City of Phoenix

Physical Evidence Manual

Phoenix Police Department
Crime Detection Laboratory

CITY OF PHOENIX

POLICE DEPARTMENT

Crime Detection Laboratory

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1990

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I. INTRODUCTION

The criminal justice system is requiring an increased use of physical evidence and expert testimony regarding the information obtained from its examination. It is no longer sufficient for an officer to determine that a crime has been committed and to simply identify and arrest a suspect. The officer must be able to demonstrate the circumstances involved in the incident by utilizing physical evidence from the individuals involved and the crime scene to support the criminal charges.

It is therefore, incumbent upon the professional police officer to make intelligent, effective use of the crime laboratory as an investigative aid. Accordingly, with the courts placing greater emphasis than ever on physical evidence, the chain of custody and the integrity of the evidence is being carefully examined and often challenged. The importance then of proper methods in collecting, marking and preserving evidence cannot be overemphasized.

The intent of this manual is twofold:

1. To inform the investigator as to what the Crime Laboratory is equipped to do for him.

2. To outline what is expected and required of him in the proper collection, preservation and submission of evidence for analysis to the laboratory.

CRIMINALISTICS:

Criminalistics is that profession and scientific discipline directed to the recognition, identification, individualization, and evaluation of physical evidence by application of the natural sciences in law-science matters.

LATENT PRINT EXAMINATION:

Latent print examination involves the detection, collection and comparison of fingerprints from a crime scene or physical evidence to known individuals.

"Latent" refers to hidden which relates to non visible fingerprints left at crime scenes. These fingerprints are located and developed by specialists utilizing a variety of physical, chemical, or instrumental methods.

PHYSICAL EVIDENCE:

The term physical evidence involves any physical entity that can furnish some degree of proof or disproof. Physical evidence may be used to establish an element of a crime such as the presence of an accelerant at the point of origin of a fire in a suspected arson. It can link the criminal to the crime scene by the various transfers of substances between the two. The laboratory findings from the analysis of physical evidence can often be used to induce a confession, exonerate the innocent, check an alibi and provide investigative leads that may well change the entire direction of the investigation.

II. LABORATORY STAFF AND FACILITIES

The Phoenix Police Department Crime Detection Laboratory is located in the basement of the Public Safety Building, 620 West Washington, Phoenix, Arizona.

The laboratory is staffed by a Director, who is also a Criminalist, a Criminalist Supervisor, three Criminalist III's, three Criminalist II's, and six Criminalist I's, a Laboratory Technician, a Police Aide, a secretary and a clerk typist. All criminalists have a Bachelor of Science degree in chemistry with post graduate work in the forensic sciences and analytical techniques.

The Latent Print Section of the laboratory is staffed by a section supervisor, three Shift Supervisors and thirteen Latent Print Examiners. There are eleven Evidence Technicians. All the Latent Print Examiners have qualified as "expert witnesses" in fingerprint identification.

III. FUNCTION AND SERVICES

The primary role of the Crime Laboratory is to develop information from physical evidence collected by the investigator and to provide assistance in the examination and documentation of the crime scene.

SERVICES:

The services of the laboratory are generally only available to officers of the Phoenix Police Department.

Outside agencies must request the laboratory's assistance through the Chief of Police. Deputy County Attorneys who wish certain tests made must first discuss the matter with the investigating officer.

FUNCTIONS OF THE LABORATORY:

1. At present, the Phoenix Police Department Crime Detection Laboratory conducts chemical, microscopic and instrumental examinations to identify, compare and interpret nearly all types of physical evidence. The Latent Print Section of the laboratory provides crime scene support in the areas of photography and fingerprint processing. Handwriting and signature comparisons are not processed by the laboratory at this time.

2. A comprehensive blood alcohol testing and training program is carried out by the laboratory.

3. The laboratory may provide criminalists for field assistance in the investigation of major crimes at the request of a command officer when it becomes apparent that special knowledge is needed for the proper investigation of the case.

4. All of the criminalists and Latent Print Examiners are qualified to give expert testimony before the courts when subpoenaed to do so, although under the new Rules of Criminal Procedure (Sept. 1, 1973) the laboratory report will be introduced as evidence at preliminary hearings and before the grand jury.

5. The laboratory is frequently called upon by the County Attorney and City Prosecutor's Office to prepare and present scientific evidence at the time of trial.

6. Instructional classes are available for officers and detectives on a variety of topics. Specialty classes to meet particular needs can be developed. Some of the class topics are:

   A. Drug Screening
   B. Hit and Run Evidence
   C. Latent Fingerprint Evidence
   D. Firearms Evidence
   E. Gunshot Residues
   F. Serial Number Restoration
   G. Breath Alcohol Testing (GCI, etc.)
   H. Biological Evidence

IV. GENERAL INSTRUCTIONS FOR COLLECTION AND PRESERVATION OF PHYSICAL EVIDENCE

THEORY:

The development of physical evidence can be outlined as follows:

1. Recognizing obvious and potential physical evidence.
2. Gathering or collecting the evidence.
3. Correctly marking and packaging evidence.
4. Preventing contamination or alteration of the evidence.
5. Maintaining the continuity of the custodial chain.

Failure to observe any one of these steps may ruin your investigation or render any Laboratory findings useless.

SUGGESTED PROCEDURE:

1. Secure and clear the scene - Access to the scene should be restricted to essential personnel required for life-saving measures (paramedics) or crime scene processing (detectives, medical examiners). All others, including officers and supervisors not assigned a specific function, must be excluded if possible to avoid contamination or alteration of the scene or the loss of valuable information. No items of evidence, including firearms, should be handled until they can be evaluated. If a suspect is already in custody, it is of paramount importance that he be kept well clear of the crime scene.

2. Systematic Search of Scene - One, or at the most two officers should collect all the evidence. Any other officers assisting in the search merely point out potential evidence for subsequent collection by the officer with that responsibility. Notes should be taken as to the date and time, condition, position, and description of each item collected.

3. Photographs - Any necessary photographs should be taken prior to removal of possible evidence. Photographs must accurately reflect the scene or specific evidence.

4. Marking Evidence - If an object can be marked, by all means mark it; and when its size permits, mark it in such a way that it becomes unique to the particular case. As an example, your initials, serial number and a DR number can easily be written on a hand-rolled cigarette with a fiber or ball point pen. Remember, if in court a year or more later, you cannot relate the exhibit to this particular offense being tried; it will not be admitted into evidence. Evidence tags and adhesive labels may also be used to mark evidence when appropriate to use.

   Items whose very nature or size precludes their being marked should be placed in a small vial or envelope, sealed, and the vial or envelope marked accordingly.

