evaluate the available information and determine if it contributes to one or more of the elements. It is helpful to employ critical thinking and evaluate what evidence can communicate to you, not just its “shape and form”. Consider the value of its relation to other items in the scene, its functionality or its contribution to the “sense of time and duration” (temporal). Seek all clues including the intangible as well as the tangible physical evidence which help define the perpetrator’s preparation, approach to the victim, control used to overcome the victim, means used to detain the victim, aggressive acts and the victim’s response, disposal, display or staging of the body and the perpetrator’s flight.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

#### **BENEFITS**

There are four instances in an investigation in which some form of reconstruction is used. 1) at the crime scene, 2) during the interviews, 3) in prioritizing forensic testing or follow-up investigation 4) in court.

#### **THE USES**

The **first** opportunity for reconstruction to assist an investigation is at the crime scene as the processing begins. Individuals responding to the scene cannot help but form a preliminary theory of what has occurred. The trained investigator can look into a crime scene and see things others do not. Scene interpretation is a complex interaction of vision, perception, recollection, recognition, a bit of imagination and role playing. This role playing helps the investigator imagine the actions and positions of the “actors” as the “props” of the scene are left behind. They then search for other “props” (evidence) which should reasonably be present if those actions are correct. By satisfying the critical element demands of a reconstruction while at the scene, it is unlikely that any evidence will be overlooked. In other words, the early stages of reconstruction can help the investigator at the scene better understand the objects in the scene, and more clearly identify the evidence of the crime.

The **second** application of the reconstruction process occurs as it provides investigators conducting interviews, and/ or canvassing the area, with key details known only to the perpetrator. Imagine the investigator, armed with substantiated (factual) crime reconstruction information, conducting an interview with potential perpetrators or witnesses. The investigator would have the advantage of details, which could be used to help detect truth from deception during an interview as a subject offered his statement. Ideally, it is the investigator, armed with a such information, who can detect interview statements which conflict with the “facts,” watch for interview behaviors which mirror the perpetrators at the scene, and perhaps even influence the subject to provide a more effective interview.

A **third** area in which reconstruction has value is to prioritize the use of limited resources such as forensic testing. It is likely that any theorized reconstruction will have elements with several alternatives. Identifying alternative paths of a reconstruction may point to physical evidence which may help to eliminate or include possibilities. Therefore, reconstruction is helpful to prioritizing limited forensic analysis or other forms of follow-up investigation.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

#### ***BENEFITS (continued)***

A **fourth** area in which reconstruction may be of value is in assisting the prosecutor in the formulation of opening statements, closing arguments or to outline key areas to be addressed in the court presentation. An opening statement based upon a well-founded crime reconstruction can set the tone and pace for the court presentation of the witnesses and the evidence. Whether all or part of the reconstruction is presented is a matter of attorney preference. A well-documented reconstruction will clarify the criminal act for those who will determine guilt or innocence.

#### **OTHER APPLICATIONS FOR RECONSTRUCTIONS**

The documentation used to develop and document a reconstruction (such as the story board) can also be used to determine which evidence is foundational to the investigation. It should list all evidence and observational clues from which the investigator, attorney or forensic scientist can select the most critical items. The impact of those items which have mitigating foundational issues, (search and seizure, chain, contamination and the like), will certainly be clear in light of their impact upon reconstruction and perhaps the case.

The reconstruction may serve as a means of introducing evidence in court. The developed documentation supporting the reconstruction may be used, (in conjunction with the crime scene sketch and still photographs of the scene), to orient the jury. The reconstruction may serve as a visual aid for the expert witness, and as a summary of the key elements of the criminal act for the jury to review. It is imperative that all forms of verified investigative information are integrated into the proposed reconstruction.

The prosecutor must decide how (or if) to present a reconstruction in court. Occasionally, the use of a video using actors or a computer graphic animation are considered to present a re-enactment of specific parts of the crime. These presentations inadvertently include details of body motion, facial expression, posture and the like, which generally cannot be supported by evidence. These extraneous features of the re-enactment are a consequence of the media used, as actors try to simulate the “play” of the crime. In general, the use of re-enactments should be carefully weighed.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

### ***IN COURT PRESENTATIONS***

A re-enactment should include documentation of the evidence which supports each element of the reconstruction. Not every reconstruction lends itself to a visual re-enactment. Many can (and should) be described through testimony to the jury, *verbally* conveying a mental picture of only the most essential elements of the crime. Regardless of the style used to present a reconstruction, the flow diagram or story board will help associate the evidence to the critical elements. This permits the jury to correlate the previously introduced evidence with the theorized reconstruction. Visual re-enactments or their verbal counterpart should be as brief as possible when used in court, and include *only* the aspects supported by evidence.

### ***A REVIEW***

During the reconstruction process, the investigator should keep in mind the critical elements of the crime, which include the perpetrator's *preparation, approach, control, detention, aggression, disposal/display, flight/ alibi and post incident behavior as well as the victim's response to the crime.*

Considering these elements may lead the investigator to evidence not initially obvious in the scene or during interviews. By addressing the critical elements of the crime, logically considering all of the alternatives, (and possibly building a flow diagram), the best pathway to reconstruction will be identified. The investigator must remain alert to contradictions within reconstructions and modify them to include challenging evidence. Such an ongoing process will ultimately reconstruct the crime, ask and answer numerous questions, and formulate a solid court presentation. What remains, after logically debating even remote reconstruction possibilities, will arguably be the most-likely and the best-supported reconstruction. That reconstruction will imply minor details of the crime which must be verified by any investigative means. The overall reconstruction is thus supported and reinforced and is a consequence of the scientific method of theorizing, testing and re-evaluation of the accumulated data..

*The investigator must consider even remotely possible reconstructions if this method is to prove successful. This will help the investigator anticipate any challenge to the final reconstruction theory. Questions asked at the crime scene and successfully answered within the reconstruction will be routine when encountered in court. Imagine the alternative; when the question is encountered in court for the first time and the reconstruction (or the investigator) has not previously addressed it!*

## *EVIDENCE AND CRIME RECONSTRUCTION*

### *RECONSTRUCTION*

### *CONCLUSION*

There are those who claim that a reconstruction comes to them in a peak of inspiration, while others might claim that it “just happens” after staring at the evidence for hours on end. While these “methods” may work, explaining the processes to the court, the prosecutor, the defense or the jury is imprecise and often vague. By whatever mechanism a reconstruction is evolved, by whomever in the investigative team, it represents a natural evolution of thought which anyone in the jury must be able to follow and reproduce.

Reconstructions based *solely* on a particular expert’s complex science can sound impressive, and perhaps even influence an attorney impressed by the notoriety of the expert. However, a reconstruction which uses and conveys “*common sense*” and is *demonstrable and reproducible* in the courtroom is more likely to gain acceptance with the persons who really determine fact... the jury. Hopefully, keeping it simple and keeping it organized will get the job done.

The best reconstructions will be based upon very straight-forward products:

- A list of evidence that was important at the scene which includes thorough descriptions capturing what the item contributes to the investigation.
- Thorough photographs (overview, approach and close-up) and those which show relationships, functional conditions and transient evidence.
- Preserving the relationships of evidence at the scene (sketches) to include detailed sketches of critical observations.
- Adequate resources (things, people, time and knowledge) to provide support to the investigation. Examples include forensic labs and experts in areas such as firearms, trace, wounds, bloodshed and pathology.
- Integration of the physical scene documentation with well documented interviews conducted of witnesses, subjects of interest or the victim. These interviews must be critically evaluated to determine the value of the statements made.
- Any and all sources of information must be challenged. These are the building blocks that will form the foundation of the reconstruction.

Of course, all these scene products are best evaluated by the open minded, investigator who evaluates and forms opinions based upon objective reasoning.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

#### ***CRIMES AGAINST PROPERTY***

Reconstruction of criminal activity has application in virtually all areas of investigation. Crimes against property demand efficiency in response and processing, which can be improved if the investigator uses the basic concepts of reconstruction. The use of "role playing" permits the investigator to imagine how the crime may have been accomplished and focus attention to the areas likely to provide the greatest amounts of identifying evidence information.

It is unlikely that the investigator will encounter the organizational problems of logistics, manpower, scene scope, and security, as they are often minimized by the fact that residential or commercial burglaries are a common event in many neighborhoods. Although these types of offenses do not draw the curious bystander, news media, or other law enforcement officers, pressures leading to error still are present. Time becomes limited and there will soon be another call to handle. The property loss at the scene may be insignificant. Yet, it is this type of scene in which the police have the greatest contact with the general public.

#### ***HOW MUCH EFFORT***

The officer must decide quickly whether to proceed with scene processing or not, and, if so, to what extent should the physical evidence be processed? Many officers have been caught with the need to placate the victim and give little serious consideration to the collection of any evidence. With just one simple concept and a few tricks, the officer can greatly increase the effectiveness of his interaction with both the victim and the scene and will quickly gather significant evidence.

#### ***THE KEYCONCEPT***

The officer should mentally assume the role of the perpetrator. By the mental re-enactment of the perpetrator's actions, important evidence may be found. In addition, the officer will have the satisfaction of knowing that his appearance at the scene is serving more than in a public relations capacity. There just may be a clue which will apprehend the perpetrator. This form of "role playing" is the same concept used in major crime investigations to help sort through all of the possibilities of the crime scene reconstruction. It can effectively lead the officer to clues which may describe or even identify the perpetrator.



## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

### ***CRIMES AGAINST PROPERTY*** *(continued)*

To assist in the mental process of developing a “mini” reconstruction of the crime, the officer should question himself in each of the following areas:

1) If force was used to gain access to the property, where was it likely to be applied? What body actions would be necessary to accomplish the entry? What evidence of these body actions was left behind? Tool marks must not be overlooked; photographs (ruler included) or a cast of the impression should be made.

For example: A footprint on an exterior wall, beneath a window implies that the suspect may have grabbed the inside surface of the window sill or framing to gain entry. The underside of the interior sill would be a likely location for the suspect's fingerprints.

2) If the motion of the suspect brings him into contact with readily transferrable materials, they may remain on the clothing of the perpetrator. Samples (standards) of those items must be collected.

Examples of these include soil in shoe tracks, flaking paint on window ledges, broken window glass, or carpet shedding from the footwells of an automobile.

3) If the perpetrator had contact with items within the scene, then transferred trace evidence should be expected. Standards of the most likely transfers should be collected. Trace evidence may also be left behind by the suspect which could be helpful in describing the perpetrator's appearance or even DNA.

Examples include fibers, hair, broken glass, (and fingerprints!)

4) The officer should consider if the method of exit was consistent with the nature of the property reported stolen or the damages incurred.

A twenty-five inch, color, console television could not be taken through the same small window a burglar allegedly used to enter the scene. This may lead the officer to search in areas such as the inside doorknobs of exterior doors for the burglar's fingerprints.

## ***EVIDENCE AND CRIME RECONSTRUCTION***

### ***RECONSTRUCTION***

### ***CRIMES AGAINST PROPERTY*** (continued)

If it is decided to process the property-loss scene, and if fifteen minutes can be allocated for processing, each of these ideas can be considered and implemented by a trained officer. To be effective at the scene, the officer needs to mentally place himself in the shoes and gloves of the perpetrator and then search for the evidence left at the scene by those reconstructed motions and actions.

### ***SOME TRICKS***

When responding to a burglary scene, the officer should check the handle on the toilet and refrigerator for suspect's fingerprints. Many times both will be used by the burglar, especially if the crime occurred while the residents were away. In stolen vehicles, check the interior mirror and driver's side outboard mirror for fingerprints. By habit, the car thief probably reset their position for his own height. Subtle clues which can help describe the age and habits of the perpetrator can be left behind by such simple things as the radio volume and station setting, incidental trash (candy or gum wrappers) and even the nature of the objects taken from the scene. The scene investigator should be watchful for DNA evidence in the form of blood or other body fluid as well as items within the scene such as beverage containers, cigarettes, partially consumed foods or even fecal material. Such evidence, when associated to the perpetrator of the crime, has a high potential for successful DNA analysis and subsequent submission to one or more reference data bases.

Evidence in property crimes can, and will be processed by the lab for latent prints, without difficulty. Other forms of evidence such as DNA and complex trace, which take many hours of lab analysis, will be prioritized against crimes against persons cases. The officer should have a realistic expectation that these forms of evidence may just remain and accumulate in the "property room" *until* such time as they become useful to solve a series of property crimes by linking them all to a common suspect! There is nothing wrong with collecting such evidence, so long as there is a realistic awareness of the forensic information that can be developed from it.

Fortunately for the investigator, proper storage of evidence may well preserve it for a time when the case conditions warrant submission to the crime lab, or perhaps at a time when new technology can be applied to the item. As many scene investigator has learned, the things not done, the items not collected may well make the difference between solving a crime and it remaining "on the books" for years as an unsolved case – with the perpetrator at large and offending against others.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **BLOODSHED EVIDENCE**

Bloodshed has long been a subject of interest. From the most ancient war to the most contemporary crime, many have tried to understand the correlation of blood loss, weaponry and the methods of killing. How do weapons affect wounds, bloodshed and the victim's response? In criminal events the criminal investigator is likely to ask the same questions, regardless of the means of an attack. Can the cause of a bloodshed pattern be determined? Will the association of patterns help detect who is responsible for the injury? However; the answers to these questions are dependent upon several factors. The simplest of these factors are the type of weapon, nature of injury and location of the attack. Understanding these will provide the investigator valuable insight into the interpretation of blood as a tool to solving a crime and what to look for within the attack scene.

#### **METHOD OF ATTACK**

Weaponry and methods of attack have evolved throughout human history, to yield greater blood loss in less time, and reduce the ability of the victim to respond to the aggressor. For example, clubs and stones (wielded at close range and high risk to the assailant) typically result in lacerations, blunt trauma and compressive injuries, as force is applied to open and bloody flesh. Knives and swords, reaching deeper into the body, result in incisions, punctures and amputations which inflict damage to internal organs and expose veins or arteries. Because of the close proximity to the victim when using these weapons, the assailant is vulnerable to the victim's self-defense response AND exposed to a transfer of victim's blood.

Weapons wielded at greater distances, such as spears, arrows, firearms, inflict puncture wounds; perforating injuries or the removal of large amounts of flesh. The increase in distance between assailant and victim makes self-defense response less effective and decreases the opportunity for the victim's blood to be transferred to the assailant.

#### **ATTACK LOCATION**

The **manner** in which blood leaves a wound, a weapon or a participant is reasonably predictable; however, the appearance of resulting bloodshed **patterns** is greatly influenced by the surroundings. **Where** the attack happens can change the appearance of a bloodshed pattern. Specifically, the presence or absence of vertical surfaces and their distance from the source of blood greatly affects the appearance of bloodstain patterns. For example, the rapid swinging of a bloody hatchet will leave decidedly different patterns if the attack is in the middle of a very large auditorium with wide open floor; in a small room with complex vertical surfaces; or in an open plowed field.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***BLOODSHED EVIDENCE***

#### **VICTIM RESPONSE**

Once the attack is begun, the response options available to the victim are influenced by the location of the crime as well as the preparedness of the victim to cope with the attacker. Does the victim lash out with bloody hands, arms or legs? Is there a counter-attack? Will the victim run about depositing blood on the surfaces around him? How is the victim clothed? Will the victim simply lie down and let blood drain flow from his body? Each of these possibilities leaves a story in blood that is best interpreted by the investigator who is fully aware of the layout and dimensions of the attack location.

#### **BLOODSTAIN RECONSTRUCTION**

Overall patterns of blood may reveal the action which caused them, the position of the origin and even the sequence of occurrence. This evidence of shape, quantity and spatial distribution, (rather than biochemical composition), adds many details to the scene reconstruction by describing body positions, motions, and the sequence of events which occurred during the assault and, perhaps, after death. Bloodstain pattern interpretation may be a valuable tool in the reconstruction of how a crime occurred. But the patterns must not be isolated from the scene or other evidence during interpretation. The gain meaning when viewed in context with the richness of other evidence at crime scene and the physical layout of the scene itself.

#### **BLOODSHED AND WOUNDING**

The interpretation of blood patterns at the crime scene, though largely based upon common-sense-reasoning applied to “cause and effect” observations, must be built upon a thorough knowledge of the following key factors:

- Knowledge of the *dimensions* of the crime scene
- An awareness of the *participants' background* (behavior and health)
- Accurate *documentation* of the blood pattern
- Knowledge of the *weapon* used to cause the injury
- Understanding of the *wound*, (*volume and force* of blood loss).

#### ***Dimensions of the Scene***

The scene may restrict the degrees of motion of the perpetrator; the way in which the weapon could be used; and the ability for the victim to respond to the aggressor. For example, confined areas such as automobiles, bathrooms and hallways will inhibit the way the aggressor approaches the victim, the manner in which the weapon can be used, the ability of the victim to defend or flee from the assailant and what the patterns will look like.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***BLOODSHED EVIDENCE***

The location of a blood pattern is dependent upon the distance from, and height of the source to that pattern. Without knowledge of the dimensions of the scene, it becomes very difficult to interpret the location of the source and perhaps even the type of motion which caused the pattern. A thorough sketch which includes elevation views and measured heights is essential. These sketches should be correlated to thorough photographs taken not only of the of the overall scene, but also of the bloodstain patterns. Those skilled in combat may behave much differently than someone lacking such training.

### ***PARTICIPANT BACKGROUND***

Interpretation of bloodshed must consider the health, age and physical training of the participants in order to understand their physical capabilities, state of mind, as well as medications which affect body response. These factors, as well as the overall body mass and muscle tone, can affect the bloodshed from a particular type of injury and the appearance of the wound. Prior injuries and physical limitations may affect the degrees of motion in the victim's response to the attack. Special training may predispose the nature of the voluntary response of the victim.

### ***THE WEAPON***

The size and type of weapon used to inflict injury to the victim, or used by the victim in defense, is critical to the degree and form of wounding (therefore the overall volume of blood available to be cast onto the surfaces of the crime scene). Weapons are typically classified as cutting/chopping, bludgeoning, constricting or puncturing (which includes bullets). If the weapon is known, it may be possible to correlate it to a wound. Conversely, from the wound, we may occasionally infer the type of weapon. The amount of blood which can adhere to the weapon's surface can then be predicted and interpreted in light of the patterns displayed within the crime.

The investigator must be aware that the type and shape of the weapon affects the direction in which energy is applied to the wound and the direction blood is projected. (For example, a baseball bat swung in an arc to deliver a blow may preferentially project blood to either side of the bat, whereas a "2x4" will compress blood forward from the flat striking surface). How a weapon is used will also affect the appearance of the blood cast onto surfaces. Short "chopping" motions will leave patterns which are often typically discernible from broad "swinging" motions. Awareness of these common-sense factors permits better interpretation of bloodshed patterns.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***BLOODSHED***

### ***UNDERSTANDING WOUNDING***

The volume and speed of blood loss is dependent upon the *number* and *type* of injuries as well as their *location* on the body. In addition, the extent of wounding will affect the ability of the victim to respond and the distribution of bloodstain patterns located in the scene. The attending physician (or autopsy physician) should always be asked for as much information as possible regarding damage to the circulatory system as well as to the central and peripheral nervous system. Without this knowledge, reconstruction of the victim's behavior and the interpretation of bloodstains become less accurate.

The *number of wounds* as well as their depth and length are important to the amount of blood passed from the body. But a direct correlation of the number of wounds to the amount of bloodshed is not possible, since not all wounds bleed the same. For example, many investigators would assume that multiple stab wounds to the abdomen would result in vast quantities of blood loss into the crime scene. Experience tells us that the speed of the attack, victim's health, the extent of victim's response and even the clothing worn by the victim, may result in little to no blood at the scene. If the percentage of body fat is high, the degree of mobility is low, and the attack is swift, then it is unlikely that large volumes of blood will pass from the body. This victim may go into shock and die of blood loss retained within the abdomen. It is possible that the major externalized bloodshed from this body will occur as it is moved or handled by the medical team or coroner staff.

The *type of injury* relates to the amount of blood loss that may *potentially* be present at the scene. Wounds which have the potential for external bleeding include abrasions, incisions, lacerations, punctures, avulsion, amputation and crushing with penetration. Each offers a differing degree of circulatory exposure, therefore a greater or lesser percentage of blood loss from the body into the scene.

The *site of the injury* may be in an extremity, which, when moved in a natural response to the attack, (rapid upper body movements) may cast blood onto the scene surfaces. The injury may be to the abdomen or chest and affect major organs of the body, yet leaving minimal external bloodshed. Alternatively, the attack may be directed to the face and neck which are rich in blood and which easily vent blood through the typically exposed skin of the neck. The specific site of the injury will primarily affect the victim's response to blood loss; however, it will also affect the volume of blood represented in the patterns in the scene.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***BLOODSHED***

#### ***CASE SPECIFICS CRITICAL TO INTERPRETATION***

There are many factors to consider in the evaluation of the bloodshed patterns in the crime scene. Assuming that the wounds of the victim are known, and the scene has been sufficiently documented, then the pattern may be interpreted. However, the following case specific issues must be considered before any interpretations are reached regarding the actions responsible for the observed bloodstain patterns.