5. Marking Containers - Appropriate containers ranging from large plastic bags to small pill vials and coin envelopes should be chosen for the packaging of any physical evidence collected. The containers must not allow loss or contamination of the evidence. Once the evidence is in a suitable

container, it should be sealed and the seal initialed and dated. The information written on the envelope or container should include:

A. DR number
B. Date and time collected
C. Location found
D. Suspect's name
E. Officer's name and S/N
F. Charges
G. Disposition of the evidence
H. Date and time of transfer

Multiple items should be itemized and the item numbers placed on the envelope or container.

Further suggestions for evidence collection and packaging will be offered in subsequent portions of this manual.

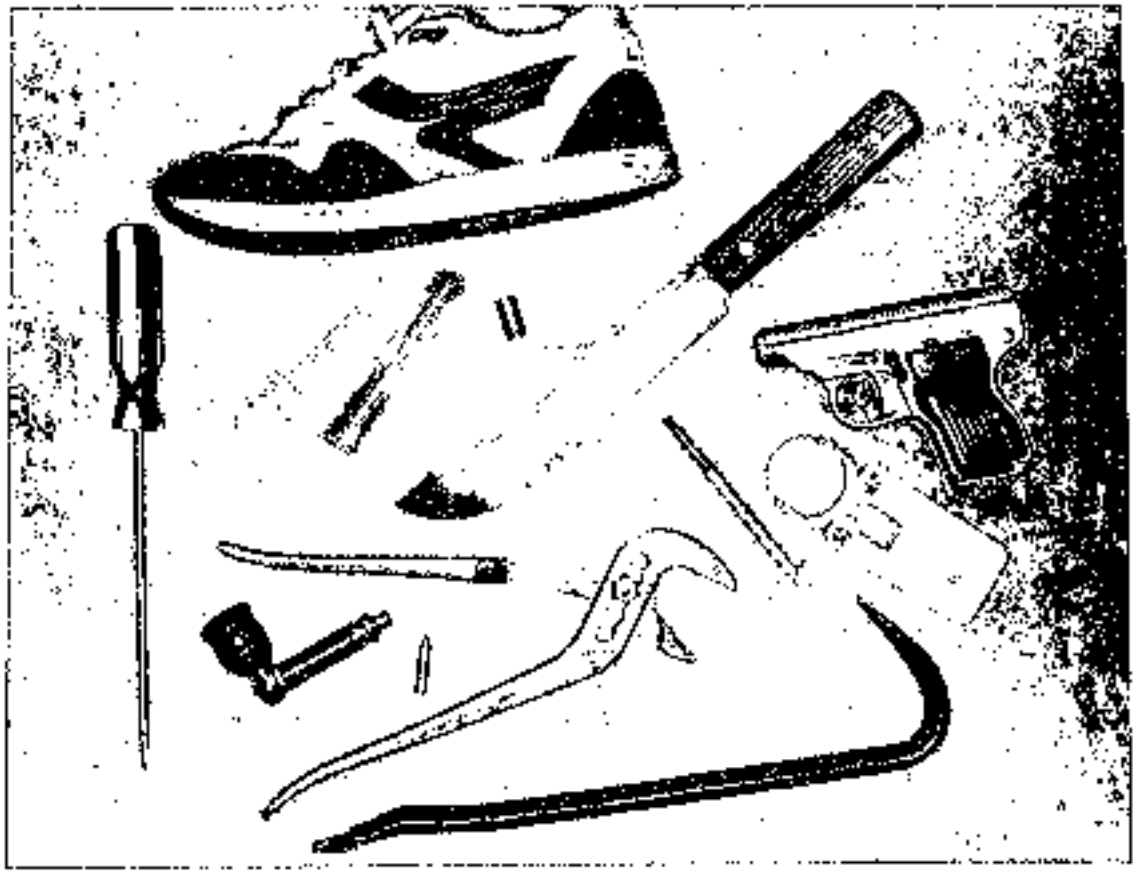


Figure 1. - Physical Evidence

V. CRIME SCENE PROCESSING AND RECONSTRUCTION

A critical element in the investigation of any crime is the collection of physical evidence. Eyewitness accounts are not always reliable and many times the victims, as well as the suspects, give biased accounts of what occurred. Frequently, there is only one survivor and one story available. It is the physical evidence which is used to resolve any conflicts.

The prosecutors often insist that the investigators have physical evidence supporting the charges and linking the suspect to the victim or crime scene before they will file the case. The trial courts are requiring that the case be supported by physical evidence which has at its foundation scientific principles relating to provable facts. If all the physical evidence has not been collected or preserved properly, it has been found to be reversible error and convictions have been overturned by the appellate courts. All these factors make it essential that the crime scene be completely and properly investigated and that all the physical evidence be collected, evaluated and preserved.

The majority of crime scene processing is the responsibility of the officers and detectives. The Latent Print Section of the laboratory provides fingerprint and photographic support while the criminalists will scientifically examine the physical evidence collected. In certain circumstances, the criminalists are available on call-out for active crime scene support. The officers are responsible for the documentation, collection and preservation of the physical evidence. The laboratory staff will assist and provide technical support.

CRIME SCENE PROCESSING:

A crime scene consists of the location of occurrence, any means of transport of a victim, any secondary locations (graves, dump sites, etc.) and the victim (him or herself). The purpose of examining a crime scene is fourfold:

1. To prove or disprove that a crime occurred.

2. To collect physical evidence linking a suspect(s) to the victim or crime scene or to link the victim and/or suspect to a primary or secondary crime scene.

3. To collect physical evidence which will help reconstruct the circumstances involved in the incident.

4. To provide investigative leads which can result in information on the victim and suspect(s).

The various techniques for crime scene processing are determined by the nature of the crime and the location of the crime scene. These techniques are covered in various texts and in in-service and on-the-job training. The investigating officer should consider a number of criteria relating to physical evidence while examining a crime scene.

1. Anything that is present in a crime scene can be physical evidence. Not all physical evidence is readily visible (latent fingerprints, shoe prints, trace evidence, etc.).

2. Minimum disturbance to the scene by non essential personnel is critical. They can remove, alter, destroy or add physical evidence to the scene.

3. The best means by which to secure a crime scene or item of evidence is to restrict access and avoid disturbance of the area. Limited entry into a scene is essential as well as minimum manipulation of items.

4. Recognition of something as physical evidence is a major factor in crime scene processing. Experience and training is important.

5. Documentation by measurements, notes and photography is necessary.

6. No item of evidence should be handled until its position in the scene, positions of any mechanical devices (on-off switches, safeties, hammers, etc.) and possible trace evidence has been evaluated and documented.

7. Collect <u>all</u> items of evidence. When in doubt, <u>collect</u>. These items can be sorted out later. The investigator normally has one chance to process the crime scene.