***What was the assailant's approach to the victim?*** The assailant may alert the victim to the threat, thereby triggering involuntary responses such as increased heart rate and blood pressure. ***What was the response of the victim to the aggressor?*** The response will likely be different if the attack is a surprise or occurred so rapidly that the victim is incapacitated quickly. If there is time for the victim to formulate a conscious response, then there may be efforts to limit the attack, counter with aggression, take flight, or absent all else, simply panic in a defensive "fetal" position. ***When and how did the wounding begin?*** Wounding is only part of the aggression which occurs in the assault. Continued aggression, even without additional wounding, will increase the distribution of blood patterns in the scene.

***What was the duration of the attack?*** The longer the attack and the more able the victim is to respond, the more blood patterns are likely to be present. ***When the wounding occurred*** in the course of the attack is a critical issue as well. Imagine a blow to the head, at the start of a foot race as opposed to a blow delivered at the end of the chase when the victim is cornered. Movement of an injured victim through the scene will deposit a greater range and volume of blood than the same injury delivered toward the end of the confrontation.

***Were all of the injuries capable of shedding blood?*** Injuries inflicted through layered clothing will not be able to distribute blood to the crime scene surfaces to the same degree as an exposed wound of the same type and extent. The general physical condition of the victim will influence the degree of bloodshed from a wound (fatty tissue retarding flow from an abdominal puncture wound). It is possible that some of the injuries may have been inflicted post mortem. The photo-documentation taken of the body on scene should be presented to the attending physician for interpretation as to when they were inflicted relative to heart function (blood pressure).

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **BLOODSHED**

#### **CASE SPECIFICS CRITICAL TO INTERPRETATION**

**What are the dimensions of the scene and the distances between objects?** Measurements are essential to accurate bloodshed interpretation. For example, an injury inflicted while the victim is lying in the center of the room may cast less blood on the walls than the same injury to a subject lying near a wall... if the distance is great enough. The investigator must document the patterns with a scene *sketch, measurements, and close-up photos with the detector parallel to the pattern* in addition to overall scene photographs. Overall scene photos alone are insufficient for interpretation as they are often taken from "an angle" or with a wide angle lens, and therefore alter the pattern's appearance.

#### **ESSENTIAL DOCUMENTATION**

The documentation of bloodstain patterns is essential to the reconstruction of the bloodshed crime. Without proper documentation, no amount of genetic or photographic analysis can provide the same type of reconstruction details. Bloodstain patterns on walls and floors at the scene can be best recorded and then preserved through the use of scaled photography or by subsequent efforts to actually bring the surface into the laboratory. However, the collection of the wall of an apartment, or the ceiling of a bedroom is at best a most difficult and costly process. Careful photographic documentation reduces the need to expend the resources to recover the complete wall or ceiling surface.

The most successful photographic documentation can be accomplished by using a grid to organize the sequence of color pictures taken. The grid can be easily constructed by running horizontal lines at two-foot intervals and crossing these with vertical lines at two-foot intervals. By placing a small letter or number in the corner of each square of the grid, each picture can be "puzzle-pieced" into its original orientation. A two-foot grid will enable the photographer to get close enough to the pattern to record the detailed shape of each drop and still keep the task manageable. If necessary, the grid can continue from the walls onto the floor to provide a total and continuous record of the stains at the scene. Digital photographs taken of each labeled 2'x2' square within the grid will preserve the appearance of each spot of stain as well as the overall pattern's relationship within the bloodshed scene.

An alternative to grid photography is to place tape measures in the horizontal and vertical axis of each picture. Either orientation for the scale may be used as a common reference baseline for all pictures taken of the pattern.



## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **BLOODSHED**

Photography is the principle method of documentation for bloodstain patterns of all types; however there are many means of augmenting these images to enhance comprehension of the sometimes complex conclusions reached from the interpretation of the bloodstain patterns. Three dimensional imaging (computer graphics) or on-scene laser-scanning may create a virtual model of the scene to provide a better understanding of the blood pattern interpretation.

It is suggested that the interpretation of bloodstain patterns be very conservative in the statements offered and not include assumptions or speculation. Minute details as listed below, can greatly affect the appearance of any pattern. The conditions relative to each of them should be integrated the overall interpretation of the patterns.

### **PRECAUTIONS**

Many bloodshed pattern interpretations are based upon photographs of the scene. Often the photos do not reveal all the information that is needed. Always consider:

- 1) Is the photograph adequate – taken with the lens perpendicular to the pattern and with a “normal lens”. Be wary of wide angle distortions that may skew the appearance of the stain or of individual blood spots.
- 2) Are you seeing all the stain? Is the target surface of contrasting color to the blood or other stain?
- 3) Do you know where the photographed pattern is with relationship to other portions of the scene? How are the photographs linked to each other? Is there a grid or other ordinate system that helps relate them? Is there a sketch?
- 4) Is the pattern on a vertical or horizontal surface?
- 5) What are the surface effects of the target? Porous, non porous, smooth, rough, **chemical treatment** (oils, soaps, greases). The presence of surface treatments will greatly affect the appearance of bloodstains. It is important to know what the target surface is and the likelihood of surface treatments. Is the target a kitchen wall (greases), shower (soaps), fabric (water repellant), garage floor (oils) or dirt (wet/dry, hard packed or tilled?).
- 6) Can you tell what the target is? What is under it? For example, a simple picture of a bloodstained sheet can represent differing volumes of blood loss depending if the sheet is over an absorbent mattress or a non-absorbent water bed.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **BLOODSHED**

#### **PRECAUTIONS (Continued)**

- 7) Read the autopsy report before interpreting patterns. Learn if there is blood on the hands and feet of the victim. Never assume that cast off blood is from the assailant and or weapon. The victim's response may well have resulted in rapid upper body movements causing "cast blood" just as easily as the aggressive movements of the attacker.
- 8) If the photograph is of bloodstains on the body (at the morgue or even at the scene) have the patterns been affected by the handling of the body by others in the emergency response team? Consider emergency medical as well as "body bag" alterations of original patterns.
- 9) Are the bloodstains "in the body"? (bruising or lividity) Were the photos taken using visible spectrum light (including flash) or were they taken with reflected ultraviolet lighting (UV); a helpful tool for cases of any type to show the full age range of bruises. (Domestic violence).

#### **POSSIBILITIES!**

It is possible to reconstruct human behaviors based upon the interpretation of bloodshed and bloodstain patterns. However, that interpretation must include full knowledge of the scene and the distribution of blood within that scene.

For the scene that lacks through documentation, there is certainly nothing wrong in a conservative interpretation of patterns that stops at "classifying them" by the words used to define them. Terminology such as "cast off", "wipe", "satellite" or "transfer" may well be accurate; however, they do little to reveal the actions of the attack and the victim response.

While it may be acceptable to limit the extent of blood pattern interpretation when documentation is limited, the converse is not acceptable. Without full knowledge of the wounds, weapons, scene, backgrounds and the patterns themselves, interpretation of bloodstain patterns that includes reconstruction of human behaviors is perilous.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***INTERPRETATION OF BLOODSHED:***

#### ***IN, ON or CAST FROM THE BODY***

Bloodstains may occur as discreet patterns that may be found:

- *Within the body* as lividity or bruising or pooling in body cavities;
- *On the body* on flesh or garments; or
- *Cast from the body* onto structures within the scene.

Bloodstain patterns are not always stable and should be observed and documented when first encountered. Such patterns are subject to alteration by the effects of weather, time and the actions of medical or investigative personnel. At all times, the effects of the first phases of emergency response should be considered. Bloodstains are easily altered or created by the responding officer intent upon controlling the perpetrator of the violence, the medical team intent upon saving the victim's life or the coroner transporting the body. The stains may also be a result of the victim's movements after the assailant has departed or even by the effects of predation by domestic pets as well animals such as mountain lions, bears, coyotes, or rodents and insects.

#### ***WITHIN THE BODY***

Stains which are contained within the body take the principle forms of lividity or bruising. However, blood pooled in the cavities of the body from organ damage or hemorrhaging also provides a ready source of external blood patterns.

*Lividity* is a result of the diffusion of blood under the direct influence of gravity, and becomes enhanced by the continued flow of blood into damaged capillaries. Lividity begins immediately after the circulation of blood ceases, but usually becomes visible within two to four hours after death. For periods up to twelve hours, the accompanying discoloration can be shifted if the body position is significantly altered. After about twelve hours, the lividity becomes "fixed" in the position relative to the death. These time estimates vary with the overall environmental conditions (which affect the cooling of the body), the flow of blood within the body, and the medical condition of the victim. Lividity appears as a light-to-deep-purple discoloration in the flesh. The degree of contrast at the pattern edges will describe the limits of lividity; therefore, skin color may affect the ability to see the lividity. As a result of lividity, the appearance of "pari-mortem bruising," (near the time of death), can be enhanced by the diffusion of blood into the damaged capillaries.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***INTERPRETATION OF BLOODSHED***

Lividity supports observations regarding body movement after death, such as by the alteration of the body's position through an effort to re-stage the scene.

For example: A body that has been hanging for five hours since death and then moved to a prone posture will retain the lividity in the feet and hands because the extensive lividity will not dissipate. The post mortem movement of the body can be detected by looking for these blood patterns which denote their inconsistencies with the current body position.

*Bruises* (or contusions) are the result of blood abnormally entering tissues or organs which have sustained compressive damage. Bruises can often provide details as to the force used to create them, their relative age, and, occasionally, whether they occurred before or after death. Bruising occurs anywhere in the body; however, we shall confine ourselves to bruising of the skin visible at the crime scene. Bruising starts as soon as underlying vessels are injured and the flow of blood into the skin begins. Depending upon the degree of force and the depth of injury, the bruise may be immediately visible or take several hours to appear. Generally, the bruise will assume a semi circular appearance with diffusely defined borders. Depending upon the area of the body and the underlying vessels involved, bruising may also spread over an area larger than the impact location. It is also possible for the blood to surface in an area of skin which is some distance from the point of injury. This "ectopic bruising" occurs with deep injuries when the tissues underlying the skin obstruct blood flow to the immediate surface and the "path of least resistance" leads to another location.

Two questions are often asked. *Can the age of the bruise be determined? Can the weapon be determined from the bruise?* Taken in context with the rest of the scene evidence, it is possible to answer these questions... sometimes. "Common sense" tells us that a fresh bruise is red or purple and that an older one is shades of green to yellow. "Common experience" tells us that this transition takes from three to six days. However, most people have little experience with the degree of force and bruising found in fatalities. Though the investigator may form a tentative opinion, it is best left to the qualified expert knowledgeable in the medical history of the victim to interpret the age of bruising. The investigator must recognize the value of these patterns and record their transitory nature through scaled photography including reflected ultra-violet techniques to visualize older or hard to see bruising.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***INTERPRETATION OF BLOODSHED***

The appearance of the bruise pattern may reveal the shape of the responsible device or weapon. But here again, the specific location of the injury and the depth of the injury greatly affects the appearance of the bruise and, therefore, the ability to infer the weapon. The *location* of the pattern in itself may provide essential clues to the investigator. Bruises on the throat, face or hands may indicate a means of control, initial aggression or victim response actions during the commission of the crime.

### ***ON THE BODY***

Stains on the flesh and clothing relate to the posture and movements of the victim and/or the suspect at the time of bloodshed. Care should be taken to document flow patterns on the body to its position when found. These blood-flow patterns are related to the other elements of the scene; however, as they are susceptible to change when the body is moved, their interpretive or reconstruction value will be lost if they are not recorded until the autopsy.

The practice of enclosing the body in a rubber or plastic bag will destroy bloodshed patterns, as body fluids seep onto the clothing from wounds during transportation of the body. The clothing should be collected from the victim while at the scene. If removed at the scene, properly packaged clothing will retain greater meaning to the pathologist, the reconstruction process and the crime laboratory than clothing contaminated within the body bag.

It is for that reason that it is recommended that clothing which contains blood patterns be photographed on the body, processed for trace evidence and then removed at the crime scene, layered with clean paper (or newspaper) and placed into a paper container to be dried out at room temperature. This process should be worked out in advance with the coroner's office, with assistance from the district attorney. It is the **ONLY** way to preserve the patterns of blood (or absence of blood) on the clothing of the victim.

### ***ON STRUCTURES***

Stains of blood outside the body relate to the relative positions and actions of the participants. Apart from the genetic nature of these stains, there are the predictable components of shape, volume, distribution, sequence, and aging properties which can accurately provide details towards the final reconstruction of the crime. There is much that can be determined from the shape and number of individual blood droplets present on a surface. Surface treatments (oils, soaps, water repellants, etc.) will affect the appearance of the spots as well as the aggregate pattern. These surface treatments will not be visible in photographs! Always avoid overstating conclusions from too little evidence or background information.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***INTERPRETATION OF BLOODSHED***

#### ***BASIC OBSERVATIONS***

Interpretation of blood patterns, though a complex specialty requiring in-depth training, can be performed by the investigator while at the scene as a tentative investigative aid. Examples of general observations the investigator may make at the scene include:

1) Arcing patterns of blood on a surface can be the result of motions of the *suspect or victim* as the weapon of the assault is being swung **or** as the victim moves bloody arms and hands typical of rapid upper body movements. When the pattern parallels a wall, these patterns will usually be composed of circular drops near the start of the arc and increasing tear-drop-shaped droplets of blood evolving towards the end. This can predictably vary depending upon the orientation of the source and target.

**NOTE:** A continuous pattern which strikes a corner of a room may leave what appear to be two different patterns. The pattern may begin with oval or elongated spots compatible with a shallow flight path however, at the corner with the intersecting wall the pattern will suddenly change to circular spots progressing to elongated spots as the pattern continues down the target wall. This is a predictable result of the walls being perpendicular to each other and should not confuse the investigator into believing this represents more than one continuous pattern.

2) A fine misting of blood high on the wall or ceiling which is accompanied by a radiating hemisphere of small to medium sized blood spots is indicative of a weapon such as a firearm or other high energy source. Such patterns will include additional materials such as bone fragments, soft tissue, or hair. There will usually be damage to the wall or ceiling resulting from the firearm projectile. Look for the hole made by the projectile in the target surface! Of course, these patterns must always be considered in light of victim injuries and the dimensions of the scene.

3) A fine misting of blood low on the wall and floor accompanied by an irregular hemisphere of larger elongated droplets may indicate a bludgeoning to the head or other exposed flesh by a blunt object; Of course, this would be correlated to the wounding found on the contributing victim. Given the lower elevation distribution of the blood on the wall, it is likely that the lower portion of the perpetrator's clothing will have similar patterning and may reflect the posture of the assailant. For example, if the perpetrator is kneeling on his right knee, the right thigh will have bloodstains, while the lower leg may have none. The assailant clothing patterns usually do not contain bone fragments, large deposits of hair, or soft tissue.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***INTERPRETATION OF BLOODSHED***

4) Bloodstains in the arch of a shoe, accompanied by patterns low on the opposite pant leg, are compatible with a stomping assault; (be sure to check the inside surface of the pant cuff for small bloodstains). Fine blood spots on the toe of a shoe and the shin area of the same pant leg support a kicking assault. At the crime scene, there may be a fine mist of blood low on the wall accompanied by larger circular and semi-circular drops (resulting from the victim's head "whipping" from side to side as it is kicked).

5) In general, as the amount of blood available to be deposited increases, the size and number of droplets comprising the pattern will increase. This may give the officer an investigative lead as to the surface area of the weapon and when correlated to the wounding develop the type of weapon used to inflict injury.

6) Blood flow is principally affected by **gravity** and the **contour of the targeting surface**. This simple fact permits the investigator to interpret the body position at the time blood ran over the skin and clothing. The investigator need only apply common-sense reasoning and role playing to duplicate the effects of body position upon blood flow in light of the effect of the wounding upon the victim's ability to respond to the attack.

### ***GENETIC IDENTIFICATION?***

The interpretation of patterns must consider the need for DNA analysis!

- To assume that all of the blood is from the victim denies the natural instinct of the victim to protect him or herself from the attack by **inflicting injury upon the assailant**.
- To assume that all the blood deposited onto the surfaces of the scene is from the bloody weapon denies the natural instinct of the victim to limit the attack with **rapid upper body motions that can easily propel blood onto scene surfaces** in a manner similar to many weapons.
- To assume that the blood on scene is from the incident at hand may be challenged by the circumstances of the location. Public bars or tavern may have deposits of blood from prior assaults; homes may have deposits from prior domestic violence. **Scenes have been encountered where prior abuse** has resulted in human or non-human blood on surfaces. Determine that all the blood in the patterns is relevant to the event in question and not a pre-existing pattern!

**CAUTION!** The importance of bloodstains should be recognized by every investigator and result in their detailed documentation. However, interpretation must be by **qualified personnel** knowledgeable of the case circumstances.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **CAUTION IN BLOODSHED INTERPRETATION**

The final interpretation of these types of bloodshed is best left to the trained and experienced expert to resolve. Interpretation of bloody patterns should only be performed after the morphology of the wounds to the victim and/or suspect has been determined from medical reports or the post mortem examination of the body. The morphology of the wounds may determine the nature of the weapon, thereby limiting the manner in which the tool could have been used to deposit the pattern.

All bloodshed pattern interpretations are tentative without this information.

*To accurately interpret a bloodshed pattern, the investigator must know the backgrounds of the participants and location; the wounds of the victim; the type of weapon; the dimensions of the scene, and, ultimately the blood patterns themselves. Removing any one of these elements makes the interpretation of the pattern more difficult and more uncertain.*

Bloodshed interpretation must be based upon the total pattern. Some blood stain experts would lead the investigator to believe that the interpretation of blood patterns is predictable from individual blood droplets. Nothing could be farther from the truth. There is a tendency for some investigators to use trigonometric calculations to find the angle of incidence of an individual drop of blood. While valuable in limited cases, this is not necessary in the majority of investigations. All of the formulas which can be used to determine the angle of entry of a blood spot are relevant only on a SMOOTH and may be affected by the (non-uniform) porosity of the target surface. A conclusive interpretation of a blood pattern is built upon the examination of the total pattern, not individual droplets. *It is possible for drops within the pattern to give false information which will mislead the reconstruction.* Rarely will the overall pattern mislead the investigator, especially when considered in full context with all the evidence at the scene.

Introductory “bloodstain pattern” interpretation courses often lead the investigator to believe that the conclusions reached in laboratory demonstrations can be applied outside the laboratory in realistic crime scene settings. While generally true, there are many limitations and conditions which must be placed upon the application of those demonstrations. They are intended to orient the investigator to the potentials of bloodshed interpretation and provide basic knowledge to assist them in straightforward cases. Unfortunately, the investigator may erroneously apply his “cause and effect” experiences to more complex circumstances. Doing so is counter-productive to the reconstruction.



## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***BLOODSTAIN SCENE INTERPRETATION***

The following pages offer some cautions in the interpretation of bloodshed patterns in the typical crime scene.

#### ***HEIGHT DETERMINATIONS***

Few experts offer that the height from which a blood spot fell, or the distance traveled, can be inferred by measuring the diameter of the spot. The premise is that the greater the diameter of the spot, the greater the energy applied on impact (i.e.; the greater the fall). This assumes a standard blood drop volume (which will vary considerably depending upon wound and weapon) on a uniform surface (so diffusion is constant). However, the maximum impact diameter is achieved during a fall when the "terminal velocity" of the object has been reached (air resistance versus mass). In the context of a real case circumstance, this height estimation is of very little value to the typical scene.

#### ***ANGLE OF IMPACT***

The formulas for the determination of the angle of impact are based upon very sound logic and testing. That testing is typically performed upon smooth surfaces such as paper or glass. The effects of porosity and texture are negligible with these testing media. However, in the real world of carpeting, asphalt, cement, textured walls and the like, the trigonometric functions have little use. The surface texture and porosity will control the shape of the drop more than the angle of impact. It is also essential that the measurements of the length and width are *very accurately* conducted. Reproducible testing among scientists has revealed that as much as a 15% variation in measurements is found even under ideal laboratory conditions. Though it is reasonable to state that "the angle of impact may be determined by measuring the length and width of the spot," on typically encountered surfaces, it is most often not possible.

Though the interpretation of blood spot angles is complex and can involve physics and mathematical computations, the angle of impact can be easily approximated on scene by using a flashlight or inexpensive laser pointing device with a circular filter. Shine the light next to the spot of blood and vary the angle of the light beam to the bloody surface. When the cone of light and the spot of blood have a similar shape, the angle of impact will be represented by the position of the light source. Place the laser alongside a smart phone with "digital level" application and the angle is displayed! Though this is only an estimate, it may assist in forming an initial impression as to the spots origin.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***BLOODSTAIN SCENE INTERPRETATION***

#### ***IMPACTS TO THE VICTIM***

It is sometimes stated that it is possible to determine the number of impacts to the head of a victim by examination of the blood at the scene. This is possible only if the blood stains are taken in context with the entire crime scene and with knowledge of either: 1) the tool which was used and/or 2) the wounds which were inflicted. Most experts acknowledge that the first **bludgeoning** blow to the head will not result in a deposit of blood on the weapon; therefore no blood pattern should yet be cast from that tool. Many will look at scene patterns and "add one swing" to their interpretation. However, this discounts the reactions of the victim. If the second blow strikes a "clean" surface of the head (as if the victim turned to face the assailant or covered the head with an arm), that second impact would leave no blood on the weapon either. This might continue for several blows until a "bloody surface" was struck which would then transfer blood to the tool. Though it is reasonable to state that "the number of blows may be inferred from the bloodstains," the investigator will discover that without knowledge of the wounds, the tools or the true dimensions of the crime scene, it is often not possible.

#### ***POSITION AND MOVEMENT OF THE PARTICIPANTS***

The positions and movements of the participants at the scene can be determined by an interpretation of the blood patterns present. This statement is the foundational premise of the field of blood stain interpretation. However, the expert must also be aware of the injuries to the assailant as well as those of the victim. An assumption that only the weapon will be casting blood onto the scene surfaces will lead to false interpretations. It is therefore critical to know the nature of all wounds, the volume of blood coming from those wounds, type of clothing that may absorb the blood and the type of weapons involved in the bloodshed incident. When combined with the "degrees of motion" possible for the participants (scene limitations), this foundational knowledge may indicate blood patterns associated with aggressive behaviors, defensive reactions or the progression of movements through the scene.

#### ***HIGH AND LOW ENERGY IMPACTS***

The investigator may encounter the interpretation that "bloodstains consisting of very small (micro) spots are caused by a high velocity force." The correct terminology should be "high energy" not high velocity. The difference in terminology is most notable when applied to case interpretations. Many investigators have heard the term "high velocity blood spots" in association with firearm injuries. These spots are typically very small, distributed in a circular pattern and may have flesh, hair, bone or other body debris intermixed with them. Most frequently there will be bullet hole near or within the pattern.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***BLOODSTAIN SCENE INTERPRETATION***

#### ***HIGH AND LOW ENERGY IMPACTS***

These complete patterns are rather straightforward to interpret. However, the same pattern (or partial pattern) lacking hair, tissue, etc., is frequently described as “high velocity” (implying a firearm), when in reality it was created by a different means. Unfortunately, many other circumstances can create very small drops of blood. For example: a chain saw or circular saw, small explosive charge, even a violent beating or kicking are capable of leaving patterns having these micro spots of blood. These forms of aggression impart *energy* to the source of blood, thereby breaking surface tension and creating drops smaller than those created when less energy is involved, as in the larger drops cast off when a weapon is swung in an arc. “Micro” blood drops are created when the energy applied to the source of the ensuing blood pattern, overcomes the natural surface tension of blood, sometimes even atomizing it into a mist.

#### ***PART OF THE WHOLE***

Many misconceptions within bloodstain pattern interpretation stem from laboratory demonstrations intended to teach but which fail to simulate the dynamics of the human circulatory system or the degree of wound exposure during a real assault. Acceptable simulations of course do not involve living subjects. It is essential that every effort be made to evaluate the results of lab demonstrations in light of the complexities of the real crime scene.

There are many more areas of “bloodshed interpretation” which read well in the texts, but tend to fail in their application to crime scene investigation if applied literally. To stand the test of the court room, a reconstruction must be based upon a full knowledge of the entire scene, not just patterns of blood. Certainly, any crime reconstruction which is based solely upon the interpretation of drops of blood without taking all the evidence and forensic results into account is destined for substantial professional challenges.

Most experts realize the limitations of their endeavors and provide very conservative interpretations of the crime scene evidence and a well-documented reconstruction of the events and actions they believed occurred during the commission of the crime. A “step by step” reconstruction should be able to withstand the most critical review, because each and every interpretation which makes up the offered reconstruction has been supported by forensic results from any applicable discipline. Bloodshed interpretation is but one of many which build the world of forensic crime scene reconstruction.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***FIREARMS IN CRIME RECONSTRUCTION***

Crime scenes involving firearms and projectiles frequently involve ballistics, the study of projectiles in flight. However, this provides only some of the knowledge needed to interpret firearm scenes. In most instances, trajectory reconstructions and bullet impact interpretations are thought of in simple terms. The investigator may think that to establish a trajectory they need only “line up one hole with another” or to estimate the caliber of the projectile, just “measure the size of the hole.” Nothing could be further from the truth.

Listed below are *some* factors of target and projectile that greatly alter the trajectory or damage caused by the projectile.

#### ***CONTROLLING FACTORS***

The behavior of a projectile striking a target is controlled by many physical properties, most of which can be encompassed by four principle categories. The *composition of the target*, the *energy of the projectile*, the *projectile's structural integrity* and the amount of *energy conveyed* to the target.

- 1) *Composition of the target*-- The composition of the target will give it strength to resist distortion by the projectile. Never presume the target to be consistent or uniform in structure. Some factors which influence a material's strength is its ability to:

Hardened material targets - resist impression or separation because of density or structural integrity.

For example: steel is hard and resists change while vinyl is not hard and can be altered by much less energy.

Maleable targets conform to a different shape without breaking.

For example: the sheet metal of a car can be formed and bent into shapes, whereas hardened concrete does not bend to a new form.

Elastic targets distort and then recover its former shape after external force has been removed (*elasticity*). (

For example, skin, rubber, soft synthetics such as vinyl fabrics.

Frangible targets are of materials that fragment easily and offer very little resistance to the projectile.

For example; sheetrock or gypsum board can be penetrated or deformed with very little energy)

Compressible targets – the projectile pushes through the target leaving a path that will distort as surrounding material compresses.

For example, lumber, plywood, oriented strand board, particle board will have a smaller path than the projectile diameter and may easily divert the path of the projectile as it passes through the target.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***FIREARMS IN CRIME RECONSTRUCTION***

- 2) *Energy*-- The greater the mass of the projectile or the higher its velocity, the greater the kinetic energy available to work on the target surface. A bullet at 800 feet per second has less energy than the same bullet at 1400 feet per second.

The kinetic energy of the projectile will be transferred to the target surface in relation to its impact diameter and angle. Energy is applied "per unit area" (much in the same fashion as a hand pushing an outstretched finger into a balloon may not pop it, but the same amount of force using a "straight pin" will pop the balloon).

*For example: a 220 grains, 30.06 caliber projectile (.30 inches in diameter) has about 2400 foot pounds of energy at the muzzle of the weapon. A 470 grain slug fired from a 12 gauge shotgun (.75 inches diameter) also has nearly 2400 foot pounds of energy at the muzzle. The 30-06 initially applies its energy over .30 inches, whereas the slug initially applies it over .75 inches.*

- 3) *Structural integrity of the projectile*-- Projectiles may be made of materials ranging from hardened steel to soft lead. They may be formed with a solid leading point or a hollowed out point; jacketed with a hard metal or lack any jacket at all. These factors, and many others, affect the hardness and integrity of the projectile as well as how its energy will be conveyed to the target.

*For example: the copper jacketed 30.06 gradually flares from the nose to the body of the projectile. The 12 gauge slug made of soft lead alloy has no jacket and presents a bulbous, round nose to the target. The jacketed projectile has a greater structural integrity and penetrates a more resistant target than will a lead slug.*

In addition, if the target offers enough resistance, the projectile will deform, thereby consuming kinetic energy as the shape changes and heat is generated. This deformation changes the energy applied per unit area, and can make a difference in penetration (or not) as well as overall trajectory.

*For example: the copper jacketed 30.06 retains its shape better than the 12 gauge slug. Therefore it can apply more of its energy into penetrating the target at a smaller point of contact and avoid energy loss due to flattening.*

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***FIREARMS IN CRIME RECONSTRUCTION***

- 4) *Energy conveyed to the target--* Even under ideal conditions, one hundred percent of the kinetic energy of the projectile will not be applied to penetrating the target. If the projectile strikes at an optimal ninety degrees to the target, the maximum percentage of energy will be conveyed. If the angle of impact is less than ninety degrees, less of the kinetic energy will be directed into the target.

*For example: a .45 ACP lead bullet striking an automobile rear window at 90 degrees penetrates. At 15 degrees, it will ricochet.*

The percentage of energy conveyed to the target is principally dependent upon the angle of impact and the construction of the projectile (jacketing or not, hollow or solid, pointed or round?). These categories are the “layman’s expression” of dozens of complex relationships in chemistry and physics applied to the interaction of forces as a projectile strikes a target surface. When dealing with commonly encountered materials and projectiles, some of these complex factors interact in predictable ways which are helpful to scene interpretation. *Caution must always be exercised in applying these observations, since variations can occur.* Experimenting with the same ammunition and type of target is always valuable. The following pages summarize some of the reproducible observations made during more than 150 training demonstrations, shooting thousands of rounds of ammunition at automobiles and other common construction materials.

### ***GLASS AND FIREARMS***

Glass can be found in many forms and locations. Of greatest interest are three common types: glass panes in stationary windows, safety glass in automobile side and rear windows, and laminated safety glass as found in automobile windshields.

Typical glass in residential or commercial windows, consists of one or more sheets of glass which is produced in many thicknesses. It is uniform in composition and is a brittle material without practical elasticity or malleability which will fracture into large pieces. Once penetrated by a bullet, the hole is characteristically circular with fracture lines radiating from it. Multiple bullet holes into such glass can often be sequenced by the intersection of the radiating fracture lines. A fracture line which ends by intersecting another fracture line was created after that fracture. In cross section, the path of the projectile through glass resembles a tapered “ice cream cone” with the pointed end of the cone on the impact side and the flaring end opened in the direction of projectile travel. Though usually true, **beware** the exceptions that may occur when the glass is “shored”, tinted or textured surfaces!

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***FIREARMS IN CRIME RECONSTRUCTION***

Safety glass is tempered to break into small pieces instead of the more dangerous large pieces in plate glass. Safety glass displays fracture lines which radiate over the entire surface of the glass. A bullet which breaks safety glass will likely leave most of it in place but highly fractured. (Unrelated shocks such as road hazards may cause the window to collapse after the first break.) Near the break, these fracture lines point to the impact (like a starburst) but farther away they appear more random (like a tortoise shell). Subsequent bullet holes do not leave radiant lines (useful to sequence the breaks) but merely knock out an already broken piece of glass. The first projectiles to penetrate this glass will exhibit the same “ice cream cone” break described with plate glass. Using this, the investigator will be able to determine the direction of projectile flight.

Windshield glass is two sheets of tempered safety glass laminated with a “plastic” layer in between them. Breakage of this glass will result in large, radiant fracture lines which emanate from the point of impact. Since this glass is used in mobile applications, it is likely that there will be secondary shocks from extraneous road hazards. These shocks will cause the radiant fractures to randomly grow in length, possibly reversing the “intersect” principle which works with plate glass. Therefore, in many instances, it is not possible to sequence the impact of multiple projectiles upon windshield glass. Because of the dual layering, the interpretation of the radiant line intersects is even more difficult to accomplish and virtually impossible to document with photography.

It is possible to fracture layered glass on the side *opposite* the impact and leave the struck surface intact. This will most frequently occur when the concave surface (the inside) of the windshield is struck first. This can be done by a bullet striking at a very shallow angle; by “jabbing” the interior surface of a windshield with the palm of the hand or by placing one end of a wooden dowel against the glass and lightly striking the other end with a hammer. The fracture lines will be on the opposite surface. This breakage is quite different from the crater-like appearance of a non-penetrating bullet or from a pebble strike. There will be no impact crater formed, just radiating fracture lines. If a ricocheting bullet is the cause, evidence may be present as described below.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***FIREARMS IN CRIME RECONSTRUCTION***

#### ***BOUNCING BULLETS OFF GLASS***

Glass can be penetrated by almost any caliber bullet “straight on,” but for many calibers and bullet styles, there is a critical angle which will result in a ricochet without breakage. Projectiles can bounce from the surface of glass if the angle of impact does not convey enough energy to penetrate the target. In the instance of lead bullets, it is possible to determine the direction of flight of the projectile by observing the characteristic “comet’s tail” pattern “wiped” onto the glass surface. The head of the comet will be at the point of impact and the tail will point in the direction of flight. In addition, at shallow angles, it is possible to determine the direction of twist of the weapon. The trailing edge of the comet’s tail will be longer on the left for a left-hand twist barrel and on the right for a right-hand twist barrel.

As stated above, lead bullets can bounce off *rear window glass* as well as the *windshield*. With most convex rear windows, an impact of up to 20 to 25 degrees with a round-nosed bullet will deflect without breaking the glass. The use of **hollow point bullets** greatly reduces this critical angle of deflection without breakage to between 5 and 10 degrees, sometimes less. Much depends upon the caliber of the weapon used, as well as the nose style. Typically, higher energy, hollow point projectiles will penetrate windshield glass at shallower angles. For example, a “.38 +P+,” partially jacketed hollow point bullet will penetrate a windshield at an extremely shallow angle compared to a .45 solid lead bullet. The investigator should be aware that it is possible for a bullet to ricochet off an intact window and leave a break, much as if it had passed through the glass rather than having bounced off of it. The hole in the glass will prompt a search of the car interior for a projectile... but one will never be found!

#### **REMEMBER**

Impact with an intact rear or side automotive window safety glass displays a ricochet pattern reminiscent of a comets tail previously mentioned. It will often including its direction of rotation (referred to as the Chisum Trail). However, glass already broken will not display this.

It is still possible to ricochet a projectile from the fractured surface; however, at the point of impact, the pieces of glass will be simply knocked out leaving no “comet’s tail.” This can be used as an indicator that the glass was intact when the projectile ricocheted from its surface.



## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***FIREARMS IN CRIME RECONSTRUCTION***

#### ***GYPSUM BOARD***

Materials that are “frangible” offer little resistance to the projectile therefore the hole left by a bullet will be of the same “nominal caliber” as the projectile. Nominal caliber refers to the diameter of the projectile and ignores the type of cartridge or weapon from which it was fired. In other words, a 30.06, 30 carbine, .308 and even a .32 caliber bullet will leave holes of the same approximate diameter (.30 inches) in any of the surfaces listed. The nose style of the bullet is of little consequence to these surfaces, as they typically offer very little resistance.

Ricochets are unlikely with these materials because they offer very little resistance to penetration. Depleted velocity projectiles can ricochet from gypsum, but it is a rare occurrence.

#### ***WOOD and PLYWOOD***

A bullet through wood, plywood or chip-board may leave a hole actually smaller than the diameter of the bullet. During passage, the wood is compressed (like a nail into wood). When the bullet is removed, the compressible material re-occupies the path thereby reducing the effective diameter. In these instances, the impacted **surface** has the more accurate diameter than the actual path through the thickness of the targeting material.

It is possible for some materials (thick plastic, vinyl and especially plywood) to create a ricochet when the angle is very shallow or the projectile is low energy. It is possible for a bullet to enter into grained or layered products (wood) and travel with-the-grain or between the ply layering for some distance. These are examples of the bullet being trapped in the material and traveling through it in the path of least resistance. This can result in a very inaccurate estimate of the pre-impact trajectory.

#### ***BULLETS AND SHEET METAL***

The relationship between the projectile and the hole described for drywall, vinyl, cloth and the like does not hold true for sheet metal, as found in an automobile. Those materials are less cohesive than metal and do not have the same malleability characteristics. They also offer little resistance when compared to automobile metal.

There are some who erroneously believe that a bullet will leave a hole equal to its caliber diameter as it passes through the metal of a car. Much depends upon the nose style of the bullet and the velocity of the projectile. There are a few reproducible observations which will assist scene interpretation.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***FIREARMS IN CRIME RECONSTRUCTION***

1. At handgun velocities, conventional hollow point bullets will leave a larger hole than solid nose bullets of the same velocity and caliber (reduced structural integrity). Higher speed rifle ammunition is designed to maintain structural integrity therefore nose style effects are greatly reduced.

2. At handgun velocities, bullets may leave a depressed crater surrounding the hole and a circle of "flaked paint." As the speed of the bullet increases and the nose remains solid, the diameter of the hole created will be reduced to the actual diameter of the projectile and the depressed crater will flatten. E.g. 5.6x28 jacketed leaves just that nominal caliber diameter hole and no depression. 22 LR leaves a 30 caliber hole and depression in the metal.

3. Using handgun velocity, hollow point bullets; a .22 will leave about a .30 caliber hole; a .38 will leave a .45 caliber hole. High velocity rifle bullets such as the .223 with a full metal jacket (or hollow point) will leave a .22 caliber hole (the actual diameter of the projectile). Jacketed bullets will retain their shape better than hollow or soft lead bullets; therefore they will leave holes in the metal closer to their original diameter.

4. Any caliber bullet can leave an elongated hole, sometimes referred to as a "keyhole" because of its appearance. This is not predictable with a specific discharge or weapon; rather it is dependent upon the irregular wobble of the bullet about its axis. This keyhole is a complex interaction of bullet profile, weight distribution, aerodynamics, the target and, marginally, the barrel of the weapon. It rarely happens with ball-shaped shotgun pellets unless the impacted surface is curved. Then it may tear in an oblong shape rather than a circular hole. Under most conditions, it is not possible to reliably say that the elongated keyhole resulted from a worn barrel in a weapon.

5. The angle of bullet ricochet on a sheet metal surface can be **approximated** with a dowel placed in the first 1/3 of the depression. The angle of exit from the ricochet path can be estimated from the last 1/3 of the depressed track. The point of impact will be sharp and the point of exit flared (like the comet's tail). Fractures in the painted surface will resemble the ripples from the bow of a boat and indicate the direction of projectile travel in the same fashion.

6. The angle of entry into a surface is greatly reduced by the nose style of the projectile. Hollow point bullets will penetrate car metal at a more shallow angle than will a soft solid nose projectile, e.g. a .38 lead bullet will require an angle of nearly 40 degrees to penetrate the hood of a car, whereas the same projectile with a hollow point will penetrate in two thirds that angle or less.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***FIREARMS IN CRIME RECONSTRUCTION***

#### ***BULLETS AND TIRES***

A tire made from "rubber" compounds is very elastic and will return to its original shape after the force of the projectile is removed. The sidewalls of a tire can be penetrated by almost any caliber bullet. A .22 caliber short bullet can flatten a tire (on a car at rest), and will leave the same diameter puncture hole as a .38 caliber round nosed bullet. This is because solid nosed bullets penetrate by stretching the rubber of the tire which then, due to its elasticity, snaps back leaving an "ice pick-sized" hole. There is a significant difference, however, in the appearance of the "wiping" or "ring" which surrounds the hole. The larger the caliber of the bullet, the larger the wiping on the hole perimeter.

If a jacketed hollow point bullet strikes an inflated tire, the hole which is left is comparable to the inside diameter of the hollow point of the projectile. The bullet simply "cores out" a portion of the rubber rather than "punching through" and leaving the rubber to snap back into place. The "wiping" surrounding the hole is nearly the same diameter as the hole and the caliber of the projectile. A tire struck by a jacketed hollow point will flatten rapidly, whereas a tire penetrated by a solid nosed bullet will slowly deflate, much as though a nail had punctured a tire and then had been removed.

#### ***APPLICATION TO RECONSTRUCTION*** ***A CAUTION!***

Bullets, bullet holes and trajectories often play a significant role in the reconstruction of crime. This evidence will often interact with other forms of evidence at the scene which might support or refute it. As with all other forms of evidence, no single item stands alone in the crime scene or in the reconstruction of the crime. Even the most predictable evidence can sometimes lead to a wrong conclusion when taken by itself. Consider the scene as a whole, not just pieces of evidence.

#### **CAUTION**

**Never** "connect bullet holes" to determine a trajectory without considering the effects of: **ammunition** (energy and composition); **target** (composition and uniformity), energy **conveyance** (at impact and during penetration), as well as the inaccuracies of measurement that do not create a "point position for the shooter, rather a broad zone (or cone) of a most likely position.

In dealing with these forms of firearm evidence, the investigator must develop two resources to augment his training and "common sense": **specialists** with **relevant** expertise and **demonstrative testing** which strives to reproduce all of the conditions of the shooting. What you "believe should happen" is not necessarily what practical testing (science) will ultimately demonstrate!

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE AUTOPSY:***

### ***AN EXTENSION OF THE SCENE***

*The homicide scene must extend to the autopsy table.* There are very few investigators who would let the weapon leave the crime scene, yet many permit the body to be removed and processed without their being present. The body is the crime scene "corpus." An investigator who was present at the crime scene should be present at the autopsy. Observations, photography, and collection of evidence are vital and should be conducted as though they were a continuation of the original scene. To perform that scene processing, the crime investigator has the obligation to inform the pathologist of what the scene looked like and what educated theories have been reached.