8. All items of physical evidence must be collected and preserved in such a manner as to:

   A. Avoid alteration, damage or loss of information
   B. Prevent contamination (trace evidence)
   C. Prevent spoilage/decomposition (biological samples)

9. Non removable physical evidence must be collected/documented in some other fashion:

   A. Photography (close-up, specialized lighting, etc.)
   B. Casts (toolmarks)
   C. Lifts (latent fingerprints, shoe prints)

10. The relationship of the physical evidence to the crime scene and circumstances of the crime must be explainable. Non explainable or overlooked physical evidence can result in a different interpretation of the crime scene.

CRIME SCENE RECONSTRUCTION:

Crime scene reconstruction is the evaluation of the case as a whole and the hypothetical recreation of what occurred during the incident. These conclusions are the basis of any criminal charges and must be supported by factual evidence. Physical evidence is considered to be the least biased and most objective source of provable facts.

The investigator has to review all aspects of the case and develop a theory as to how the crime was committed and how the suspect was involved. He/she needs to utilize the physical evidence and results of the crime scene processing to confirm or contradict interview statements, demonstrate the events of the crime and connect the suspect with the crime scene and/or victim. There must be a close interaction between the Crime Laboratory and the investigator in order to properly interpret the scientific analysis of the evidence in the context of the case.

Each crime and crime scene is unique and will involve various types of physical evidence encountered in different configurations. The following are some examples of Crime Laboratory technical support which can assist in crime scene reconstruction:

1. Photographic documentation of the crime scene and the physical evidence.

2. Firearm distance determinations by gunshot residues, powder tattooing or shot-shell pellet patterns.

3. Entrance/exit bullet-hole determination, bullet trajectory.

4. Identification and typing of biological stains (blood, semen). Blood splatter pattern analysis.

5. Firearm function testing and trace evidence on firearms (blood, fibers, etc.).

6. Trace evidence evaluation on bullets, weapons, objects from crime scene.

Figure 2. - Marijuana Leaf

VI. MARIJUANA, NARCOTICS AND DANGEROUS DRUGS

MARIJUANA - BOTANICAL DESCRIPTION:

Cannabis sativa L. - The plant is a herbaceous annual that exists in two sexes, both of which contain the active resin. The general appearance of marijuana, particularly the seeds, to a trained observer is often sufficient to establish probable cause. The growing plant can be identified by the characteristic leaf structure. Marijuana is mostly sold by the plastic sandwich bag (baggie) and is commonly used in the form of hand-rolled cigarettes or in pipes. Alligator clips and homemade devices for holding marijuana cigarette butts called "roaches" are frequently found in the possession of marijuana users. These should be impounded as associative evidence, but packaged separately from the items requiring analysis.

NARCOTICS:

A complete description of the narcotics can be found in A.R.S. 13-3401. Under normal circumstances only, two of these are likely to be encountered by the officer:

1. Heroin - Chemically, heroin is diacetylmorphine and is prepared synthetically from morphine in clandestine laboratories in Europe, Asia, and Latin America. In the southwestern United States, its origin is usually Mexico.

   The common form found in the Phoenix area is a dark brown to black gummy solid known as "tar" or "tootsie roll" heroin. It is ordinarily wrapped in small sections of

plastic bag material and a single dosage unit is approximately the size of two match heads. Papers (or small envelopes) of white Asiatic heroin have also been rarely encountered in Phoenix. Since heroin is a drug of injection, a suspect should be searched for needles, syringes, sooted spoons (or bottle caps) and needle marks. A field test (Marquis) can be conducted on suspected samples to establish probable cause to believe that the sample is heroin.

2. Cocaine - Cocaine is found in two forms: cocaine hydrochloride (for inhaling [snorting] and injection) and cocaine free base (known as "crack", for smoking). Cocaine hydrochloride is ordinarily found as a white to yellowish-white powder that often has a lustrous or pearly appearance. It is packaged in vials, small envelopes, or plastic bags. Common paraphernalia include snorter tubes, syringes, cookers, scales, etc. Cocaine free base takes the form of white to yellowish-white, irregularly shaped fragments ("rocks") usually about 3/8 of an inch in diameter, but can be larger or smaller. The most common packaging is in plastic bags. The most common paraphernalia is the crack pipe; a sooted glass tube with a wire mesh filter. Both forms of cocaine can be tested with the Scott reagent.

DANGEROUS DRUGS:

A.R.S. 13-3401 lists approximately 100 drugs which are classified as dangerous because of their potential for abuse as a result of their hallucinogenic, stimulant, or depressant action on the central nervous system. Only four of these are commonly encountered: methamphetamine, lysergic acid diethylamide (LSD), phencyclidine (PCP), and psilocybin mushrooms.

1. Methamphetamine - This drug is a stimulant and is known in two forms: white to yellowish-white powder or chunks

(no pearly appearance) and in clear crystalline chips. The first form ("crank", "speed") is used for inhaling (snorting) or injection.

The second form ("ice") is preferred for smoking. The packaging and paraphernalia is very similar to that for cocaine. Both forms can be tested with the Marquis reagent.

2. LSD - This hallucinogenic drug normally comes in tablet or small decorative paper squares ("blotter acid") form. The tablets are very small (approximately 1/8 inch in diameter) and can be any color. The "blotter acid" form is LSD deposited on paper that has been perforated to be torn into small (1/4 inch) squares. It usually has some type of a design printed on the paper.

3. PCP - This drug is an hallucinogen that is usually encountered in the form of a brown paper cigarette (often foil wrapped) called a "Sherm." The cigarette has been dipped into a solution of PCP/ether in order to deposit the drug on it. PCP in this form has a disagreeable organic odor.

4. Psilocybin Mushrooms - This plant has two hallucinogenic drugs; psilocybin and psilocyn. The mushrooms are usually dried and have a bluish discoloration on the stem. They are often packaged in plastic bags. The street name is "Magic Mushrooms."

VII. PRESCRIPTION ONLY DRUGS

PRESCRIPTION ONLY DRUGS:

A.R.S. 13-3401 basically limits the possession of prescription only drugs to persons who have a valid prescription for the particular drug. Prescription drugs are not enumerated under 13-3401 as they were in the narcotic and dangerous drug sections.

The determining factors are:

1. The item is available by prescription only (law).
2. The person does not have a prescription for them (law).
3. A potential for abuse exists for this particular preparation.

Generally, prescription drugs with CNS activity such as tranquilizers, mood elevators and anti-seizure and anti-depressant drugs are the types of prescription drugs on which these types of cases are made.

Field tests are not available for these drugs and initial identification is most often through use of the P.D.R. or personal experience and training.