The physician augments the team processing of the total scene. The interpretations and conclusions at which he will arrive will be greatly assisted by the "scene images" provided by the investigator. The collection of specific forensic samples can be assured and made easier by a cooperative team approach to the autopsy. The physician in charge will usually be responsive to the questions and suggestions of trained and knowledgeable investigators. If at all possible, the autopsy should be performed by a physician who has received additional specialized training as a forensic pathologist.

There are some investigators who erroneously believe that pathologists can effectively conduct forensic post-mortems without knowledge of the crime scene. In the limited sense of answering the question: "What was the cause of death?" that may well be true. However, to answer the greater question: "How did the person die?" (meaning the sequence of wounds and the reconstruction of the actions leading to the death), the investigator must convey essential information to the pathologist. In addition, the pathologist and investigator must convey their opinions and information to the crime laboratory. The pathologist may be able to give a medical cause of death; however, only the full team can arrive at opinions as to how the victim died, which includes a reconstruction of the actions, timing, motive and identities of those involved.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE AUTOPSY***

### ***A TEAM APPROACH***

As a member of the autopsy team, the investigator has five primary obligations to perform:

- 1) Observe: Record critical details as to the wound trauma to the body, or clues as to contact with the suspect or events leading to the victim's death.
- 2) Ask: Allow no question as to the physical condition of death go unasked of the pathologist. All questions, regardless of how trivial they may seem, must be asked and answered at the autopsy. It is most unlikely that the body will ever be examined by a pathologist again: and, if it is, it will never be in the same condition as it is at the first autopsy.
- 3) Inform: Advise the pathologist of the appearance of the body at the scene as well as details of the mechanism of the victim's death. It is important that the doctor have all information relevant to assisting the investigator in answering the question: "How did the person die?"
- 4) Record: Document and photograph the wounding, both those which are evidence of the attack as well as those which describe the defensive actions of the victim. Note such features as the lividity, rigor, or adhesions of trace evidence as the conditions of the scene indicate.
- 5) Collect: Though the investigator does not in most cases personally collect samples from the body, as the case investigation is his responsibility, it therefore falls to him to insure that they are collected.
- 6) Share: Theories as to the commission of the crime should be shared with the pathologist during the autopsy. Many of the observations and opinions drawn at the crime scene will interact with the medical findings of the doctor; some may even alter the procedure.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE AUTOPSY***

The autopsy can be considered as at least four phases, each of which requires extensive photographic documentation of all surfaces of the body and clothing.

- 1)At the scene.
- 2)At the morgue, prior to washing the body.
- 3)At the morgue, after washing the body and prior to the post-mortem dissection.
- 4)The post-mortem dissection of the body.

### ***AT THE SCENE***

The autopsy “at the scene” **does not** include the invasive procedures as conducted by the medical personnel in the morgue. The focus of this “autopsy” is to observe, evaluate, document and as necessary collect evidence found on the victim’s body and clothing.

- a) Transient evidence, such as gunshot residues, should be collected at the scene prior to any handling of the body and as soon as it is practical: Time is of the essence for this form of evidence. Successful testing will occur on samples collected within six hours of the shooting provided the effects of the environment are kept to a minimum. In addition, the investigator should consider the need to process the body for assailant fingerprints (on the smooth flesh of the victim) and swabs of the victims exposed erogenous zones for foreign DNA, (neck, breasts, thighs, etc). “Gun powder patterns” should also be collected.
- b) Bloodstains on the body of the victim must be noted and photographically documented for later reconstructive interpretation. Once placed into the body bag, these patterns will be lost forever.
- c) Bloodstains on the clothing should also be photographed and then removed from the victim while at the scene. This material should be layered with paper both inside and out and packaged in paper containers until they can be air-dried, and then frozen.
- d) Adhering (trace) evidence will have additional significance by their position on the body. These items should be collected and their location noted prior to bagging the body. To wait until at the morgue to remove these items ignores the unpredictable changes made by the body bag. Each garment or portion of the body should be separately processed for trace evidence and items placed into separate containers carefully layered with clean paper to prevent cross contamination.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE AUTOPSY***

#### ***SCENE TO MORGUE***

Ideally, when the doctor has the body delivered to him, it will have been already processed for the perpetrator's fingerprints, gunshot residues, fully photographed, and the clothing will have been properly packaged for his careful examination. All items, including the measurements and sketches, should be made available to the doctor to provide him thorough details of the scene.

#### ***NOTE***

*Removal of the clothing may conflict with the existing administrative practices, but is the best way to preserve the full value of the clothing as evidence.*

Observations as to lividity and rigor mortis are important at the crime scene as soon as the "scene processing phase" begins. These timely observations will assist in the determination of the time of death of the victim by giving the pathologist a "baseline" of observations from which to interpret. Remember that reflected ultraviolet light photography can enhance contrast and improve visibility of bruising and lividity in darker complexioned individuals.

#### ***AT THE MORGUE***

Several forms of evidence on the body are fragile and need to be quickly recorded and collected. This becomes very significant when one considers that the morgue preparation often includes a thorough washing of the body to provide a clean work surface for the pathologist.

#### ***PRIOR TO WASHING THE BODY***

1) If there is a wound to the exposed skin where distance of discharge would be critical, samples of the powder residue pattern must be collected for lab analysis and interpretation. This should be done at the scene, but if not, then here at the morgue. This is especially true for distances between six inches and three feet. By applying moistened (acidic) large filter paper to the area around the wound, residues of lead or gunpowder can be collected for later analysis. The doctor should collect tissue sections for microscopic examination of charring and the disruption of the underlying flesh evident in close-range discharges. These tissue sections should be examined by a forensic pathology laboratory for the inclusion of powder residues and cellular disruption.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE AUTOPSY***

### ***PRIOR TO WASHING THE BODY***

2) Blood should be collected from the heart, or, if any abdominal trauma is present, from a major artery in the leg. This sample can be placed into an appropriate blood tube, as though it were being drawn from a living subject, or absorbed onto a clean gauze pad. If there is no blood available otherwise, the pathologist should obtain a sample from deep muscle tissue in the thigh with a gauze pad; saturate, air dry, then package.

3) The pubic region, head hairs, and beard should be combed for transfers of foreign materials. Standards should be obtained from head and pubic regions as necessary per case conditions, or from any other body hairs where a transfer seems likely (near a scratch wound on the eyebrow, for instance). The investigator must be certain that these standards are not loose hairs trapped in the mat of hair from the deceased. One way to accomplish this is to “tug” on the hair to be sure it is attached to the deceased. It may then be cut close to the skin or pulled.

4) The gumline should be swabbed for the collection of seminal fluid residues. The vaginal and/or anal tracks should also be swabbed or aspirated for seminal fluid residues. Significant samples may be present for up to 72 hours after deposition and death. The mouth should also be checked for bits of flesh which may have been bitten from the suspect. These bits of flesh can be compared to wounds on the suspect's body and perhaps matched to their origin by either serological factors or by actual shape.

5) Bite marks, if present, should be photographed and then should be swabbed in a manner suitable for DNA analysis. If there is any saliva or foreign cellular residue on the flesh, it may well be comparable to the DNA database. A Duplicast or Mikrosil cast should be made to preserve the indentations in the flesh for later comparison with the suspect's dentition.

Bite mark evidence has diminished in application with living victims in lieu of DNA testing. With the deceased, the bite mark should be well documented and cast for the Forensic Odontologist to examine. Be sure to include scales and many angles of photographs, especially on curved surfaces of the body.



## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE AUTOPSY***

#### ***PRIOR TO WASHING THE BODY***

6) Any remaining trace evidence should be searched for before the body is washed. Package each item of trace evidence separately and indicate that it was removed from the body in the morgue prior to washing of the victim.

7) Fingernail scrapings, previously of value in very few cases, should now be considered for collection in each case. The advent of cell level DNA detection capabilities means that the genetic profile may be under the nails of the victims hands! Even if there is nothing visible, the nails should be carefully evaluated and swabbed or clipped.

8) Many observations at the autopsy require photographs; therefore, a good camera and flash must be available. Many details of wounds and trauma marginally visible under normal illumination will be enhanced by flash photography. Details of the extent and depth of wounds can best be documented by color flash photography which includes a scale for reference. Photographs should also be taken with available lighting to provide a complete documentation of the body. When necessary utilize reflected ultraviolet light photography to capture bruising and lividity.

#### ***AFTER WASHING THE BODY***

It is imperative that the perimeter of wounds be examined prior to the autopsy, and certainly before there is any insertion of probes, to determine trajectories through the body. There are many forensic pathologists who advise against the practice of using probes for pathway determination. Many would rather utilize x-rays to locate the bullet and its path within the body from the distribution of lead and bone fragments.

The investigator should be aware that though any medical doctor may perform an autopsy in some states, many who do so are not forensic pathologists. Though most medical doctors certainly can determine the medical cause of death, only the most experienced and most enthused use their abilities to address the forensic and police questions as to the "how" of the death. For example, the pathologist must note the damage to the major organs (and the immediate effect of the damage), injury to veins or arteries, (to help estimate the amount of blood loss), impact to the central and peripheral nervous system (immobilization of the victim) as well as opinions as to the weapons used to inflict the observed damage to the body. Above all, the doctor must be a "team player" in the investigative process.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE AUTOPSY***

#### ***REMEMBER***

The pathology components of an autopsy should not be concluded until all questions have been answered. It is essential that the autopsy be performed as a team: the forensic pathologist and the police investigator. Once the autopsy is "finished," it is too late to ask and answer questions. The body will be lost to burial, or worse, to cremation.

Ask the doctor two questions essential to the reconstruction of crime activities and the interpretation of bloodstain patterns:

- 1) What was the damage to this victim's **central and peripheral nervous system**? (How can you testify to movements without knowing if the participant suffered partial paralysis or lost consciousness?)
- 2) What was the **damage to the vessels of the body**? (How can you interpret bloodstains to develop motion, duration, position etc. without knowing the amount of blood flow from the injuries? Imagine testifying to arterial spurting and have the doctor say there were no arteries damaged!

#### ***A CHECKLIST AT THE SCENE:***

- 1) **Thoroughly** photograph the clothed body at the scene. Note lividity and record the positions of the extremities as well as the presence or absence of blood on the tops and bottom of the hands or feet (or shoes).
- 2) If a firearm is involved, sample the hands for gunshot residues while at the scene. Note any visible patterns on the body or clothing.
- 3) If there is a firearm the injury to an exposed part of the body (inferring a gun powder pattern), collect the pattern from the exposed skin.
- 4) Process the body for the suspect's prints and foreign DNA.
- 5) Remove any remaining adhering trace evidence from the body or clothing.
- 6) When appropriate, remove the clothing and package them in separate paper containers layered with paper. Retain the packaged clothing for the pathologist to view and the lab to analyze.
- 7) Place the body into the body bag for transportation to the morgue.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **AUTOPSY CHECKLIST**

#### **AT THE MORGUE:**

- 8) Photograph the naked, unwashed body thoroughly.
- 9) Remove any remaining adhering trace evidence, even though this was done at the crime scene.
- 10) X-ray the body as necessary.

#### ***THE AUTOPSY***

- 11) Examine the fingernails for trace evidence. If any is found, clip the nails into small bindles.
- 12) Record the victim's fingerprints.
- 13) Collect vaginal, oral, and rectal swabs, as needed.
- 14) Comb the pubic region and head hair for any transfer materials.
- 15) Pull or cut close to the flesh, samples of hair from the head and pubic region or any location wherein transfers may be involved.
- 16) Color photograph all injuries and lividity using flash photography.
- 17) Collect blood from the heart for grouping and drug studies. If abdominal trauma threatens the purity of the heart sample, use the femoral arteries (thigh). Lacking all blood, obtain a deep muscle tissue sample from the thigh.
- 18) If possible, collect a urine sample for drug studies.
- 19) Be sure that the autopsy includes examination of the head and throat as well as the abdominal cavity. Any wounding to the extremities must be thoroughly sectioned. Note damage to vessels and nervous system.
- 20) Be sure that the pathologist sections any firearm wounds to determine the inclusions and extent of damage to the flesh. These samples must be saved.
- 21) Be sure that the pathologist has viewed the x-rays and incorporated the observations into the autopsy protocol!

#### ***REMEMBER***

This checklist will serve the officer in securing most of the evidence required to provide the crime laboratory with samples and standards; however, it should not be used as a substitute for creative thinking while at the autopsy.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***GRAVESITE DIGS***

Processing the exhumation of an illicit gravesite is always an awkward task for the investigator because:

- There is no clear definition as to the boundaries of the scene,
- The location of the grave usually complicates access,
- It is an unusual task that involves specialized approaches not frequently practiced.

Much of the hesitancy is from not knowing how or where to begin. A few hints should make the task more manageable and less a mystery.

Consideration must be given to how certain it is that the location found is truly a grave and not just a household dumping site. Usually, a confession by the suspect or a co-conspirator, statements of an eyewitness, or hearsay from third parties, leads the investigator to the suspected gravesite. The total confidence in the information should dictate the degree of logistical support and the technical involvement committed to the dig.

The investigator may have a large terrain to search, based upon a vague description of the suspected gravesite. The first step in searching for a gravesite is to reduce the total area to be searched. It is impractical to search more than ten acres without an extra commitment of costly resources. Infra-red, magnetic, sonar and vapor detectors, advertised as being able to speed the search over large acreage, have not proven to be successful in locating a gravesite. Dogs are often helpful, but be certain that they are properly trained and regularly re-trained in the scents they will be searching for. Even a trained dog can be of little use if the handler does not follow proper procedure or influences the dog in subtle ways.

After the investigator has limited the size of the area to be searched, the next step is locating the gravesite itself. The easiest and most efficient method used in finding the body is to conduct a ground search for the features of an aging gravesite. This may be done using a lane or grid search and a variety of tools (including a backhoe or road grader as a last resort). The use of probes during the lane search detects the subtle differences in soil compaction which occur after the hole is filled. This compaction is dependant upon the time since original excavation, weather conditions and the type of soil. Generally, a grave less than five years old will have less compact soil above the body than that of the surrounding native soil and can be located using probes.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***GRAVESITE DIGS***

#### ***APPEARANCE OF GRAVES***

Compaction of the soil and the other appearances of the grave are a result of several factors. These are:

#### ***THE SEASON***

1) Consider the time of year the grave was dug and the time which has transpired between closure and discovery. The growing seasons for ground cover and the amount of rainfall can greatly affect the appearance of the gravesite in as little as a few weeks during the late winter or early spring. In the middle of the dry summer season or a cold winter, little plant material grows. Very wet soil will compact much sooner than the rate for dry soil of the same type. However, this will result in settling of the surface topography.

#### ***GROUND WATER***

2) The presence of ground water can lead to a faster soil compaction rate which affects a probe's ability to discern between undisturbed soil and fill. Settling will be greater as the amount of water increases; however, lush ground cover can mask the detection of slippage and settling.

A secondary effect of water will be to wash the tailings (the remainder of the soil removed from the hole) from around the grave. These tailings at one time partially covered the existing plant growth. The tailings were reduced as the hole was filled in and as subsequent surface water eroded the pile. This allows the plant growth to re-surface. Water will also deteriorate clumps of soil and accelerate the return of the earth to the natural appearance. Settling may be all that remains and that may be obscured by the plant growth in the area.

#### ***OBSCURED SURFACE***

3) Settling may also be obscured by dead ground cover, leaves, needles from trees, by placement of limbs or stumps over shallow graves, or by the effects of field cultivation and plowing in a vacant parcel of land. Plowed earth implies a deeper grave, or else the body might well have surfaced by the plowing of the earth. This deeper tillage may appear as a different texture or coloration when observed in a field, even one freshly plowed.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***GRAVESITE DIGS***

#### ***COMPOSTED SOIL***

4) A mat of leaves and needles will require the use of density or odor probes combined with a "hands and knees" search to detect the inversion of the naturally occurring compost effects.

The appearance of lush vegetation may flag the gravesite. The growth may be greener if sufficient time has passed to allow the aerated, moist soil and the additional nutrients to germinate new growth. It is also possible that moisture from the body may extend the growing season during dry months and leave vegetation above the body green, while the surrounding plants are brown. The ground cover may be from a different generation of plant life than the surrounding plant materials. This may be indicated by the presence of short, broad-leaf plants instead of taller, slender grasses.

Debris incidental to the filling process may provide the key to locating the grave. Examples include: piles of forest debris, excessively groomed soil, overturned tree trunks, and large stones with exposed bleaching or soil stained lines. Many of these items may have been existing in their prior position for a long time and may well show signs of weathering on surfaces now visible, yet inconsistent with their current position.

#### ***WHERE LOCATED***

Grave sites are likely to be near roadways or vehicle-accessible locations. If the grave is in a remote location not accessible by automobile, it is probable that the victim was alive and walked to the scene; or that the perpetrator had assistance in transporting the body. It is unlikely that a body would be carried for great distances; rather, the suspect would look for a different convenient location. To aid in the search, it is helpful to remember graves are commonly concealed by: 1) grooming the soil to appear undisturbed, 2) concealing the grave under brush or debris, or, 3) simply choosing an obscure, remote location.

Sometimes, the best way to locate a grave is to stand back and observe the way nature has painted the landscape and patiently discern how man has altered the composition by repositioning fallen logs, or by overturning rocks long-since weathered by the sun and rain. Usually it is a combination of search techniques that leads to one or more possible sites for the suspected grave.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **GRAVESITE DIGS**

#### **PROCEDURES FOR THE DIG**

Once the officer has established specific sites to be dug he should:

- 1) Prepare a rough sketch of the general area to coordinate the search plan, establish reference points, and locate prospective graves as progress is made in a lane search.
- 2) Secure the area around the most likely grave sites. Take overview photos.
- 3) Decide the following:
  - a) What digging tools should be used (from backhoes to gardening tools). During the critical stages of the dig, smaller tools prevent evidence loss.
  - b) Where will earth from the dig be dumped? Will it be screened in this case, as it normally would be?
  - c) What reference points will be used to measure items recovered from the grave?
- 4) Before the dig, check the area for evidence, such as casings, personal possessions, and weapons. Clear and secure an area for the excavated soil. Place a tarp on the ground to separate existing undisturbed soil from the soil removed from the grave.
- 5) Dig a small exploratory hole to assess to depths of about two feet. Check the odor of the earth at the bottom of the hole. If confirmed, then proceed.
- 6) Carefully clear vegetation from the area to facilitate the search for evidence on the surface of the ground. Watch out for anything that may be trapped in the vegetation itself.
- 7) As the dig progresses, take ample documentary photographs.
- 8) As articles are discovered, measure their location from reference points, their depth, and sketch their location. Photograph and then collect the sample.
- 9) In wet soil, where sifting will probably not be effective, consider the use of a sluice box.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***GRAVESITE DIGS***

- 10) Continue digging until firm, undisturbed soil is encountered. If possible place the body on a plywood pallet to remove it from the grave. If any evidence supporting the use of firearms is found, continue the digging for one foot more in depth. The bullet may be located just inches beneath the body.
- 11) Use sectional and overview sketches to properly document the scene.
- 12) Package items only after they have been fully photographed in place.

### ***HELPFUL HINTS***

If the grave can be approached from the sides by forming a trench on either or both sides, then access to the items of evidence is greatly eased. Carried to its fullest extent the trenches can be dug so as to place the body on an earthen pedestal for access and collection.

These procedures should not be employed until the body is confirmed as being in the particular site. This may be accomplished by digging a "pilot hole" or using a bore tool to core a sample of the earth to the depth of the body. While both of these methods may damage the body, the risk must be weighed against the time a methodical dig will take and the inherent costs in personnel resources any department would face. Learning that all of these efforts were spent digging up household trash will quickly sour the investigator and their supervisors from tedious methodical excavations in the future. A small pilot hole will remove the possibility of a "false start" in retrieving the body.

### ***ORGANIZING THE PROCESS***

If the gravesite search is going to involve more than two or three people, the investigator will be confronted with the need to organize the search and the logistics of the effort. It is not unusual for a search and dig to involve ten to twelve people and take three or more days. This means that arrangements must be made to maintain the comfort and enthusiasm of the scene searchers. Meals, sanitation, rest sites, medical support, communications and even lodging must be considered in all such situations.



## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***GRAVESITE DIGS***

It is helpful to explain how the processing will proceed and how tedious duties, such as digging, will be rotated among all staff. Though a seemingly minor point, clarifying the length of the workday and the frequency of rest periods puts the mind of the searchers at ease and helps to maintain their energy levels. It is critical that the team leader impress upon the whole team the importance of their full attention during the search and dig. Inattentiveness may cause a vital sign or clue to be overlooked, thereby casting doubt on a day's worth of searching or digging.

### ***SAFETY AT THE DIG***

Proceed with caution, both to secure the evidence, and for your personal safety. Never eat, drink, chew, smoke or "scratch" at the gravesite. Wear protective gloves (cotton work gloves over surgical gloves are best). Wear some sort of particle mask over your nose and mouth to keep dust and bacteria away. If you have an open wound, stay away! And for personal hygiene... always wash before a visit to the "lavatory" as well as after. Decaying flesh can harbor a wide variety of disease, none of which are pleasant.

### ***THE VERY OLD GRAVE – or is it?***

Very old investigations have their own set of problems. The search for body parts, discarded decades ago, is an intimidating task. The following list of questions are those this author feels essential to the search for an "illicit" grave. For the very old case, the responses to these questions substantiate (or not!) the commitment of resources to the search and the methods used during that search.

### ***QUESTIONS TO ASK***

- What is the source of information leading to the area of the excavation? Watch out for hearsay and the effects of time upon "eye witness statements!"
- How large an area is to be considered in the search for the illicit grave site? If large, how will the search area be prioritized? Why?
- What resources are needed to locate the grave and "forensically" remove the contents? Consider specialized human resources based upon skills, magnitude of the search area, complexity of terrain.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **GRAVESITE DIGS**

### **ADVANCED GRAVE EXCAVATIONS**

- Is there a necessity for specialized personnel? This may include botanists, geologists, climatologists, entomologists, grave taphonomy specialists, archaeologists, pathologists, naturalists familiar with local predators (surface and subterranean), forensic scientist, cadaver canine unit, as well as general law enforcement.
- Scientific technologies applicable to a search such as FLIR, Sub surface sonar devices, magnetometers, metal detectors, vapor sampling devices, canine units, density probes, soil sampling (bacteriology). Find an expert to learn the limits of each of these!
- Search methodologies such as lane or grid patterns, vertical insertion (trenching), horizontal stripping (soil gradient dependent), unobstructed areas and underwater burials!
- The history of the location. What else is there in the area of the search? Other “non-technical” factors that may affect the detection of an illicit grave in the areas to be evaluated. How well is the prior activity in the area known?
- Prior habitation (recent or historical) that may have penetrated the earth and left “clues” of digging from “non- criminal” behaviors
- Plane crashes, harvesting, mining operations, efforts to change ground contours (house “pad”, pools, wells, cisterns, garbage dumps, out-houses, etc)
- Aggressiveness of surface and sub-surface predators to human remains.
- What is the realistic investigative goal for the excavation?
  - Develop physical evidence leading to a prosecution intended to eliminate future threat to the people?
  - Exhume physical evidence of the burial to identify remains without likely link to a perpetrator?
  - Eliminate possibility of illicit grave (no previously dug hole is located or no evidence of reason for the “hole previously dug”).

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **GRAVESITE DIGS**

### **ADVANCED GRAVE EXCAVATIONS**

Once these factors have been evaluated, the team should consider the technical details relating to the various natural and man-made clues that may remain on the site that may be useful to detect locations for excavation.

### **WHERE TO LOOK**

The following questions address the areas that have been used in a wide variety of illicit grave searches (personal experience). Though some may seem less relevant, experience has shown each to contribute to an overall sense of the “likelihood of success” that an investigator or supervisor must consider prior to committing resources available under their command.

- What are the relative sizes of the person killed and the killer? This can affect the initial transport of the body to the excavation or disposal location (limiting the search area). This may even affect the positioning the body into the illicit grave site (body position in the hole affects detect ability and method of search).
- Is there a description of the clothing or other personal effects that may be buried with the body? (Rate of decomposition for synthetic materials, naturally occurring fibers or metal).
- What is known of the means of homicide? (Projectile, sharp, blunt trauma, poison, etc. influences how deep to dig once a body is found)
- What were the resources available to the killer at the time of the initial burial? This includes the means to transport the victim to the disposal site? (vehicle, pack animal, gravity) as well as the means to excavate a burial site (shovel, backhoe, etc.)
- What are the time frames involved? How much time was available for the digging of the hole? What is the duration from death to burial (autolysis – putrefication – predation?)
- When was the hole(s) dug? (Season of the year/ calendar month?). Consider local climatic conditions: (wet/dry; snow, heat, wind etc.) affecting soil density and compaction. Do local surface conditions impacting human comfort (125 degree day or heavy rains?)

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **GRAVESITE DIGS**

### **ADVANCED GRAVE EXCAVATIONS**

- Meteorological conditions since the burial to determine: (US Weather Service) such as the amount of soil moisture, wind shift of terrain or the effects of heat on soil chemistry or subterranean life.
- Are there any man-induced means of affecting water content of the soil, acidity or bacterial content? (US Geological, County Agricultural Department) such as irrigation, waste disposal, garbage or refuse, chemical disposal (gasoline, clan labs, toxic waste, etc.)
- Geological elevation position of the hole being dug to assess susceptibility to water runoff (drainage), wind erosion (exposure) or earth movement - further burial
- General compass direction exposure in relation to surrounding topography that may affect solar exposure, or shelter from direct effects of wind, and rain
- Stratification of the soil in the area of the grave, (topsoil, subsoil). Consider the layers of various soils (loam, sandy, clay, hard rock, etc.) that create barriers to penetration by the digger, or the flow of subsequent water through the illicit grave or redirection of vaporous materials.
- What is the chemistry of the soil and its effect upon bacterial conditions, or the presence of fungi (spores) that affect the putrefaction or decay of the soft and hard tissue of the body,
- Chemistry of the soil that may accelerate or inhibit putrefaction or decay (acid/alkaline, aerated or anaerobic, moist or dry)
- What is the native foliage in the area of the illicit grave and their typical lifespan of naturally occurring plants given climatic conditions of the period in question?
- How do those plants change (adapt) to survive if there is surface soil movement? (Exposure of roots, burial of trunk, branches, etc.)
- Do the plants provide any information regarding surface soil movement in the area of the illicit grave?

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### **GRAVESITE DIGS**

### **ADVANCED GRAVE EXCAVATIONS**

- What are the (non-human) predators prevalent and active on the surface of the soil? Could the surface predator detect mammalian remains and would it be attracted to the potential food source? If so, where would the predator consume the remains? Where would the predator abandon or excrete the remains?
- What predators occupy the soil beneath the surface? What is their range of depth, extent of travel?
- Has the area been controlled to limit access or activities in the area that would inhibit unpredictable factors affecting the natural “aging” of the terrain or the burial site. Include consideration of physical barriers such as remoteness, fencing or security measures, active patrol or potential site being a scenic, historical, sensational attraction.
- What has been the history of human occupancy in the area in the interval since the illicit grave was dug?
  - Is there evidence of earth movement (larger or small scale) or other activities such as roads, soil exploration for valuable earth resources (minerals etc.), development of water sources or water holding capacity, horticulture/ agriculture, human sanitation? (Bodily waste or garbage) disposal, or archaeological excavation (professional or amateur)
  - Natural movement of the earth by forces such as water, wind, earthquake, fault migration, slope-settling by erosion or compaction?
  - Is there a record of fires in the area that would alter plant life?
  - Plane crashes, military activity, prior amateur excavations.

### **CONCLUSION!**

And with all these factors considered, the investigator “stuck” with this case can move forward with the strongest case to acquire needed resources – or not!

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE ARSON SCENE***

The processing of an arson scene is a very specialized problem area of scene examination, which should be undertaken only by the well-trained investigator or team of investigators. It is a subject that calls for on-site interpretation of burn patterns, experience with the effects of heat upon construction and occupancy materials, as well as a knowledge of the behavior of various accelerant, ignition devices and fuels.

Arson is used to satisfy one or more motives, among them: revenge, profit, the concealment of another crime, or the act of a pyromaniac.

In each case, evidence will remain which can support one or more of these motives. It is helpful to the investigator to consider those elements which will document or substantiate which of these reasons is applicable. The officer should keep in mind:

- 1) Was an ignition source used which was not natural to the environment of the fire area?
- 2) Does an accelerant appear to be the likely source of initial fuel?
- 3) Were fuels concentrated near the ignition point in an effort to enhance the initial effect of the ignition?
- 4) Were valuable items removed from the location prior to the fire itself?
- 5) What evidence is there that damage or violent activities occurred at the scene prior to the fire?
- 6) What effect did the suppression activities have on the appearance of the evidence at the scene?
- 7) If the scene contains bodies and extensive fire debris, it is helpful to approach the excavation and recovery as though it was an extensive elicit grave site. When informed by interviews of fire suppression personnel to learn what they did in suppression and large debris removal, the recovery team can best establish a plan for excavation of the bodies and increase the likelihood for significant small or fragile evidence recovery.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE ARSON SCENE***

Scene processing for evidence item collection must address itself to each of these areas through the use of the well-trained eye, careful photography with flash, and the acquisition of carefully selected and packaged samples.

Examples of each of the above listed areas will serve to more fully explain them.

### ***IGNITION SOURCE***

1) There are many methods for igniting the fuel at an arson scene. Among the possibilities are matches, cigarettes, candles, electrical devices, and chemical mixtures which generate heat when mixed. The complexity of possibilities prevents thorough details from being given here; however, for our purposes, it need only be understood by the investigator that these methods of ignition exist and are frequently used. The investigator should thoroughly document and collect samples from likely ignition sources, and then package them to protect their value as evidence. They can be analyzed later to determine function and meaning.

### ***THE ACCELERANT***

2) Accelerants such as vapor and liquid samples may yet be present even in the most severely burned fire scene. Volatiles are most likely to be found remaining under carpeting, beneath floors, in crawl spaces, in the padding of chairs or car seats or even under the floor mats in a car. Any area which is suspected as having a volatile accelerant should be sampled, and the material then placed into an airtight container to preserve the vapors. If the burned area is composed of a plastic or synthetic material of an oil base, be sure that a "control" sample is also collected and separately packaged.

Occasionally, the fuel is natural or bottled gas from a stove or heater. These gasses can and should be collected from the scene and from several different elevations in the scene. A container once filled with water can be poured out, thus allowing the "tainted" room air to replace the water volume of the container with the vapors or fumes of the scene. Other, more sophisticated methods exist to collect these samples; however, this method will work just as well as syringes and evacuated bottles.

## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE ARSON SCENE***

#### ***FUELS***

3) The arsonist's efforts to simply concentrate fuels to support a fire are often difficult to detect. In the most simple case of an incomplete combustion, there may yet be excessive fuels visible: for example, newspapers or clothing piled up, or containers of fuel placed in unusual locations. Many times, especially when the fire was extensive and the suppression efforts very thorough, evidence of fuels can be destroyed. In those instances, the fire damage may not be consistent with the amount of fuel normally encountered in that portion of the building. Careful observation of the burn pattern can lead to an opinion as to what fuel might have been responsible and whether it was "naturally" occurring to that portion of the structure.

#### ***LOSS OF PROPERTY***

4) Valuable items are often removed by the owner-arsonist to increase financial gain realized from insurance claims. The officer should search the rubble of the fire for the remnants of the television set, or the absence of common household items such as toasters and microwaves or expensive items claimed on a loss form such as silverware or the latest in computer hardware.

#### ***TO CONCEAL A CRIME***

5) Occasionally, the police investigator is involved at the scene of an arson, especially when the fire was used to conceal a major crime against persons (homicide). It becomes important, therefore, that the scene processing incorporate both the arson and the homicide elements.

Just as the evidence of the arson remains, so can the details of the homicide or other crime remain. Depending upon the extent of the fire, items such as bullets, knives, ropes, bones (sufficient for identification), guns, and even blood can remain in a form suitable for laboratory analysis.

#### ***WHAT REMAINS?***

6) For the trained investigator, very little evidence is actually destroyed by a fire or by the suppression efforts. For those who encounter arson only incidental to other crimes, it is helpful to know that there are many forms of evidence which can survive a fire and still prove to be valuable evidence. For example:



## ***SPECIAL FORMS OF RECONSTRUCTION EVIDENCE***

### ***THE ARSON SCENE***

- Blood held by the folds of material at the hinge of an automobile seat.
- The numerals on a clock may reveal the time of the incident.
- One side of the victim's body may be protected enough to reveal that the victim died of stab wounds and not from the fire.
- A melted firearm can be subjected to X-ray analysis to determine the position of expended cartridges relative to the hammer.

In these and many other situations, viable evidence can still be found and suitably analyzed, often with amazing results.

Among the many observations that an expert arson investigator will make at a fire are specific burn patterns on all surfaces; general patterns of heat or soot; damage patterns which serve as indicators of the relative positions of furniture or building components (burn marks on the inside of a doorjamb indicating the door position at the time of the fire); and the condition of the remains of the structure which might indicate the temperatures which were attained during the fire. The thorough documentation of these critical observations at the scene rely upon photography to record them.

### ***ARSON PHOTOGRAPHY***

The photography at an arson scene should include overall shots taken with a detached flash used at oblique angles to the field of view. This is done because the usually blackened and charred surfaces will not photograph well if the light is directly incident to the surface. It will be absorbed by the rough top-layer or cast irregular lighting patterns. Oblique illumination will provide increased surface contrast and greater resolution of detail in burn margins, smoke horizons, and the usual "alligator" effect on burned or charred wooden surfaces.

### ***REMEMBER***

As with every major crime scene involving other life saving or property saving personnel, those entering the scene must be interviewed. In arson cases, interview the fire crew to determine what they saw and did at the fire. Get their impressions of the scene. They may have a well-founded opinion as to the fire's origin and fuels used.

## *ADVANCED RECONSTRUCTION*

### *ADVANCED RECONSTRUCTION*

#### *GETTING MORE FROM RECONSTRUCTION*

There are many varieties of reconstructions. Some simple ones only deal with a single action, such as the interpretation of cast-off bloodstains resulting from a bludgeoning. Interpretation for some simple reconstructions were discussed in the section of this text titled “special evidence”. On the other hand, complex reconstructions often deal with a series of actions, such as the abduction, rape and murder of a victim and require dozens of clues to create.

The effort to reconstruct a crime is found at every step of an investigation regardless of the complexity of the crime. Everyone wants to develop information which can reconstruct the “who, how, why, when, where” and more; information that will solve the case. But, how do we extract more information from the crime scene? How do we recognize clues that others may miss? The answer comes from realizing that not all clues surrounding an item of evidence come from lab analysis.

#### *MORE THAN PHYSICAL EVIDENCE*

The guidelines for the collection and preservation of evidence are often based upon an items physical form. But the information contained by an item is not limited to just its tangible physical form, but also in its intangible relationship to other items and to the scene. If there were but two items at the scene, their relationship would be easy to recognize. But with so many items at a scene, it becomes very difficult to recognize which relationships are important. Often, an item or its particular relationship to other items is acknowledged because it supports or denies a reconstruction someone has developed while at the scene. But the scene will be processed and released before the lab analysis is finished; before all the interviews are completed; before all the possibilities for a reconstruction come to light. How can the investigator find more clues BEFORE all these other tasks are completed? The key may be in understanding the “elements of a crime” and considering them at each crime scene. These elements help create the activities within the “story of the crime.”

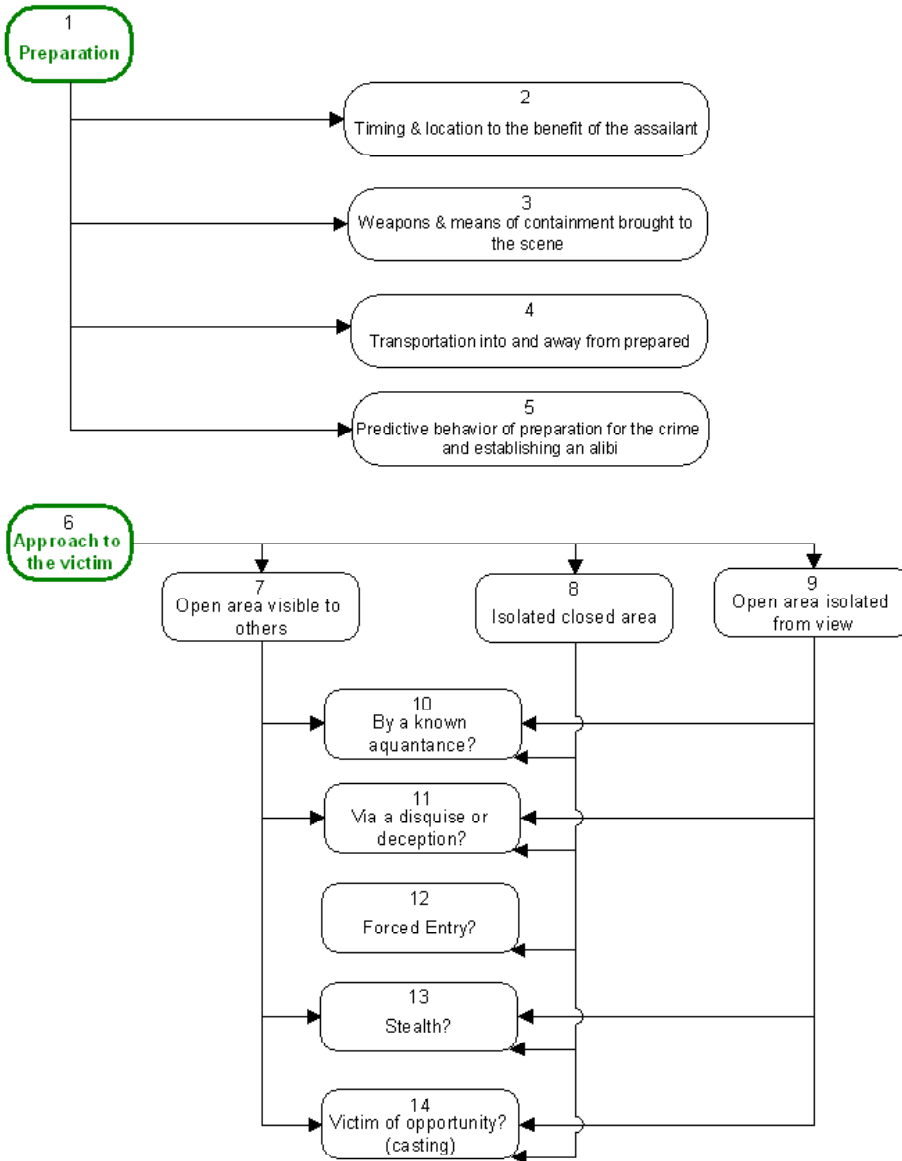
#### *DETAILS OF THE CRITICAL ELEMENTS*

The actions that occur in the commission of a person-person crime such as assault, rape or murder generally fall within certain predictable patterns of the “critical elements.” Not all the elements are involved in every case. However, **the investigators should search for clues that may shed light on each and every possibility.** This section describes the interaction of “clues” and the “critical elements of the crime” to help frame the story of the crime.

## ADVANCED RECONSTRUCTION

### The Critical Elements

#### Assailant and Victim Interaction



## ***ADVANCED RECONSTRUCTION***

### ***DETAILS OF THE CRITICAL ELEMENTS***

#### ***PREPARATION***

Preparation: This addresses the efforts of an assailant to develop a course of action in the crime and ready all participants and resources. This may be the first stage of an aggressive act against another person (or property). The assailant may develop and rehearse the approach, control and containment of the victim as well as obtain weapons, develop a plan of aggressive action and a means of escape from the scene. Usually the **timing and location of the crime, the weapons, bindings, access and transportation** are subject to this preparation or planning stage.

#### ***APPROACH***

Approach: The initial contact between the assailant and would-be victim comprises the “approach.” The approach selected by the assailant may be imposed by external circumstances beyond his ability to manipulate or control. The spontaneity of this initial action is often reflected in the degree of force or forcefulness of action as well as the choice of bindings, weapons or even the speed of the attack. Little planning may be evident in the approach, especially if it erupted spontaneously.

However, if the perpetrator can maintain control of the circumstances, a degree of planning and preparation will be evident and reflected in the approach selected; the time and place for the attack, the weapons, bindings, and the duration of the event.

The approach depends upon several factors, including the environment surrounding the victim. For example.

An open area visible to others such as a crowd of people who might intervene.

An area isolated from view in an open area concealed by darkness, vegetation or remote location.

An area isolated from view in a closed area safe from outside observation such as a home, car or even a bathroom cubicle.

The approach will also depend upon the mental agility, physical strength and likely defensive reaction of the victim as perceived by the assailant.

For example

The very young or mentally challenged who lack the awareness of the approaching hazards require less skill and perhaps less force by the attacker.

## ***ADVANCED RECONSTRUCTION***

### ***DETAILS OF THE CRITICAL ELEMENTS(continued)***

#### ***APPROACH (cont)***

The physically fit and aware victim requires more ingenuity and more force in the assailant's approach.

The person who displays defensive training or concealed weapons may require even more skill or force by the assailant in his approach.

These factors blend in a variety of ways to create a situation in which the assailant becomes aware of the potential risk to himself and selects a method of approach to the unwary victim. These approaches can take the form of the following styles or guises.

*Known acquaintance* would be allowed entry into the "secure space" of the victim. There would be no indicators of forced entry such as broken windows, kicked doors or damaged door handles.

*Disguises or deception* may be used to deceive the subject to gain access to the secure space of the victim. The disguise must be believable enough to diffuse any concerns of risk by the potential victim. Usual disguises are as maintenance workers, utility personnel or law enforcement staff.