DRUG EVIDENCE PACKAGING:

Suggestions for marking and packaging drugs:

Packages of heroin, cocaine, marijuana, methamphetamine, etc. can all be marked with the officer's initials, S/N, and date or

DR number. Non-porous surfaces (plastic, glass, etc.) can be marked by placing tape on the item and marking on the tape. Do not use fiber tip pens on these surfaces. Marijuana cigarette, cigarette butts and tablets also can be initialed. If a vial of tablets is seized, a few of the tablets should be marked before sealing the container. Sometimes it may be necessary to place a small piece of tape over the ends of a hand-rolled cigarette or the flap of a "paper" to prevent loss of the contents. Do not encase the entire item in tape. Once marked and secured against loss of contents, seal the item in a suitable evidence envelope for transfer to the laboratory or placement in the laboratory locker system in the basement of the Police and Public Safety building (PPSB).

Small amounts of narcotics/drugs in non-arrest situations can be impounded at the precincts for submission to the Crime Laboratory. The appropriate paperwork must accompany the evidence.

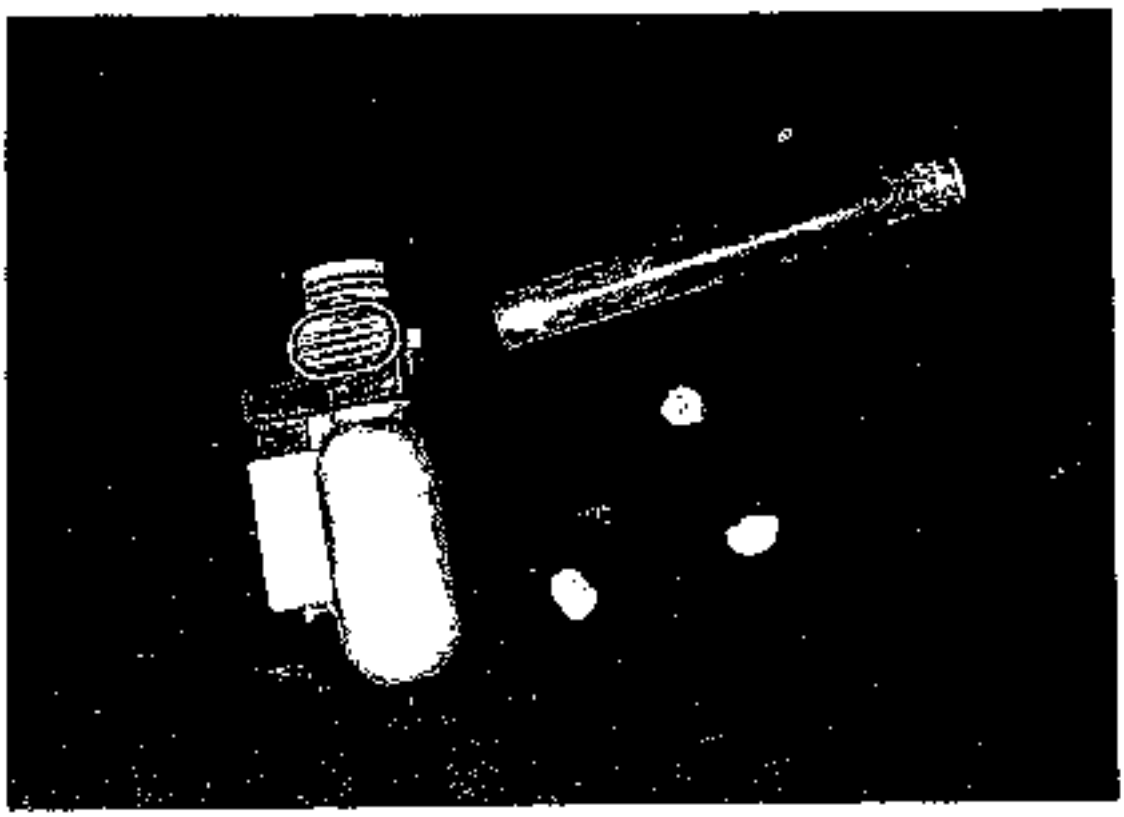


Figure 3. - "Crack" Cocaine

VIII. TOXICOLOGY

Toxicology examinations conducted by the laboratory are directed primarily toward the measurement of alcohol concentrations in blood samples. No postmortem analysis of body fluids or organs are made by the laboratory as this is within the jurisdiction of the medical examiner and his laboratory. Samples of suspected poisons, food or beverages alleged to be poisoned, blood alcohol specimens for D.W.I. suspects and toxic vapor (glue, paint and solvent) sniffing are all examples of the types of analysis that are considered in toxicology.

COLLECTION OF TOXICOLOGICAL EVIDENCE:

1. Blood Alcohol Specimens - When hospital personnel are drawing a blood sample from a D.W.I. suspect for their own use, they must provide a sample to the police officer present for alcohol analysis. The officer should request that they use a vacutainer tube with an anticoagulant (gray stopper), or provide a blood alcohol collection kit. The alcohol concentration of an improperly collected (clotted) blood sample can only be approximated. Also insist that a nonalcoholic antiseptic be used for the pre-puncture swabbing. Briefing stations are supplied with a completely self-contained blood alcohol collection kit that may be provided for use by a person qualified to draw blood. Blood samples collected with these kits should be labeled, marked, sealed and placed in one of the laboratory lockers at Police Property, along with a Request For Analysis and Property Invoice. Samples collected during the weekday should be brought directly to the laboratory.

2. Toxic Vapor - The evidence in glue and paint sniffing cases requires special packaging to prevent loss of vapors. The presence of these toxic vapors is essential to the prosecution of "Vapor-Releasing Substance" cases.

   Glass jars with screw-on tops are the preferred containers for paint or glue-soaked rags. Any container used must be air tight and impervious to vapors.

   Paper sacks and plastic bags are not suitable for preserving this type of evidence. If a partially used glass food jar is all that is available, wash it out and use it. Soap residues or water in the jar will not affect the solvent vapors.

3. Poisoned Foods or Beverages - These materials should be packaged to prevent sample loss and contamination then submitted to the laboratory as quickly as possible. If the laboratory is to be of assistance, it will be necessary for the officer to gather all possible pertinent information from the victim and the victim's doctor concerning symptoms and possible poisons for which to search.

   In the absence of any such investigative effort by the officer, the laboratory will embark upon a non-specific search for mammalian poisons. Findings in these instances will usually be that the presence or absence of mammalian poisons was shown. No further tests are conducted at this time.

IX. BLOOD STAINS

Blood stains or smears are often found in crimes of violence, either on weapons or clothing, or deposited at the crime scene itself.

Wet and dried blood stains can be typed if sufficient quantity is present and if not decomposed by putrefaction, heating, exposure to sunlight or altered by other substances. In the absence of these problems, a complete blood analysis through typing in a number of systems can be carried out on a stain the size of one square inch and still leave a portion of the stain for courtroom presentation. Stains or smears smaller than these are still of value since the initial testing for the identification blood and species origin (human or animal) can usually be carried out as well as <u>some</u> of the other typing procedures.

1. <u>The Shape of Blood Stains</u> - The shape of blood stains or splatters can be useful in determining direction of movement and approximate height from which they have fallen. Overall and scale photographs of the stains should be taken if such information is desired. This can be very important in reconstruction of the crime scene.

2. <u>Wet Blood Stains</u> - Movable objects bearing fluid blood stains should be delivered to the laboratory immediately, if possible. If the object is not movable, a portion of the blood should be collected in a vacutainer tube of the type that is pre-treated with a preservative anticoagulant (purple top tube with EDTA).

If the wet blood cannot immediately be brought to the laboratory or collected in a vacutainer tube, then the stain must be allowed to air dry. Garments should be hung in a low humidity, ventilated room out of direct sunlight. There is a GIB drying room located in the basement of the Police and Public Safety Building located at 620 West Washington. Once the stains are dry, mark the item for identification purposes and seal it in a large envelope, paper bag or box. Do not use plastic bags for blood-stained evidence. Package each item, stained or unstained, separately. Minimize handling in order to preserve any trace evidence.

Blood stains are biological evidence and care must be taken to avoid unnecessary exposure to a biological hazard. Proper precautions are recommended in handling and packaging any biological evidence. Biohazard kits with protective equipment (gloves, etc.) are available.

3. Dry Blood Stains - Collectible items should be marked and individually packaged in a suitable porous container other than a plastic bag.

   Stains on large, solid objects must be scraped or lifted with a clean razor blade, scalpel or knife and transferred to a small vial or folded piece of paper. Commercial envelopes are not suitable for loose dried blood samples. The blade must be cleaned and dried between samples to prevent cross contamination. Also collect a sample of the unstained surface adjacent to the stained area. This control sample of the unstained surface is needed by the laboratory to insure meaningful results.

4. Comparison Samples - Known samples of the victim's and the suspect's blood are required and are essential for a complete analysis. The analysis of both sources allows the

laboratory to exclude one of the individuals (victim or suspect) as a possible source of the questioned blood and to compare the blood stain to the other individual in the various blood typing systems.

Known blood samples should be collected in appropriate vacutainer tubes and submitted to the laboratory as soon as possible. Blood collection kits are available from the Crime Laboratory or from the GIB Homicide or Assault Details (any questions, contact the laboratory).

A thorough examination must be made of both the victim and suspect as to nature and location of any injuries which may have resulted in bleeding. If the victim received any blood transfusions as a result of the injuries, the laboratory must be notified. If control liquid blood samples are unavailable or unsuitable for analysis (putrefied), the victim's clothing or another blood stained item associated with the victim can serve as a secondary blood standard.

5. Laboratory Findings - Five basic determinations can be undertaken in the analysis of a possible blood stain:

   A. Demonstrating the presence or absence of blood.

   B. Determining the species origin of the blood, either human or animal, and occasionally the species of animal when desired.

   C. Typing in the basic ABO blood group system. All humans possess one of the following blood types in the ABO system: A, B, AB, or O. The incidence of these four blood types is not equal among the population nor between racial groups.

D. Protein and Enzyme Typing - Modern blood typing techniques now include characterization of blood by identifying protein and enzyme types. The Crime Laboratory routinely utilizes eight different blood type systems on evidence blood stains. In special circumstances, another nine blood type systems may be analyzed for in biological evidence involving blood.

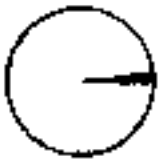
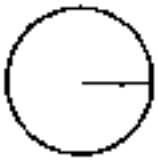
Varieties of enzymes and proteins are genetically inherited in much the same manner as the blood types in the ABO system. These types allow for further characterization of blood samples. Examples of enzymes that may be typed at this time are Phosphoglucomutase (PGM) sub-type, Erythrocyte Acid Phosphatase (EAP), and Glyoxalase (GLO). The significance of typing blood stains rests in two areas. One is the ability to rule out or exclude certain individuals as having produced a given stain. For example, a type "A" blood stain could not have been produced by a type "O" person. The second area is where the blood stain matches the victim's blood in all the blood types determined in the testing of the stains. The fact that the stain matches the person's blood in all the particular blood types determined does not specifically identify it as having come from that person. However, there may be considerable significance in the matching types. If, for example, the stain matches the known sample in the ABO system, say type B, it also shares the type with approximately 13% of the population. If it matches in the PGM subsystem (type 1+ for example), it shares the type with approximately 40% of the population. For a third example, a matching type CB in the EAP system shares the type with 4% of the population. In the fourth system, the blood type is a GLO 2 (31% of the population). None of these types, when taken separately, is very unusual. However, the usefulness of these matching types can be seen when one considers the

frequency of occurrence of the combination of these blood types (see Diagram 1). The frequency of occurrence of this combination can be calculated as six (6) in 10,000 which means that in a group of 10,000 people, a small group of six (6) would have this same combination of blood types. It becomes obvious that the likelihood of encountering this combination of types by chance alone in an individual becomes quite small. This serological evidence combined with other evidence in the case is quite valuable to the investigator and prosecutor.

This example is only utilizing four of the over 15 blood types which are suitable for forensic analysis in evidence items.

E. DNA Typing - This advanced typing technique isolates and identifies selected portions of a person's genetic code (DNA) and compares the test results to DNA from questioned samples. DNA typing can be performed on any portion of the human body which contains genetic material (e.g. blood, semen, or tissue). DNA is more stable than blood enzymes, less subject to decomposition, and has greater ability to differentiate between individuals, even close relatives. Forensic DNA typing has the potential to virtually identify or exclude a given blood or semen stain as having come from a single individual.

At the present time, cases which require DNA typing are processed by the Crime Laboratory with conventional serological techniques and then selected case samples with appropriate controls are submitted to a qualified outside agency for DNA analysis. DNA analysis is a new technique and is still under evaluation by the scientific and legal communities. It is anticipated that DNA typing will become a major tool in the analysis of biological evidence.

Blood Type	Population Distribution	Percent
ABO Type B		12%
PGM Sub Type 1+		40%
GLO Type 2		31%
EAP Type CB		4%
Combined		.06% or 6/10,000

Six (6) out of 10,000 people would have this combination of blood types. Another way to view this is that you can exclude 99.94% of the general population as possible sources of the blood stain.

Diagram 1.

6. Summary - The laboratory will conduct complete testing on suspected blood stains when requested to do so only where the results may have value. For example, to type dried blood from the point of entry in a burglary in the absence of a suspect will not aid in his apprehension. Such evidence should be collected and retained in freezer storage in the event a suspect is found and his blood types can be determined for comparison. Then the officer with crime scene samples and a known sample of the suspect's blood should submit the complete case to the laboratory. All biological evidence must be stored properly according to Arizona case law. Dried stains must be stored frozen and liquid blood samples must be retained in refrigerated storage.