*Forced entry* is the result of one or more persons gaining access to the victim by sheer power or ingenuity. This may result in broken glass or door locks, unless the doors or windows were originally unlocked! There need not be any sign of the initial entry into the residence if there was no effort made by the victim to keep others out of the area.

*Stealth* can be used by the assailant to get closer to the victim without his knowledge until some form of "containment" can be applied preparatory to aggression. This could be accomplished if the victim was sleeping or unconscious when the subject entered through an unlocked door or window.

*"Casting"* depicts the situations when the assailant is actually "baiting," overtly or passively, the victim to approach him. In this manner, the victim never suspects that he is being controlled and ultimately lured into a threatening situation. The victim is unaware that his cooperative "free will" is actually placing him at risk. The need for a "control" stage is usually limited in this approach.

## ***ADVANCED RECONSTRUCTION***

### ***DETAILS OF THE CRITICAL ELEMENTS (continued)***

Control: Once contact is made with the victim, how does the assailant initially deprive him of his free will and gain control over him? Again this is reflective of the environment and the victim. If the attack is very aggressive, then the control and containment phases may blend with the aggression used against the victim.

*Force or intimidation* may take form as any of dozens of possibilities. Guns, knives, domineering size differences and even a red light on a patrol car are just a few examples of things used to gain control of others. They may be used for a long or short period of time.

Close proximity force is one where the aggressor is in physical contact with the victim. Examples include a choke hold, knife to the throat or even an overpowering physical strength.

Intermediate distance force occurs when the control device must be administered at close proximity to be effective and yet there is some distance between the assailant and the victim. This distance affords the victim the opportunity to evade the threat. Examples include an assailant with a baseball bat, or a knife closing the distance to the victim.

Force at a distance does not require the assailant to get close for the force to be effective. Examples include the firearm or explosive device.

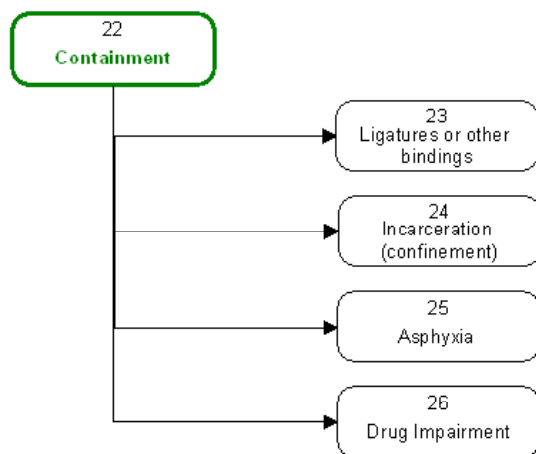
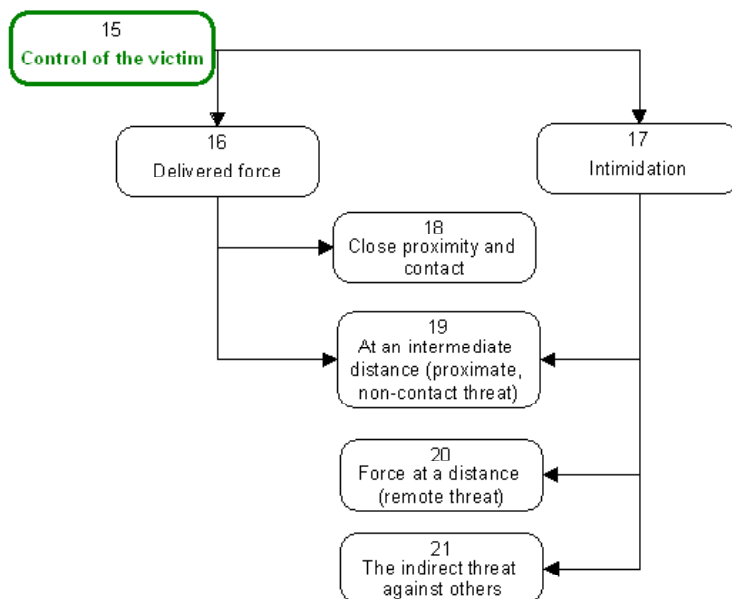
The indirect threat may be directed to another to coerce the subject (a parent-child relationship or a threat made to harm another significant person)

*Blitz* is a swift use of force that the subject cannot overcome. The combination of surprise and force places the subject at a disadvantage and leads to their loss of control of their surroundings.

*Mentally controlling* another person (in the absence of an implied indirect threat) is a sophisticated and complicated form of interaction. Extensive time without external influence is typically required for this to be effective. This control may be of short or long term duration and may or may not involve some form of containment.

## ADVANCED RECONSTRUCTION

### The Critical Elements



## ***ADVANCED RECONSTRUCTION***

### ***DETAILS OF THE CRITICAL ELEMENTS (continued)***

Containment: After the victim has been deprived of his free will through the active attention and efforts of the assailant, how does the assailant maintain that control? This phase permits the assailant to deliver the aggression in a measured and prolonged fashion. Often the “containment” phase is bypassed and the assailant progresses to rapid and energetic aggression (blitz). Containment is not always a sign of prolonged extreme violence; it may also be present in a lesser crimes against persons such as assault and property theft (home invasion for example).

*Ligatures and other bindings* are common forms used to contain the already controlled victim. Occasionally, devices such as sleeping bags, bedding and other commonly encountered domestic objects are used to restrict the degree of mobility of the victim.

*Incarceration* may be used to isolate and contain the victim in a confined area. In this manner, the victim remains under the control of the assailant without actively involving the assailants personal energies.

*Render the victim unconscious* and unable to thwart the efforts of the aggressor by blunt trauma to the head or asphyxia. This asphyxia may be induced by manual strangulation, by garrote or noose, or by blockage of the air passages.

*Drug impairment* can also be used to rob a person of free will. A controlled substance is usually found in blood or urine of the victim.

### ***AGGRESSION***

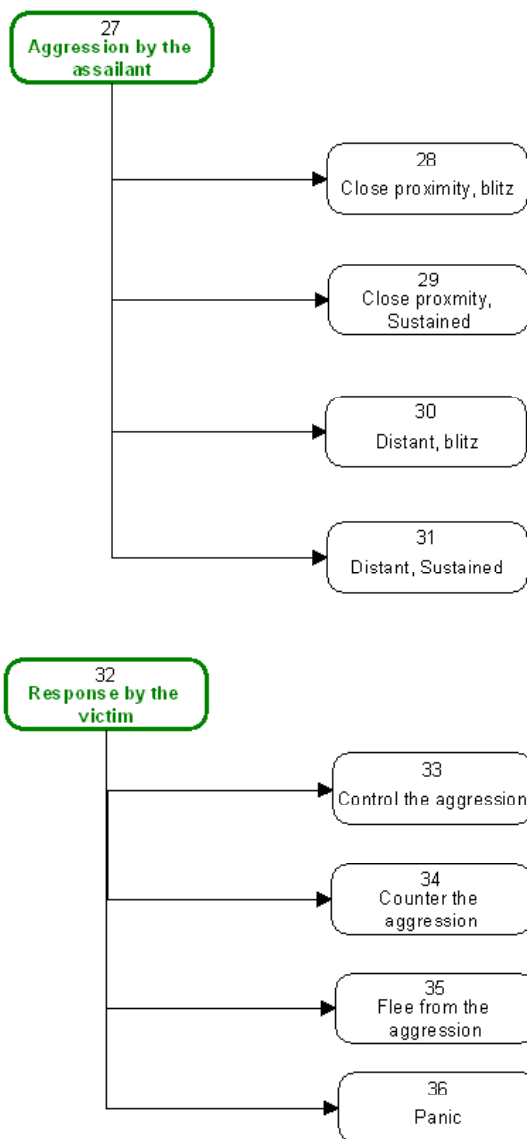
Aggression: During this phase of the interaction, the assailant performs the act of violence that is the core of the incident. Only the energy and resources of the assailant limit this aggression. The environment and victim will influence the choice of aggressive behaviors employed; however, the determined aggressor may attempt again and again to follow a planned pattern of aggression.

Aggressive behaviors may be exhibited at various rates, distances and actions. The aggressive implement may be a single weapon or multiple weapons. The evidence of the victim's response is often intermixed with the evidence of the assailant's aggressive behavior.



## ***ADVANCED RECONSTRUCTION***

### **The Critical Elements**



## ***ADVANCED RECONSTRUCTION***

### ***DETAILS OF THE CRITICAL ELEMENTS(continued)***

#### ***AGGRESSION (cont.)***

*Close Proximity (blitz)* is the rapid onset of physical contact that adversely affects the victim. This force is intended to be sufficient to debilitate and or to rapidly impair the victim. The ability of the victim to respond is diminished or perhaps non-existent because of the rapid, overpowering force that may be used.

*Close Proximity (sustained)* may be initiated rapidly; however, it is sustained over a longer period of time. The level of force gradually debilitates the victim who has a greater opportunity to react and to respond to the aggression. The perpetrator places himself at jeopardy from a defensive response by the victim or perhaps a counter attack if the victim is capable.

*Distant (blitz)* is force applied from a distant vantage point which immediately debilitates the victim. There is little opportunity for victim response because of the speed of the attack, and little risk of detection or injury to the assailant because of the victim's distance.

*Distant (sustained)* is force applied from a distant vantage point which may be rapid or prolonged over time. This force may not immediately debilitate the victim, however, the risk of injury to the assailant is minimized because of the distance between him and the victim.

#### ***RESPONSE***

Response: The victim will respond to the aggression through voluntary motor reflexes as conscious or instinctive actions. The transition from one state to another may progress or regress from one to another very rapidly. Typical conscious responses are to:

*Control the aggressor* by commanding (or pleading) words, physically blocking, grasping or defending against the threatening action or object.

*Counter the aggression* by placing the assailant on the defensive, thereby interrupting the immediate threat to the victim. This can include the use of hands, legs, feet, available weapons of opportunity (chairs, bottles, guns, knives or virtually any object which can be used against the threat) or through the use of a planned defensive response such as martial arts, chemical agents, mace and carried weaponry.

## ***ADVANCED RECONSTRUCTION***

### ***DETAILS OF THE CRITICAL ELEMENTS(continued)***

#### ***RESPONSE (cont.)***

*Flight* from the aggressor occurs when there is no means or opportunity to control or counter the aggressor. This may be a conscious action or a spontaneous response to the initial threat. Training, physical ability and the scene environment affect the “flight response” decision.

*Panic* occurs as an involuntary response to the threat when all other alternatives are exhausted. A panic response will occur when the victim’s inability to control the environment or adequately affect the assailant combines with the absence of a clear escape route.

In addition to the voluntary response of the victim and assailant, there are other involuntary responses such as heart rate, blood pressure, shock and loss of consciousness which will affect the overall scene.

#### ***DISPOSAL AND DISPLAY***

Disposal (or display): These will occur after the aggressions by the assailant and the response of the victim have ceased. This may mean that the victim has died, but can take place while the victim is in an incapacitated state.

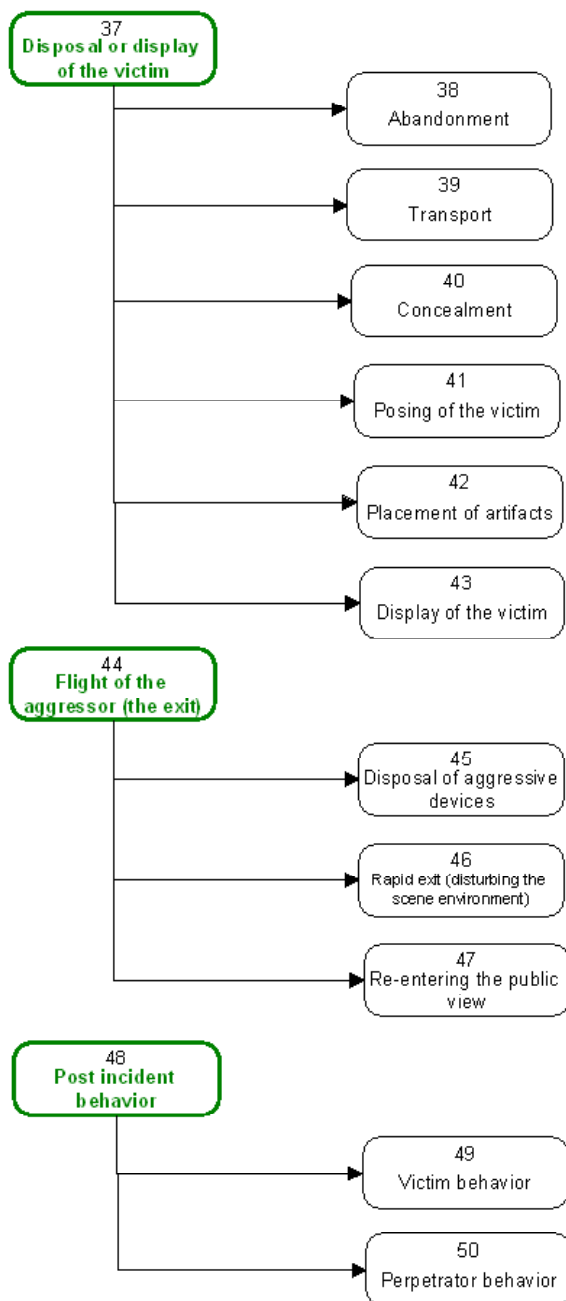
*Disposal* is a general term which includes the transport of the body to another location OR simply leaving the body in its existing location and position. In “disposal” there are no overt signs of evidence placement, body positioning or alterations to the body or associated evidence.

*Display* on the other hand, is usually associated with the conscious act by the assailant to alter the body position (and or location) or place evidence in conspicuous places to impart a “final message” to those who discover the body. This should not be confused with “staging” of the scene (described below).

*Staging* the scene is an effort by the assailant to alter the meaning of the evidence and to create an “implausibility” of his involvement. If a death can be staged to be a suicide, then why look for the murderer? This staging, if successful, would divert the attention of law enforcement from the intense scrutiny associated with a homicide investigation. These efforts usually involve alteration of the crime scene by the placement (or removal) of evidence, repositioning of the body and removal of any linkages to the assailant’s involvement in the incident.

## ADVANCED RECONSTRUCTION

### The Critical Elements



## ***ADVANCED RECONSTRUCTION***

### ***DETAILS OF THE CRITICAL ELEMENTS(continued)***

Flight: Anything the assailant does to leave (or to try to leave) the scene after the break in aggressive behavior is “flight.” This flight or escape has no prescribed form, rate or duration. The purpose of escaping from the scene is to create a “distance” between the victim and the perpetrator, thereby making it more difficult to develop the assailant as a suspect. The converse of this is when the perpetrator remains behind at the scene, thereby drawing attention to himself from law enforcement investigators. When the investigation draws the name of a potential perpetrator, an alibi (or plausible denial of association, motive or opportunity) becomes essential to the suspect.

### ***POST INCIDENT BEHAVIOR***

Post Incident Behavior: A temporary or permanent change in the patterns of previously “normal” existence by the assailant is a form of “post incident behavior.” These changed behaviors infrequently offer any physical evidence at the principal crime scene. However, secondary locations (vehicles, residences and businesses) as well as various forms of interactive communications (mail, telephone, computer linkages and personal contacts) may contain physical or otherwise testimonial evidence to demonstrate a change of behavioral patterns associated with the incident.

In some instances this behavior may include fantasizing over the event and reliving the experience. Serial criminals may use the prior crime as a kind of training experience during this time and may rehearse their next crime to better achieve their intended effect.

**All of the actions during a crime**, regardless of the “critical element” in which they happen, are linked with each other and transition very rapidly. Some actions are planned (voluntary), others involuntary. The investigator must realize that the dynamics of human interaction involve rapid change; so rapid that the positions of the participants may not be reflected by some of the physical evidence discovered on scene. For example, the victim of a debilitating upward gunshot wound to the head may rapidly collapse. Many of the blood stains on their exposed clothing may be interpreted as “straight down” (as onto the floor from a directly down position). The pattern interpretation is correct, however not reflective of the victim’s position at the time the shot was fired.

## ***ADVANCED RECONSTRUCTION***

### ***CRITICAL ELEMENTS AND THE “STORY”***

A case example of this process may help demonstrate how an investigation can fit the methods presented here. We shall begin by presenting an overview of a specific case; establish foundational information for the reader; and then proceed to list a few of the plausible reconstructions (guesses) which address each of the critical elements. As “experienced guesses” are developed, they will be compared against the evidence recovered in the investigation. Listing the evidence, observations and lab results in this fashion allows us to see their interaction with our “guesses.” Of all of our guesses, the alternative which is best supported by the evidence and case facts becomes the primary reconstruction.

### ***THE CASE OVERVIEW:***

A middle-aged female is found dead in the living room of her suburban home where she lived alone. There is no sign of forced entry, or indication of missing property. The victim is lying on her back on the floor with her arms to her sides. She is dressed only in a nightgown which is stretched tightly from her buttocks to her shoulders. Blood, running from her nose and mouth, runs to the eye sockets then over the brow. Blood running from her mouth is smeared on her right cheek. Blood and gray soot surrounds a circular wound in her right temple. A small caliber handgun lies near her right hand. Blood coats the palm of her right hand, which also has a dark sooty deposit in the area of the ring finger. The victim was last seen the night before, at a local restaurant in the company of her sister. The victim had been somewhat despondent, but by the end of the evening was in good spirits. The victim was visible through the open front door when she was found by the newspaper boy. The emergency responders did not alter the body or the scene.

### ***SUICIDE?***

The investigator may focus upon an initial reconstruction (story) of suicide based upon the presence of the weapon, damage to the head and alleged depression.

This first impression, though a starting point, must be set aside if any evidence exists at the scene to refute that story. The officer may obviously set aside the “natural death” scenarios; however, the possibilities of ACCIDENT, SUICIDE or HOMICIDE remain. The thorough investigation requires that the efforts of medical intervention, responding officer as well as the finding (reporting) party and anyone else entering the scene, must all be understood. Any alteration of the scene and evidence be documented and considered in the tentative “reconstructions” of how the crime occurred. .

## ADVANCED RECONSTRUCTION

### CRITICAL ELEMENTS AND THE “STORY”

### FOUNDATION FOR A RECONSTRUCTION

The foundational information necessary for a reconstruction is as follows:

1) ***Learn the backgrounds of all participants and the scene history:***

The mental, physical and financial status of the victim are relevant history. The names of known associates and activities prior to this incident bear upon the interpretation of the crime scene. Her state of mind is also relevant; however, there was nothing unusual in her medical history. No prior law enforcement 9-1-1 calls are associated to the house or victim. There was no record of prior calls to this location and all the evidence appeared to be relevant to the existing event.

2) ***List all first impressions and initial reconstruction theory. These will be developed through powers of observation, common sense and imagination.***

The initial impression is of a suicide; however, *why is the front door open?* If a suicide, this may have been part of the victim's efforts to “display” her own body in order for it to be discovered. *Did she fall or was she dragged into the position in which she was found?* What significance does the nightgown stretched from buttocks to shoulders have to the initial suicide theory? (If a person drops to the floor will the nightgown be drawn tight?) *How did smeared blood get on her hands?* The blood flow from the nose indicates that the victim did not die immediately, therefore she could have touched her own wounds as an *involuntary response* to injury. *How did the blood flow over her brow?* The blood flow patterns on the surface of the victim's face are contradictory to the suicide theory since they ran upward from nose to forehead and over the brow. This would mean the head was tilted back at some point after wounding. This contradiction alerts the investigator that the first opinion of suicide should be replaced by the instinctive response to “treat every death case as a homicide.”

3) ***Consider the evidence in light of the critical elements of preparation, approach, control, detention, aggression, response, display/ disposal, flight/ alibi and post incident behavior. (See the flow chart and find the correct pathway through the alternatives.)***

There was no forced entry and no sign of struggle. An assailant's preparations or the form of approach are not evident. The victim was in her own home with no chance of escape (and perhaps asleep?).

## **ADVANCED RECONSTRUCTION**

### **CRITICAL ELEMENTS AND THE “STORY**

#### **FOUNDATION FOR A RECONSTRUCTION (cont)**

There was no evidence of bindings or other forms of detention. The act of aggression (the firearm to shoot the victim) did not result in an obvious *voluntary response* by the victim (restraining the attacker or counter aggression). The victim displays evidence of involuntary response (touching an injury). She was found near where she fell (no signs of aggression or wounding in another location). The use of the handgun to kill the victim awaits confirmation by autopsy and forensic comparison of the gun to projectile(s) which might be recovered.

- 4) ***Determine the tools or weapons used and the implication of close or distant range to the victim. This helps clarify the interchange during the victim’s response to the assault.***

The .22 caliber handgun next to the victim’s right hand is consistent with the external appearance of wounding to the victim’s right temple (small hole with flakes of dark material surrounding it). No signs of struggle or other weapons being used are visible. There is no sign of rape.