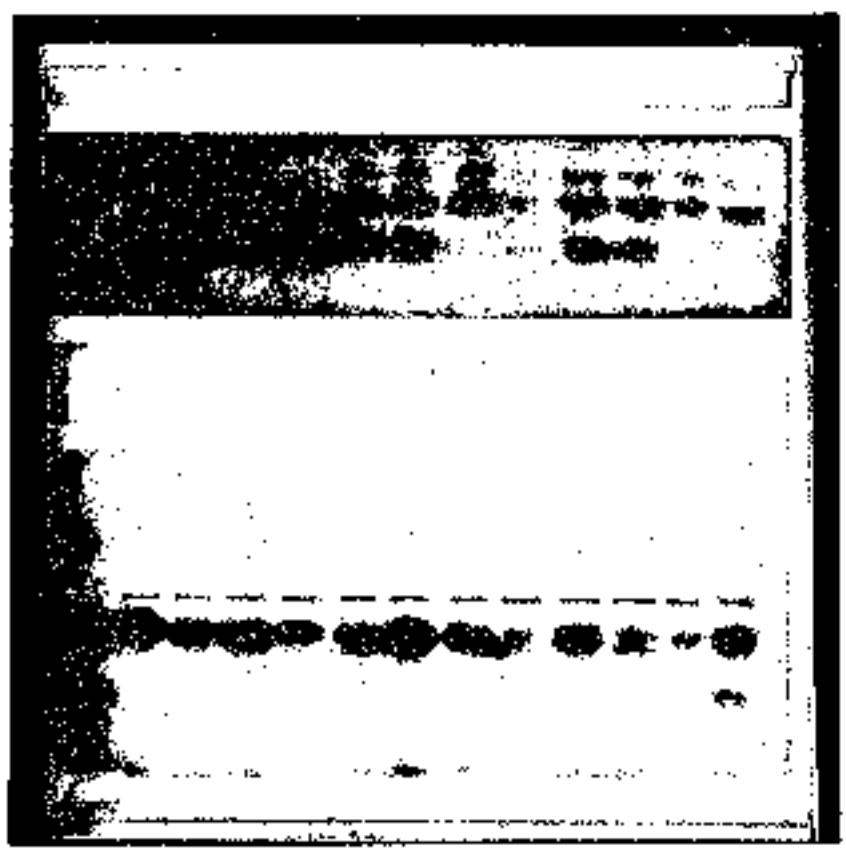


Figure 4. - Electrophoresis Plate with polymorphic enzymes from blood samples

X. HAIR

Hair evidence is commonly encountered in criminal casework. It is found in crimes of violence as well as hit and run accidents. Hair is most valuable as negative (exclusionary) evidence and is seldom positive evidence. This means that hair can be used to exclude a suspect but generally cannot individually identify him or her on the basis of hair comparisons alone.

COMPOSITION OF HAIR:

Hair is a non-living, pigmented fibrous material composed of three (3) basic structures: the cuticle, cortex and medulla which may be likened to the paint, wood and lead of a pencil when viewed in cross-section. The length of a hair is divided into the root, the shaft and the tip, all of which are potential sites of evidential value. Hair characteristics can vary on a given individual so adequate control samples are essential to determine the range of variation for that individual. The characteristics can vary from different sites/areas of the head or pubic region.

1. Collection and Preservation of Hair Evidence - Hairs collected from different locations should be packaged in separate containers of an appropriate size. Small snap-cap plastic vials or small circular cardboard pill boxes are ideal.

   Hair imbedded in objects such as weapons should be left in place and the area wrapped in such a way as to protect the hairs from accidental removal.

2. Comparison Samples - Multiple hairs must be collected from different sites in order to provide adequate comparison samples. The hairs should be plucked in order to obtain full length hairs. A minimum of ten (10) hairs per site is requested.

Head - front, back, sides and top
Pubic - upper and lower pubic areas
Torso - chest and abdomen
Arms - upper and lower

If the hair samples must be cut, the hairs should be cut at skin/scalp line in order to obtain maximum length.

3. Laboratory Findings - Hair can be identified as human or animal. The tip of a hair will often reveal whether it was recently cut, burned, broken or crushed. Examination of full length hairs can yield information concerning chemical treatments such as bleaching or dying and the approximate time of such treatments. The root bulb can establish whether or not the hair fell naturally or was torn or pulled out.

Hair color or pigmentation can be compared, however, wide variation in color will often be present among the hairs of one individual. This is the primary reason for the large number of control or comparison samples.

Tissue attached to the hair (e.g. root sheaths) may be used in enzyme typing or DNA typing procedures. These tests can often differentiate hair samples which possess similar physical characteristics or narrow the possible sources to a smaller segment of the population.

4. Summary - Hair to date cannot generally be identified as specifically having come from a particular person. DNA analysis, if sufficient tissue is present, may be the exception.

Hair can be used to absolutely rule out a suspect. As an example, blood and hair found on the bumper and grill of a suspected hit and run vehicle may turn out to be that of a deer or other animal. It is essential that adequate control (known) samples of hair be submitted along with the questioned hair(s).

A number of points of comparison between the evidence hairs and a victim or suspect's hair can be found that show that the hairs are consistent with having come from that person.

Combined with other associative evidence, hair comparisons will certainly heighten the probability or likelihood of a suspect's involvement in the offense.

Figure 5.
Dog Hair

Figure 6.
Human Head Hair

Figure 7.
Cat Hair

XI. SEMINAL STAINS

Seminal stains are often found and collected as evidence in sex offenses such as rape, sodomy and incest. The presence of seminal stains confirms sexual activity took place. However ejaculation is not a necessary element of proof in any of these crimes. It is not unusual for ejaculation not to occur during the sexual assault. The presence or absence of seminal stains are useful in corroborating or disproving a victim's account of the crime.

Semen is a complex mixture of secretions from the testicles, seminal vesicles and other glands of the urogenital tract and formed elements (spermatozoa). However, a number of diseases, congenital conditions or a vasectomy will result in semen that is sperm-free. Within 10 to 30 minutes, fresh seminal fluid will liquefy and upon drying out the resultant stain will have a starchy feel.

Seminal stains are most often found on the victim's person or clothing, bed sheets, blankets, carpeting or upholstery. Vaginal smears (slides) prepared by the examining physician can be examined by the laboratory if the hospital chooses not to do so. Seminal stains on the suspect's clothes are generally of little investigative value unless they can be used to substantiate some element of the crime (i.e. a specific location relating to victim's statement, etc.).

Seminal stains are biological evidence and care must be taken to avoid unnecessary exposure to any biological hazards. Proper precautions are recommended in handling and packaging of any biological evidence. Biohazard kits with protective equipment (gloves, etc.) are available.

COLLECTION AND PRESERVATION OF SEMINAL STAINS:

1. Wet Seminal Stains - If removable, attempt to collect a portion of the liquid in a clean test tube or vial and cork it. (Spermatozoa may survive as long as 24 hours at room temperature.) Allow moist stains to air-dry in the same fashion as a wet blood stain. Mark and package the items in a similar manner. Do not combine items in a single envelope.

2. Dry Seminal Stains - These may usually be located by the use of a UV (black) light or laser. Fold the garment carefully to avoid abrasion of the stained area. Package in a suitable sized envelope or paper bag.

COMPARISON SAMPLES:

The collection of appropriate control samples from the victim and the suspect is essential in the comparison of seminal stains. If the victim has been sexually active prior to the incident (assault), control samples from the other party (husband, boyfriend, etc.) should also be submitted for comparison. The major problem in serological analysis of sexual assault evidence is interpretation of the test results from mixed stains. Control samples are important and must be submitted in each case.

Control samples consist of the following:

1. Blood drawn in a purple top vacutainer tube (EDTA preservative).

2. Saliva sample collected on filter paper.

3. Hair/clothing etc. for trace evidence evaluation.

Blood and saliva collection kits are available through the Crime Laboratory or GIB - Sex Crimes.

KITS:

Sexual Assault Evidence Kits for the collection of forensic evidence during the medical examination of the victim are available at the various hospitals and through the Sex Crimes Unit in GIB. These kits are designed for the collection of swabs for seminal fluid analyses, slides for spermatozoa and hair transfers plus collection of control hair samples. After the evidence swabs are collected, they should be dried prior to packaging for submission.

There is a Sexual Assault Report which is filled out during the medical examination. A copy of this report should accompany the Sexual Assault Evidence Kit. The kits need to be submitted as soon as possible to the Crime Laboratory for analysis or stored frozen until they can, or need to be, submitted. Associative evidence such as underwear, clothing, etc. should also be submitted with the kit.

LABORATORY FINDINGS:

The presence or absence of seminal fluid in a stain or on a swab can be determined by chemical or instrument analysis at the laboratory. The presence of spermatozoa can be determined by a microscopic examination of prepared slides or from an extract of a stain.

The presence of seminal fluid/spermatozoa confirms that sexual activity occurred. It does not necessarily prove that a crime was committed.

Investigative information, coupled with other evidence is necessary to complete the case. The medical report on the victim, statements, witnesses, plus blood, torn clothing and other physical evidence all combine to form the elements in the case. These can be utilized to prove or disprove the victim's or the suspect's story.

Seminal stains can be tested for secretor blood typing in the ABO system and for some polymorphic enzyme types. There are not as many enzyme types present in semen as there are in blood, so the ability for these tests to restrict the possible sources to a very small group is limited. The test results can definitely exclude a suspect as a possible source of a given seminal stain.

Seminal stains can also be tested by DNA typing. This test is particularly useful because of its ability to resolve mixed stains which are common in sexual assault cases and because DNA typing can virtually identify a seminal stain as coming from a given individual (see Blood Stains).

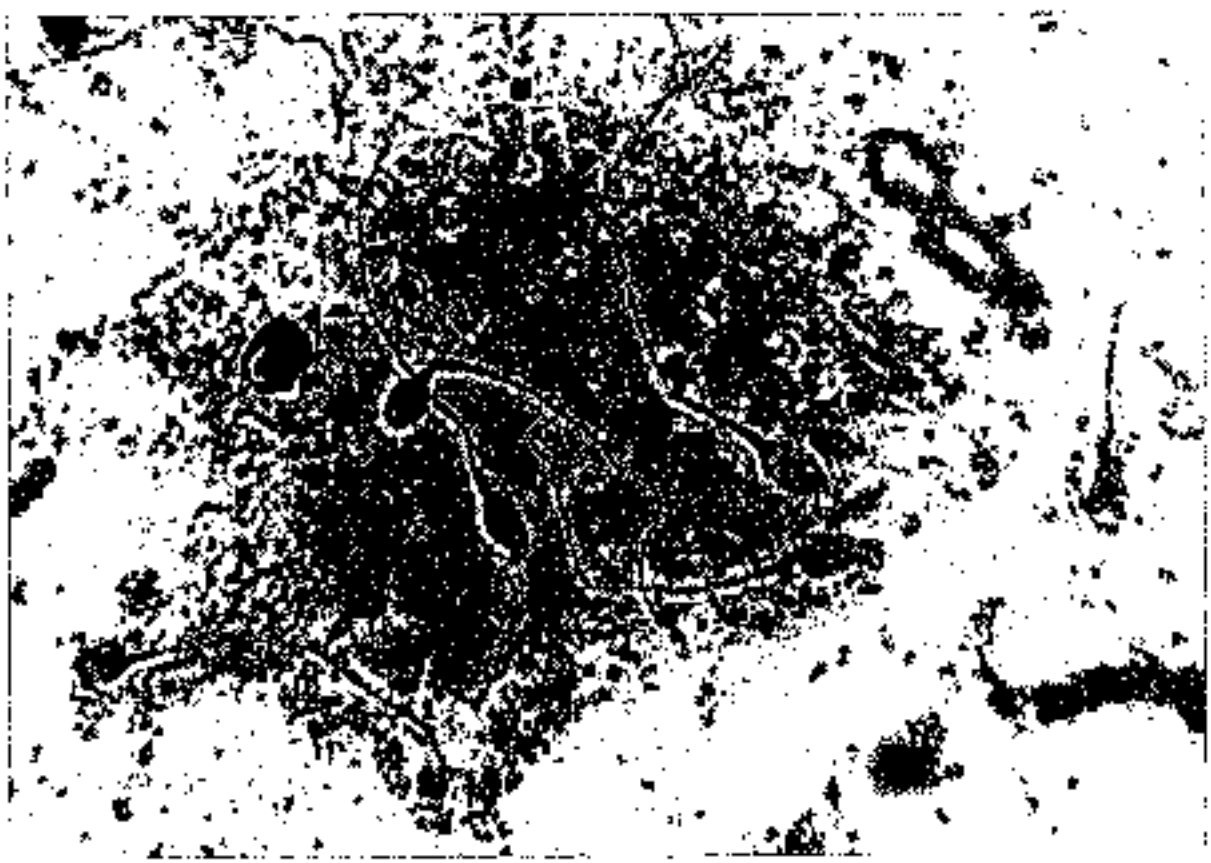


Figure 8. - Spermatozoa

XII. FIBERS

Clothing, carpeting, ropes/cord, insulation and upholstery fabrics are composed of various types of fibers which can be transferred from criminal to victim or crime scene and vice versa. Lint, threads, fibers, and fabric fragments are often overlooked as possible evidence.