- 5) ***Seek the possible motive(s) of the crime. The evidence may point to the motive which, combined with background information point to a small list of suspects.***

The classic motives include revenge, money, power and love; but insane acts must also be considered. Understanding the motive is instrumental in narrowing the list of suspects from the entire population to a more manageable number. The state of mind of the victim and the perpetrator is also of value in understanding the crime. If this is a suicide, the state of mind will play a key role, whereas the “motive” in the classic sense may not be so obvious. (Leave it to the psychologists to argue that suicide may be a form of control, or power instead of a mental dysfunction.)

- 6) ***Items taken or left at the scene are forms of “tokens” which can be used to associate the perpetrator to the crime scene. This is very helpful in reducing the list of suspects from the original list.***

The victim’s purse and all contents remain in plain view in the crime scene and no valuable items are missing. Nothing tangible seems to have been left behind at the scene. Further investigation might develop assailant fingerprints on the victim’s body, the firearm or the residence or detect other associative items of trace evidence.



## ***ADVANCED RECONSTRUCTION***

### ***FOUNDATION FOR A RECONSTRUCTION (cont)***

#### **7) *Seek alternatives to the most obvious reconstruction via an open minded objective approach to the possibilities.***

Apply the circumstances of the case to the four basic forms of death:

- natural,
- accidental,
- suicidal or
- homicidal (unexplained is not truly a manner of death).

This is where common sense, training and prior casework help identify the “cause and effects” issues to be resolved. Some of the many possible reconstructions include:

### **APPLYING THE LOGIC TO THE SCENARIO**

#### ***Accidental:***

If the gun accidentally went off with or without contact with another person the powder patterns (dark soot) in the victim’s right palm may be indicative of how the weapon was held. They are consistent with the victim’s hand over the cylinder, not on the grip of the revolver. Powder residues around the wound may help estimate distances. There are TWO, nearly overlapping bullet holes in the victim’s right temple. If this was a self-inflicted accidental shooting the weapon may be defective, or there may be only a single cartridge casing in the revolver, as in Russian roulette.

#### ***Suicidal:***

The two bullet holes are possible in a suicide, but the condition of the garment is not consistent with a person simply falling after being shot. Did she “squirm” on the floor, pushing with her legs and sliding on her back, thereby stretching the nightgown? What would that do to the throw rug under her feet? (It was undisturbed on the hardwood floor). Did she sit up and shoot herself again? (If she sat up, the blood on her face should have run down her chin, not in the opposite direction, up over her brow).

If this is a suicide, an expended round SHOULD be under the hammer, and functional condition of the weapon should match the circumstances (the number of expended casings would likely equal the number of bullets; expended casings should be in chambers which have “discharge halos”). What was the mental state of the deceased? Is there any personal crisis which would suggest suicide? Are there any obvious signs of preparation (removal of identification, ingestion of controlled substances, notes or insurance policies)?

## ***ADVANCED RECONSTRUCTION***

### **APPLYING THE LOGIC TO THE SCENARIO**

#### ***Homicidal:***

The circumstances are also consistent with homicide. Why is the garment stretched tightly under the body? (Dragging perhaps?) Are there any signs of preparation? Why leave the gun near the victim's hand and the powder residues in her palm? Is it to give the appearance of suicide? If so, then the functional condition of the weapon, the clothing of the victim, and the locations of the blood and powder residues may conflict unless the perpetrator has committed "the perfect crime." If this is a homicide, what would be the reason to kill? The victim showed no outward signs of rape or struggle; there was no burglary, and the weapon was hers. Was anything taken from, or inadvertently added to, the scene?

The above processes generate questions which demand a search for information. The investigator should also seek any evidence which addresses questions regarding the *actions, positions, origins, duration, function and direction* of the crime. These will provide details for the reconstruction needed to tie together and sequence the various actions of the crime. For example:

The condition of the victim's clothing should be evaluated in comparison to how a suicide victim would react versus a homicide victim (*function*). How did the garment get stretched from the buttocks to the shoulders (*action*). How did the blood flow in a direction which defies gravity (*direction*). Where did the weapon come from? Who owns it (*origin*). Does the weapon operate normally (*function*). Is the functional condition of the weapon (as found at the scene) consistent with its being the fatal weapon (*function*). Why was no blood found anywhere else in the home other than under the victim's body (*action*). When did the crime occur (dried blood, *duration*). Since the home is in good order without signs of ransacking by the perpetrator, what is the  *motive* for the crime?

### **LOGIC AND "ROLE PLAYING"**

"Cause and effect" interpretations are applied to the information gathered to formulate plausible reconstructions. Role playing and imagination may be used to bridge minor gaps in the reconstruction until evidence to support or refute them is found. Personal experiences and prior case investigations can bring to mind possibilities which must be explored. Often it is these starting points that develop the most credible reconstructions.

## ***ADVANCED RECONSTRUCTION***

### ***THEORIES OF THE RECONSTRUCTION***

Potential reconstructions create a “premise” against which the evidence may be tested. When creating each of the possible reconstructions it is helpful to address each critical element and include as many of them as possible. The reconstruction “story” should be imagined as though each element will be present, and only when there is evidence to refute its presence is that element abandoned. The next step is to apply the principles of the Scientific Method to test each “story” and test the accumulated factual information gained during the investigative process. A reconstruction remains viable until the weight of tangible evidence, intangible clues and validated interview statement can be applied to them. This constitutes the easiest form of reconstruction. It is called “premise negation”. “Premise negation” may also be applied to establish the accuracy or inaccuracy of a statement offered by a participant in an event (such as a confession, eye witness statement or a victim’s recollection.)

#### **Theory One: Suicide—**

- The despondent victim gets the .22 caliber handgun and
- Self inflicts a shot to her own temple leaving visible gunpowder patterns.
- Not yet dead, she inflicts a second shot to her temple. And even more possibilities of “suicide” can be developed.

#### **Theory Two: Homicide—**

- The victim was approached by an assailant who obtains gun from a concealed location.
- The perpetrator fires into the right temple of the victim.
- The perpetrator unsuccessfully tries to drag the victim
- The victim is shot a second time in the temple.
- The weapon was placed in the victim’s right hand and fired to leave gunshot residues on her hand. Many versions of this can be imagined.

After all the credible theories have been enumerated, the “story board, event analysis, chronological timeline, via map” or other information tracking mechanism is created. In it, all the observations, analytical results, and other information is listed and then tested against the theory. The investigator may also use this documentation to note details of observations and testing results. Gradually a full documentation is accumulated that supports or refutes each of the potential reconstructions. This reconstruction will be based upon demonstrable facts, not opinion or assumptions and ready to face the challenge of contemporary court processes.


## **ADVANCED RECONSTRUCTION**

### **The Story Board Example**

Objectively develop several reasonable reconstructions based upon facts known at the time. Construct the story in short segments of time. It is helpful to begin final location of prominent evidence's location and ask "how did it get there". To give flow and movement to the activities during the crime, consider the "elements of the crime" **If the evidence does not fit the story, find the story that fits the evidence.**

Alternative A: (self inflicted wound): --Victim obtains weapon (1A); and then shoots self in head once (2A); and falls to floor on back (3A). Victim sits up to acquire and fire weapon again (4A); then falls back on floor as found by reporting party (5A)

Alternative B: (wound inflicted by other): -- Assailant obtains weapon (1B); and shoots the victim (2B); who then falls to floor (3B). Victim is not moving (4B) and then assailant tries to drag (V) by arms (5B)

#	Source (evidence or record)	Detailed observation of source	Comment or Interpretation	Support	Refut
1	Field report of Officer Smith	(Page 2 Para 2), no alteration of scene by responders	Evidence as observed indicative of original scene	Either	
2	Revolver Item 17	Four live cartridges with bullet similar to bullet located on floor.	Ammunition consistent with bullet at scene. Lab analysis needed	Either	
		Two spent cases similar to four live in weapon	Two circular wounds seen in victims head. Two spent cases.	Either	
		No halo on spent case in position under hammer	Spent case requires halo if fired normally	Alt B	(2A)
		Cylinder of revolver rotates to bring up spent case next	Cylinder position not as weapon functions.	Alt B	(2A)
		No blood on grip of weapon	(victim has bloody hands)	Alt B	(4A)
3	White nightgown tem 12	On scene, stretched tightly from buttocks to shoulders	Indicative of possible dragging rather than "slump/fall"	Alt B	Alt A
		Two circular bloodstains on end of right sleeve (short sleeve)	Possible transfer from two injuries at right temple	Either	
		Left sleeve has distinctive pattern of blood (see photo)  Circular bloodspots at neck of shirt.	May be caused by fabric twisted when contacting blood source.  Circular implies direct in trajectory.	(5B)	
4	Victims body	Face stains run from nose to ear.	No stains running towards chin.	(4B)	(4A)
		Smeared bloodstains at wounds	Contact with object (sleeve?)	(5B)	
		Blood from nose to eye then brow	Head position changed for flow	(5B)	

## ***ADVANCED RECONSTRUCTION***

### ***RECONSTRUCTION DEVELOPS EVIDENCE***

Creating a **documented** flow chart of the reconstruction comprised of short segments may infer further details which need to be investigated to support the assumptions or to refute the theory as stated. It is the investigator's burden to seek out these clues and modify his theory and update the story to adapt to the evidence found. In so doing, the investigator would eventually focus upon the most credible theory, (in this example, homicide with an effort to stage the crime to appear as a suicide). As a result of on scene evaluation, better evidence is located (the gun in this example did contain two expended casings, however, in the wrong rotational positions relative to the hammer. Further, the discharge halos on the chambers of the revolver did not correspond to the position of the expended casings. Indeed, there is a third bullet found in the floor of the residence, which could correspond to the effort to add gunshot residues to the victim's hands.)

### ***SOMETHING LEFT BEHIND***

The perpetrator had left behind something at the scene. A damaging clue was the detail he placed into the concealment of the crime. Of all possible suspects, who would want to hide a murder as a suicide? Would a burglar? A rapist? Who would have the evidence knowledge to set up the scene with such detail? The list of suspects becomes short indeed. It contains the names of known associates who could be implicated in a murder, but would never be suspected in a suicide.

Though obviously not the complete investigation, this example serves to demonstrate that these efforts in **case reconstruction rely upon the investigator capturing the full information value of evidence at the crime scene.**

No amount of laboratory analysis can restore the full information potential of evidence as it was at the scene.

Only the person(s) at the scene can make these observations and provide vital details to the courts. These details are supported by thorough documentation and provide the answers to the questions confronting the investigation and reconstruction efforts, the trial, and the penalty phase. They will convey to the jury the thorough and competent efforts of the investigators to reconstruct the crime and help the jury keep the issues clear as they determine whether the accused is guilty or not guilty.

## ***MAJOR SCENE LOGISTICS***

### ***SCENE LOGISTICS***

#### ***THE MAJOR COMPONENTS***

There are two major aspects to be managed in every crime scene: **administrative** and **investigative**. In the simple crime scene, one investigator may handle both aspects. However, as scenes increase in complexity and the number of people in the investigative team, the organization of the event itself becomes more difficult. Many of the problems encountered are the same as with a major disaster response and many of the solutions are also the same. The most difficult scenes to organize are those wherein there are large numbers of personnel from various departments covering a large area scene. It is rare that agencies practice major crime scene response in the same way they practice for a major disaster response. Therefore, the solutions to problems may be improvised as the situation and local resources dictate.

To help the investigator and incident commander charged with large scale investigations recognize potential problems, some of the most likely are outlined below. Dependant upon the resources available to the agency, there may be many solutions to each of these problems. It is suggested that the agency look to its disaster preparedness or critical incident command manuals for workable models for solutions to these problem areas.

#### ***SPECIAL HAZARDS***

The welfare of the personnel at the scene is of highest importance; therefore, the tactical deployment to the scene must include a threat assessment. This is a standard component of law enforcement tactics. However, with the crime scene there may be subtle risks that are not so obvious. Scenes may contain chemical, biological, explosive or other physical threats to the team. The initial walk-through should verify that the preceding security sweep of the area did not overlook lingering risks. Special teams are required to diffuse these risks and render the scene safe prior to considering the investigation of the crime that originally prompted police response.

Once these factors have been considered, the mechanics of scene investigation can be pursued. The following outline presents the major problems in the processing of the scene. These are present in all scenes, but become amplified in large or complex crime scenes.

#### ***DEVELOPING ESTIMATES***

After considering the impact of the above factors, the chief investigator should develop an estimate of the time and resources needed for the scene investigation by considering the following areas:

## ***MAJOR SCENE LOGISTICS***

### **SCENE LOGISTICS**

#### ***DEVELOPING ESTIMATES (cont)***

##### Personnel

Depending upon the investigation, staffing may come from a variety of agencies in a “mutual aide” situation. The lead investigator must evaluate the talents and training of the assembled team to insure that they are appropriate for the investigation. In addition, these individuals may not have the level of equipment required for the scene. Take time to learn about a person's skills rather than wait until they have created a marginal work product. There must also be an awareness of the work shifts of team members. They will tire and need rest at some point in time.

##### Equipment

The lead investigator should establish a list of the equipment resources that will be required to investigate the scene. The type and quantity of equipment will be dictated by the unique nature of each scene. Consideration should be given to the use of military, state and county as resources of resources. Specialized equipment should be accompanied by trained operators if possible.

##### Maintenance

The area of maintaining the equipment as well as the people at the scene rapidly becomes a dominant consideration as the number of people, the duration of the on-site investigation or the complexity of the terrain increase. Logistical support must consider the medical, food, sanitation, housing and transportation needs for all personnel at the scene. Scenes at remote locations where the usual forms of communication and perimeter security may be challenged may well require some very creative solutions. The state department of forestry is experienced in the logistics for such events and is a helpful source of resources. The lead must also be mindful of the teams needs for renewed supplies, individual rest breaks and the need to know what is expected of them and what is going on in the investigation.

##### Special requirements of the environment and location

The scene may require special lighting and generators for searching as well as photography. Extremes in climate may dictate cooling or heating in order to keep investigators safe and mechanisms to safeguard the scene from snow or sun. Helicopters may be needed for transportation and security or heavy duty excavation equipment for isolation of grave sites. Even dogs may be needed for drugs, cadavers, guns or arson evidence. There should be no limit placed on acquiring resources to solve the problems of a major investigation.

## ***MAJOR SCENE LOGISTICS***

### ***SCENE LOGISTICS***

#### ***LOCATION PROBLEMS***

The following are typical concerns dependent upon the scene's location:

- a) Larger geographic areas create access, communication or security problems which strain perimeter security needs (more staff) as well as radio frequencies (multiple agency radio frequencies).
- b) Number of scene locations within that area: multiple locations create issues of staffing, timing and adequate tools to process the scenes (cameras and the like)
- c) Complexity of the environment can create problems if there is inaccessible terrain, crowds of people, inclement weather, congested with public et cetera. These place special demands upon the tactical approach to the locations and may involve larger numbers of support staff than the number actually doing the investigation.

#### ***EVENT PROBLEMS***

The following are typical concerns dependent upon event complexity:

- Multiple body count cases: such as mass murders have problems created by the size of the investigative team. Such cases are usually within well defined areas, therefore, perimeter security is more manageable, leaving staff for the investigation. Issues regarding identification, personal effects, notifications and "backgrounds" will tax any agency. Consider efficient processes that can be used repetitively to insure thorough evaluation and investigation of each victim.
- b) How the victims were killed: The modality of death can generate a different set of problems. Were the deaths one at a time or were they by some means of "mass destruction?" Repetitive acts leading to many deaths in a well defined area may leave far more items of evidence than the single act of mass killing (bomb, fire and poisons). This places a drain upon the materials and record keeping requirements at the scene.
- c) Perpetrator- victim interaction: Were the deaths at close range or from a distance? Events at closer range may generate more evidence and the need for more background standards useful to associate the perpetrator to the scene. Events at a distance can expand from the original dimensions and involve areas that may have been impacted by bystanders or early emergency response teams. This may create a burden on the canvassing, search teams and perimeter security teams.
- d) Duration of the event: Events that happen quickly will likely leave fewer items of evidence than those which take longer and have greater opportunity for victim response to the aggression. The demands for documentation, including photography and measurements, will be greater when the scene is prolonged with a lot of victim-perpetrator interaction.



## ***MAJOR SCENE LOGISTICS***

### ***SCENE LOGISTICS***

#### ***EVENT COMPLEXITY (cont)***

f) Survivors: Were survivors interacting with the scene prior to emergency response? If so, their actions will have altered the scene in ways that only interviews can sort out. Survivors may not have accurate information about the actions that occurred at the scene.

g) The cumulative effects of initial emergency response including tactical and medical teams. They have priority over the “preservation of the scene and evidence content.” The better this is controlled or at least the more known of the initial response, the better the subsequent investigation.

Staging of the crime will add another layer of difficulty to the interpretation of the evidence within the scene. Signs of staging are usually very evident when examined carefully and slowly. Haste to complete the scene processing is the greatest ally of the perpetrator who stages a crime. Slow down and look carefully.

i) Non-essential personnel - If the scene attracts administrative personnel or media attention, the scene perimeter security will be challenged and the investigation may be compromised. Consider the use of two perimeters, one for the general public and a second interior perimeter for the “brass.” Conduct briefings at regular intervals for the administrative personnel to keep them aware of their department’s efforts.

#### ***ADMINISTRATIVE DECISIONS***

Once these issues have been assessed, the agency must select an administrative course of action to deal with the following:

##### **a) Command and Control functions**

Every event has a person in charge of the total agency response. Often the command center is a patrol car’ front seat. The need for a staffed command post increases as the number of responding staff increases. Other factors include a longer duration response, increased media demands or a more complex investigative response involving multiple agencies and extensive resources.

##### **b) Communications**

Radio or telephonic communications staff must assess the radio system availability and insure it is accessible to all staff, regardless of their agency. Be sure the transmissions secure. The use of cellular telephones may be acceptable, but that system is easily overloaded in high density transmission situations. Access to data systems, such as records and evidence inventory, may become difficult if the scene involves remote terrain or if several agencies pool resources at the scene.

## ***MAJOR SCENE LOGISTICS***

### **SCENE LOGISTICS**

#### ***ADMINISTRATIVE DECISIONS (cont)***

##### **c) Investigative briefings**

These briefings should be established to insure that all team members have adequate information to complete their assignments and to develop all case-related information. The lead investigator should consider how the information will get back to those not in attendance at the briefing. A written summary of these meetings is helpful, if time permits.

##### **d) Media relations**

The presence of the media always presents an additional area of concern which the department must address. Some believe that the media should be given only the minimum amount of information. Information must not be released if public knowledge may jeopardize life or the success of the investigation. Press conferences are best given at locations away from the scene. A "media relations officer" should be identified as the person responsible for press conferences and release of information.

##### **e) Logistical Requirements**

There will always be some degree of logistical support requirements for a crime scene investigation. As the scene expands in scope, complexity, duration or in the number of staff assigned to the investigation, the logistical requirements will increase beyond the ability of one person to manage the scene. If large numbers of people are brought together for a prolonged period of time, food, housing, transportation, sanitation, medical must be considered as well as rest periods and shift transitions.

#### ***INVESTIGATIVE DECISIONS***

Someone must coordinate the approach to the scene(s) and insure that the final products from each person will merge into a consistent set of investigative reports. One of the first tasks of the investigator is to evaluate the scope and complexity of the situation and the demands it will make for personnel and equipment. There is an obvious correlation between the time needed to complete the processing and the number of people needed to complete the job. Circumstances will limit one or the other. The key is to take whatever steps necessary to conduct a thorough investigation, hopefully, as free as possible from unnecessary external pressures from any source.

## ***MAJOR SCENE LOGISTICS***

### **SCENE LOGISTICS**

#### ***INVESTIGATIVE DECISIONS (cont)***

As personnel are acquired for the team, the investigative coordinator must assess their skills and equipment and consider their fatigue limits (end of shift?). The assignment scope and location must be clearly stated and periodically monitored to maintain consistency between those conducting similar tasks in different locations. In assembling the final investigation package, it is helpful to have the final products look similar in format. Share information on a regular basis and care for the logistical needs of the investigative staff.

#### ***SCENE PROBLEM AREAS***

Areas which deserve special attention to insure a thorough scene processing include the following.

##### **a) Scene Documentation**

If there are adjacent scenes, as in a school setting or multiple grave sites, be sure that the photographs of one scene overlap with and show the relationship to the next scene. Overview sketches and video should be similarly constructed.

Be sure that the photographs are taken in the overview, approach and then close-up method. The overview need not have number stands; however, the intermediate and close-up photographs must.

Decide if there should be a short orientation video taken of each location as well as an in-depth video to augment still photographs.

If the scenes are in poorly lighted areas, acquire adequate flash or other auxiliary lighting. Small built-in flashes are not adequate.

##### **b) Evidence collection**

A decision must be made as to the degree of detail used to describe each item in the property sheet. These descriptive property sheets are one of the best tools to remind the investigator of all evidence encountered and collected from the scenes.

## ***MAJOR SCENE LOGISTICS***

### **SCENE LOGISTICS**

#### **b) Evidence Collection (cont.)**

The manner in which evidence will be numbered must be established. It is suggested that each scene receives a letter and each item within the scene a unique number. For example, a location with three scenes may refer to them as "A, B and C". Within each scene increasing numbers are given to each item. Therefore, there will be an Item A1, A2, A3,(etc.), as well as B1, B2 and B3.

It should be decided if the evidence will be sealed by each person or at a central evidence location. There may be a single property officer, or each scene may maintain its own property list. It is suggested that each site be responsible for labeling and sealing the evidence and transferring it to a central location where the property sheets can be compared to the package descriptions prior to "booking into evidence."

How much evidence evaluation or processing done at the scene? The decision whether to collect fingerprinted items once the lifts are made should be discussed with the team. Will fingerprint cards be itemized in the property sheet individually or collectively? Either is correct, but once decided the entire team should be consistent.

Should one person move between the scenes to process and collect special evidence types such as blood, bullets, bullet trajectories and the victims body; or is everyone expected to be able to process such evidence.

#### **c) Sharing Information**

Determine the frequency of briefings as well as their goals and who will attend them. What is expected of attendees before and after the meeting.

These briefings also inform the administrative staff of the progress of the investigation and the status of staffing or equipment resources.

A media relations officer should establish a location and time for press briefings. The lead investigator, administrative staff, (and prosecutor) are responsible for identifying the information to be released to the media.

The lead investigator must define the final investigative product and how each persons efforts will contribute to it. Be sure everyone on the team knows what is expected of them and knows enough to get the job done.

## ***SAFETY***

### ***SAFETY***

#### ***HIDDEN DANGERS***

The concern for the officer's well-being during the investigation goes far beyond the obvious physical threats he routinely anticipates as a police officer.

There are hidden, much more subtle dangers which await the officer from the chemicals he uses or the biological samples he handles. Many of the chemicals or materials used to process the scene are handled under special "safe conditions" in the crime laboratory so as to minimize exposure. The officer must exercise the same caution in the field.

#### ***AREAS FOR CONCERN***

There are five specific areas which will be discussed briefly here. These are: fingerprint powders, chemical development techniques for fingerprints, the use of lasers, drug screening by officers and the hazards posed by biological materials. Other areas for concern have been mentioned throughout this text.

#### ***FINGERPRINT POWDERS***

One example of a hazardous area is the use of fingerprint powders. The powders commonly employed should not be inhaled by the user. The effect upon the lungs is similar to the health dangers experienced by coal miners. Premature death or respiratory disability is a possible consequence of the careless use of these products. A simple face mask, much like the ones used by painters to prevent particulate inhalation, will eliminate most of this hazard. As powders are so widely distributed in law enforcement agencies, a great concern is for the user who is not aware of their potential threats and of some simple precautionary measures.

The method used to apply these powders can further reduce the amount which is airborne and therefore available for inhalation. The "swirling" or "spinning" motion sometimes suggested by the latent examiners should be avoided. Light pressure combined with a slow, painting motion is very effective in developing fingerprints and keeping the airborne powder to a minimum.

## ***SAFETY***

### ***SAFETY***

### ***CHEMICAL DEVELOPMENT***

Other areas of concern are fingerprint chemicals applied by immersion or spraying which react with the amino acids and oils of the body. If they react with these body secretions on a piece of paper, they may be expected to react with the very same materials naturally occurring in the body of the investigator.

For this reason, protective clothing (gloves and eye protection) must be utilized. Chemicals should be applied only in well-ventilated areas or under "fume hood" conditions. Whenever possible, avoid the use of sprayed chemicals such as ninhydrin. The use of a chemical bath inside a "fume hood" reduces the amount of airborne contamination that might be inhaled.

The use of lasers to locate fingerprints follows the application of chemicals which bind with the fingerprint residues and then fluoresce when struck by laser light. These chemicals are often sprayed onto the evidence, and sometimes even on the walls, doors and property within crime scenes. It has not been determined whether or not these chemicals cause cancer or can result in the mutation of a fetus; however, it is better to err on the side of safety. At least one manufacturer of Rhodamine 6G has listed it as a cancer causing agent. The use of such chemicals may place the officer or others who subsequently handle the evidence item at risk. The officer should refrain from applying chemicals to crime scenes which will later be occupied. Mechanical methods should be used on fixed objects, and leave chemical methods for items which can be enclosed to prevent chemical contact with the chemicals.

There is yet another area of chemical development in use by some scene investigators. Some prefer to field test blood with benzidine-related compounds. It is suggested that all such chemicals be avoided. If a stain has the texture, color and solubility of blood, or if the investigator is uncertain, the sample should be submitted to the laboratory for proper analysis. Benzidine is a known carcinogen restricted in the United States.

### ***LASERS***

Portable lasers are becoming common in modern crime scene kits. They may be used to help determine bullet trajectories or, in conjunction with chemical reagents, to locate fingerprints. Most field-operable lasers are of low power; however, even they can cause significant damage to an unprotected eye. Always wear protective goggles and avoid eye contact with the direct beam at all times. It is recommended that the investigator also avoid staring at the reflected light given off from a laser striking an item of evidence.

## ***SAFETY***

### ***DRUG SCREENING***

An area not otherwise mentioned in these pages includes the use of field kits for drug screening. There are very caustic chemicals capable of causing severe injury to flesh and lungs used in the field kits. If handled with caution, gloves, and adequate ventilation, these kits are safe to use. If used in areas such as the back of a patrol car, or in the squad room, these kits are dangerous. Ventilation is an essential element to the safe handling of these chemicals. The officer should inquire further from the laboratory providing the kit as to the general health hazards associated with them.

### ***BIOLOGICAL HAZARDS***

The last area to mention includes bloodstains, fecal materials, decomposed body parts, or clothing which contains residues of these materials, all of which carry subtle hazards for the unwary crime investigator. Injuries, even small ones, should be protected from infection by bandages, surgical gloves, and the simple modification of behavior while handling evidence of this nature. Food or drink must not be consumed while handling any biological or chemical hazard. The hands must always be cleansed *prior* to eating or use of lavatory facilities.

It is expected that the officer will share the general public concern for diseases such as AIDS and hepatitis. In the course of handling any recently deposited biological materials, the investigator must use non-porous gloves to protect the hands and should consider the use of eye protection. If blood is on the floor, then protect shoes from contamination by using disposable "booties." In the event of a direct injection, such as foreign blood entering an open cut, or a needle puncturing the hand during a "pat-down" search, the officer should seek medical advice. Though the chance of infection is remote, no incident should be considered as insignificant if there is a chance that foreign biological materials may have been introduced or injected into the body.

### ***COURTROOM CAUTIONS***

During the presentation of the scene evidence throughout the criminal justice process, it is the obligation of the knowledgeable officer to restrict the spread of any health hazard to fellow officers, attorneys, jurors, judges, attendants to the court and citizens in general. Consideration must be given to the proper packaging of these items for later safe viewing by those in the criminal justice system who may be unwary of the dangers.

### ***REMEMBER***

*The investigator should at all times keep part of his attention upon these health hazards. By so doing he will be extending not only his own chances for survival, but also insuring the welfare of others.*

## ***COLLECTION TECHNIQUE SUMMARY***

This section contains specific suggestions for tools, collection methods, standards to collect, packaging containers and storage conditions for some of the most troublesome areas of evidence collection. Among them:

TRACE (Hair, fibers, soil, glass, paint and vegetation)  
BIOLOGICAL (Blood, semen and saliva)  
FIREARMS (Weapons, projectiles and casings)  
FRAGILE (Headlamps, charred documents)  
VOLATILES (Gasoline and perfumes)

### ***HAIRS & FIBERS***

#### **TRACE EVIDENCE: Hairs and Fibers**

Tools: Forceps, tweezers, scissors, adhesive tape, magnifying glass, flashlight or other light source.

Collection methods: Search the area with the best lighting possible and collect any hair or fibers with the forceps (tweezers). Photograph, document the location, and place into a paper bindle or "leakproof" container.

Alternate method: If hair and fibers are not plainly visible, loop adhesive Tape (such as fingerprint tape) as if you were cleaning lint from a suit and sample a limited area, noting the location. Open the loop and stretch the tape between the upturned edges of a glossy latent print card. Keep the exhausted adhesive side facing, but not touching, the glossy side. Some may prefer POST-IT adhesive edges or even a lint roller. Any of these may also be stored in a Petri dish or clean (new) a plastic sandwich bag.

Standards to collect: From head hair, twelve strands of hair from *each* of five, separately packaged areas; the sides, neck, crown and nape of the suspect and victim. Fiber standards should be collected from sources deemed feasible by a re-enactment of the crime. Cut full length of carpet fibers or get representative color/type samples from fabrics.

Packaging: Use a separate bindle or leakproof container for each area sampled. For example, if sampling the hands, package separately.

Storage conditions: Comfortable room temperature.



## ***COLLECTION TECHNIQUE SUMMARY***

### ***SOIL***

TRACE EVIDENCE: Soil.

Tools: Knife, small metal spatula, tweezers, spoon.

Collection method: Soil will likely be adhering loosely to shoes, tires or the underside of cars. Photograph, document, then scrape off or pick up with tweezers.

Alternate method: If soil is caked into a shoe, leave it there. Forensic staff will segregate the soil as it is removed from the different areas of the shoe.

Standards to collect: Collect a tablespoon-size amount from points of entry and exit at the scene. If possible collect standards also from areas near the corpus and from areas in the near vicinity. Five standards will suffice.

Packaging: Dry soil may be packaged in a paper bindle or other leakproof container. Wet samples should be placed into a sturdier container such as a pill vial. Air should be allowed to enter to prevent mildew. (Small hole in top of vial cap.)

Storage conditions: Comfortable room temperatures.

### ***GLASS***

TRACE EVIDENCE: Glass.

Tools: Knife, pliers, tweezers, adhesive tape.

Collection methods: Glass may be loose in the scene, loosely adhering to an object, or it may be bonded tightly to a surface. Photograph, document, then use tweezers to pick up loose samples; or loop the adhesive tape as if you were cleaning lint from a suit, and sample the area for loosely adhering glass. Store the tape as with fiber evidence. Glass which is integral or bonded with another item may require pliers or tweezer to remove it.

Standards to collect: Collect from areas around the broken edges of the originating piece of glass. From window panes, collect from at least three places in order to “map the variations” in glass characteristics of the source.

Packaging: Use a separate paper bindle or leakproof container for each sample.

Storage conditions: Store at comfortable room temperature.

## *COLLECTION TECHNIQUE SUMMARY*

### *PAINT*

TRACE EVIDENCE: Paint.

Tools: Knife, small metal spatula, tweezers.

Collection methods: Paint may be loosely adhering or it may be bonded tightly to a surface. Photograph, document, then use tweezers to pick up loose samples, or the metal spatula to scrape paint loosely adhering on a background surface. Bonded paint may require the knife or razor blade to cut into the surface. Sample all the layers of paint present, not just the top layer.

Standards to collect: Collect from an area very near the “point of contact” which resulted in the transfer of paint from one surface to another. Select an area near the evidence which appears to be the natural paint color.

Packaging: Use a separate paper bindle or leakproof container for each sample.

Storage conditions: Store at comfortable room temperature.

### *VEGETATION*

TRACE EVIDENCE: Vegetation.

Tools: tweezers, knife, sturdy scissors, tablespoon.

Collection method: Vegetation may be any size and loose, loosely adhering,

or bonded to other items at the scene. Vegetation may generally be collected in the same fashion as fiber evidence, using tweezers to pick up loose items and scissors or knife to manage larger items. Photograph and document before collection.

Standards to collect: Sample from the scene any possible origin of the unknown evidence. This type of evidence is prominent in “body dump” cases. It is important to evaluate the evidence and collect standards which are similar in appearance from the scene. Standards from possible “kill sites” may link the body to a perpetrator.

Packaging: Use a separate bindle or leakproof container for each sample. The container should permit the passage of air to prevent mildew or rot of the sample.

Storage conditions: Comfortable room temperature.

## ***COLLECTION TECHNIQUE SUMMARY***

***BLOOD, SEMEN  
SALIVA***

**BIOLOGICAL EVIDENCE:** Blood, semen, saliva.

**Tools:** Biohazard gloves, protective footwear, surgical mask or dust mask, forceps, toothpicks, razor blade, knife, swabs, gauze pads, distilled water, test tubes.

**Collection method:** Always wear protective clothing to reduce biohazard risks. Photograph and document the stains carefully. Sunlight and heat and continued moisture adversely affect bloodstains. Evaluate exigent circumstances. Collect blood or semen with a swab moistened with distilled, sterile or even bottled water, depending on the requirements of the DNA lab that will be used. If a kit is provided by your lab, use their materials. Saturate the swab with the stain as much as possible. After documentation, it is acceptable to cut away the surface of an item (concrete or wood) if necessary to collect the stain. If stains are wet, absorb them on swab.

**Alternative methods:** Some prefer to collect the stains using dampened swabs for all types of surfaces, whether the stain is wet or dry. So long as the sampling “tool” (gauze or swab) is dried out first, both methods are acceptable. The fewer times a stain is diluted, the greater the opportunity for successful forensic testing.

**Alternative methods:** Saliva does not lend itself to scraping as do blood and semen. Saliva is usually found in conjunction with bite marks. Photograph the area of the suspect saliva stain and then collect with moistened swab or gauze. Keep the gauze size to an absolute minimum.

**Alternative methods:** For bloody clothing, evaluate the patterns for reconstruction purposes. Photograph and document thoroughly, then consider removing the clothing at the scene by cutting along the seams. Clothing with wet blood, semen or saliva stains should be layered with paper, inside and out, then folded to transport to a location where it can be dried, then permanently packaged. TRACE evidence should be removed before the garment is packaged- at the crime scene is preferred. Clothing with already dry stains should be treated the same, then placed into a permanent evidence container.

## ***COLLECTION TECHNIQUE SUMMARY***

### ***BLOOD, SEMEN SALIVA (cont.)***

Standards: Collect samples of blood from each of the participants in the crime, as well as those who may have “legitimately” contributed blood, semen or saliva stains to the crime scene or onto the corpus of the crime. Request a yellow or lavender colored tube be drawn by medical personnel. Collect blood under the body onto gauze in case venous samples not be available.

Packaging: Wet stains are usually dried first, then placed into a suitable container. Most labs prefer a container which allows air to enter and reduce moisture which enhances bacterial decay. Wet swabs or gauze are a problem in that they will soak into the packaging. A test tube can hold the swab until it dries, or a rolled fingerprint card can keep the swab or gauze away from the sides of a container until they dry out. Some laboratories recommend drying the sample and sealing in a plastic container with a “desiccant” (drying) agent. Drying, then packaging in a paper container is preferable.

Storage conditions: Evidence stains of blood, semen or saliva samples should be stored at the lowest possible temperatures, preferably freezing. Standards taken in test tubes should NOT be frozen since that would cause the tube to crack and the sample to be lost. Refrigerate tubes of wet blood standards. AVOID heat, which causes the samples to break down faster.

### ***WEAPONS***

#### **FIREARM EVIDENCE: Weapons.**

Tools: Flashlight, indelible marker, styrofoam cup, plastic handcuff, cardboard box or “gun box.”

Collection method: Photograph and document. Think of what is “down range of the loaded gun!” Examine with oblique lighting for patent/latent prints, trace evidence. If unfamiliar with the weapon, stop and ask for help from someone who knows how to operate it. Mark cylinder of revolver. Block hammer from falling with finger or piece of styrofoam cup. Drop magazine of semi-automatic with hammer blocked. Open cylinder of revolver and block open with styrofoam cup. Block action with the plastic handcuff or similar device. Collect trace and biological evidence on the weapon.

## ***COLLECTION TECHNIQUE SUMMARY***

### ***WEAPONS (cont.)***

Standards to collect: Gather all ammunition at the scene. It will be needed to determine muzzle-to-target distance.

Packaging: Avoid bags or paper if fingerprints are desired. These containers can abrade fresh, oily fingerprints. Hand transport in a "gun box" designed to keep the weapon upright and minimize surface abrasion. The weapon may also be placed on its side and tied flat to a piece of cardboard or into a cardboard box.

Storage conditions: Comfortable room temperature.

### ***BULLETS & CASINGS***

**FIREARMS EVIDENCE:** Bullets and Casings.

Tools: Indelible marker, rigid packaging materials.

Collection method: Photograph and document, then collect loose items with fingers. Avoid use of metal forceps or tweezers which scratch evidence. If the items are integral to another item (bullet in wall), cut the larger surface away avoiding contact with the projectile. Use fingers whenever possible. Protect with gloves.

Standards to collect: Gather any and all ammunition associated with the crime. The weapon function may be affected by the age, type or brand of ammunition used.

Packaging: Place the UNMARKED, tissue-wrapped items into a rigid container such as a pill box, metal tin or small cardboard box, seal and label appropriately.

Storage conditions: Comfortable room temperature.

### ***FRAGILE EVIDENCE***

**FRAGILE EVIDENCE:** Headlamps and charred documents.

Tools: Pliers, screwdriver, packaging materials, scissors.

Collection methods: Collect the entire assembly of the lamp, not just the bulb. The wiring harness is critical to interpretation of "off/on" questions surrounding lamps. Treat the fragile items carefully, and package immediately in soft tissue and rigid box. Hand carry.

Standards to collect: Any materials which can be compared to the evidence item to help determine its functional condition or its identity. For example, with headlights, collect the undamaged side as well as the broken one. With charred documents, collect all of the ashes, not just those which look like documents.

Packaging: Rigid container with very protective packing. Pack with tissue or cotton balls to absorb shock to the item.

## ***COLLECTION TECHNIQUE SUMMARY***

### ***VOLATILES***

**VOLATILE EVIDENCE:** Gasolines and perfumes.

Tools: Various; including saw, knife, hammer and air-tight containers.

Collection method: Volatiles can be encountered in so many circumstances,

it is not possible to describe all possibilities. However, volatiles at scenes are usually trapped in another item of evidence. For example, gasoline in wood or perfume on clothing. These can be collected as the item itself would be except that the packaging will be different.

Standards to collect: Any areas of the scene which LACK volatile materials will be important to collect. For example, carpeting in the fire scene where NO gasoline is believed to have been poured will serve as a "background level" of volatiles. In addition, any possible origin of the volatile should be collected into a non-soluble container such as glass or metal.

Packaging: Where most evidence can be stored in a container which allows

air passage, volatiles CANNOT be. Volatiles require a package which can be totally sealed from air flow. If you can smell volatile evidence, the vapors are being lost!

Storage conditions: If volatiles are totally sealed, store at comfortable room temperature. It is preferred that volatiles be stored at refrigeration temperatures whenever possible.

Storage conditions: Comfortable room temperature.

### ***RICOCHET EVIDENCE***

**RICOCHET EVIDENCE:** Bullets deflecting from metal, glass or other surfaces.

Tools: Camera, fingerprint powder and brush, casting materials (MIKROSIL or DUPLICAST), white vinegar, water, filter paper, ( see page 64 of text) dowel or pencil and indelible marking pen.

Collection methods: Photograph the ricochet mark on the impacted surface, being sure to include a ruler.

Glass Surfaces: After photography, the residues of the ricochet may be collected using the filter paper moistened with water and vinegar solution (5 water to 1 vinegar).

Label the paper to orient the viewer and indicate which side is against the residues. Apply for 5 to 10 minutes. Sandwich between two dry pieces of paper, roll them up, package in plastic bag and transport.

IF a copper jacketed bullet is suspected, moisten a piece of filter paper with an ammonia and water (5 water to 1 ammonia) solution and place over the mark. Handle as with the water and vinegar solution.

## ***INDEX***

### ***RICOCHET EVIDENCE (cont)***

Sheet metal surfaces: After photography, the same procedure for the collection of the residues and their pattern may be used as in the case of glass. Additionally, the surface of the impressed, painted surface may be lightly fingerprinted to enhance the “rippled paint fractures” which radiate away from the point of initial impact. These can then be recorded by photography (as above) or by casting with a suitable synthetic material such as “MIKROSIL” (white) or a light-colored material such as “DUPLICAST.” These casting procedures will capture the “rippled paint fracture lines” AND the angle of incidence and angle of exit from the sheet metal surface.

Wood, asphalt, concrete or other surfaces: After photography, the filter paper overlay may be used to capture the pattern of residues on the impacted surface.

Standards to collect: A swab of the surface using the “vinegar/water” mixture will serve as a background control to eliminate false positive results. Any bullets or live cartridges should be collected for potential comparison with the residues on the impacted surface.

Packaging: The “filter paper” overlays should be layered with similar dry paper and rolled into a “tube”, packaged in a suitable paper container and transported to the lab.

Storage conditions: Comfortable room temperature.

### **ADDITIONAL COLLECTION METHODS:**

*See indicated pages in text.*

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