Mutual transfers of fibers are apt to occur in direct suspect and victim contact. Hit and run investigations invariably produce fibers adhering to the vehicle and occasionally torn pieces of fabric or weave impressions in the paint. Surfaces bearing fabric impressions that cannot be collected should be photographed with a scale included. Weave design and dimensions can then be compared with the victim's clothing.

Contact with carpet or upholstery will often result in fiber transfers. Victims who are transported from the scene and dumped often have fiber evidence on them which can be linked back to the scene or transport vehicle.

Burglars often leave fibers from their clothing at the point of entry and will pick up insulation fibers or other trace evidence from the scene.

Weapons or other objects used to strike or cut a victim will often snag fibers in cracks or on sharp corners.

Clothing to be processed for foreign fibers should be individually rolled up in paper or plastic (if dry) and sealed. The suspect's clothes should be impounded and individually packaged.

Fibers adhering to immovable objects should be removed with tweezers and placed in a small vial, then sealed and itemized as to the location found.

1. Types of Fibers - Fibers used in cordage and textiles will fall in one of the following broad groups: natural or synthetic fibers. The abbreviated chart below should give the reader some insight into the large number of possible fibers that might be encountered as evidence:

NATURAL FIBERS

Animal		Plant	Mineral
Staple	Filament	Bast	
Wool	Silk	Flax (Linen)	Asbestos
Alpaca		Hemp	
Camel		Ramie	
Mohair			
		Leaf	
		Sisal	
		Maguey	
		Seed	
		Cotton	
		Kapok	

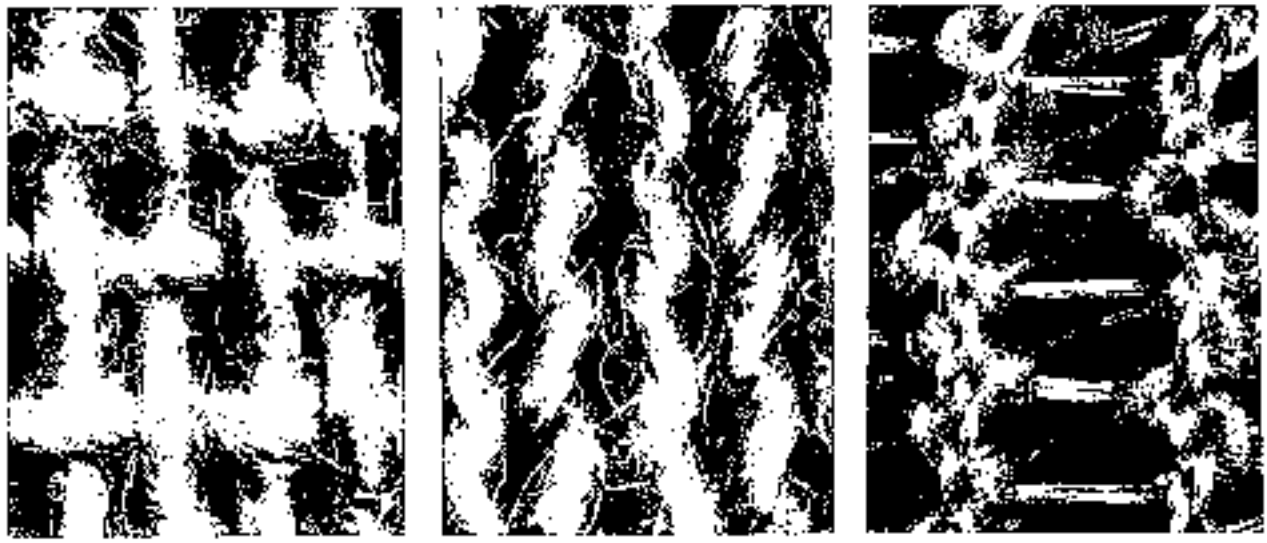
SYNTHETIC

Organic	Inorganic
Rayon	Fiber Glass
Nylon 6,11,66	Metal Fiber
Polyesters	
Polyurethanes	
Olefins	
Sarans	
Acrylics	
Modacrylics	
Vinyls	
Acetates	

In addition, new fibers and fiber combinations appear on the market each year. Also within a particular type, various diameters of the fiber are produced and a wide variety of dyes employed to color them. The result is that a large number of combinations exist out of which the suspect and the victim exchanged only one particular combination of fibers during the commission of the crime.

2. Laboratory Findings - A combination of microscopic, chemical and instrumental means are employed to determine the color, composition, size, surface and cross-sectional shape of the fibers and compare these characteristics with the submitted clothing, cordage or carpeting. Weave patterns are compared through photographic means. This valuable evidence will be useless, however, if a scale is omitted in the crime scene photograph. All photographs must include a ruler if comparisons are to be made.

Identification of fibers has having come from a particular source is not possible. Physical matches of torn pieces of fabric with their corresponding parent piece do, however, constitute an identification.



Simple Weave T-Shirt Nylon Stocking

Figure 9. - Fabric Weave Types

XIII. PHYSICAL MATCHES

Whenever two torn or broken objects can be fitted together and there is sufficient irregularity to the matching edges, the two pieces can conclusively be said to have once been one. Microscopic examination along the matching edges may be necessary to confirm small breaks or tears such as those made on tape, book matches and pieces of broken plastic and glass. Physical matches are self evident to officers and to jurors.

There is no stronger form of comparative evidence than the physical match. Sophisticated instrumental or chemical analysis on two pieces of broken plastic tail light lens that fit back together is not necessary.

The opportunity for a physical match exists in nearly every conceivable crime. Consequently, the officer should recognize the various possibilities for physical matches to occur in any investigation.

Specific examples of potential physical matches will be described in subsequent sections of this manual where appropriate.

1. Collection and Preservation - All pieces of material from the two sources (suspect and victim) must be collected. For example: If only representative samples of glass from the street and glass remaining in a headlight rim are taken, the chances for establishing an identity through a physical match are severely reduced. In this example, the laboratory may only be able to report that the two samples possess several matching chemical and physical properties but that no opinion of common origin was possible.

The two samples must be kept separate and packaged in such a way as to prevent further breakage or alterations of a torn or broken edge. Tape used to bind the hands of a victim should be removed by cutting through an area where no torn ends are present then flattened out on a piece of plastic or metal from which it can be readily removed. Fingerprints can be obtained in some instances from tape.

2. Laboratory Analysis - The Criminalist's job consists of reconstructing a two piece or multiple piece jigsaw puzzle. Once this has been done, microscopic confirmation of the match concludes the examination.

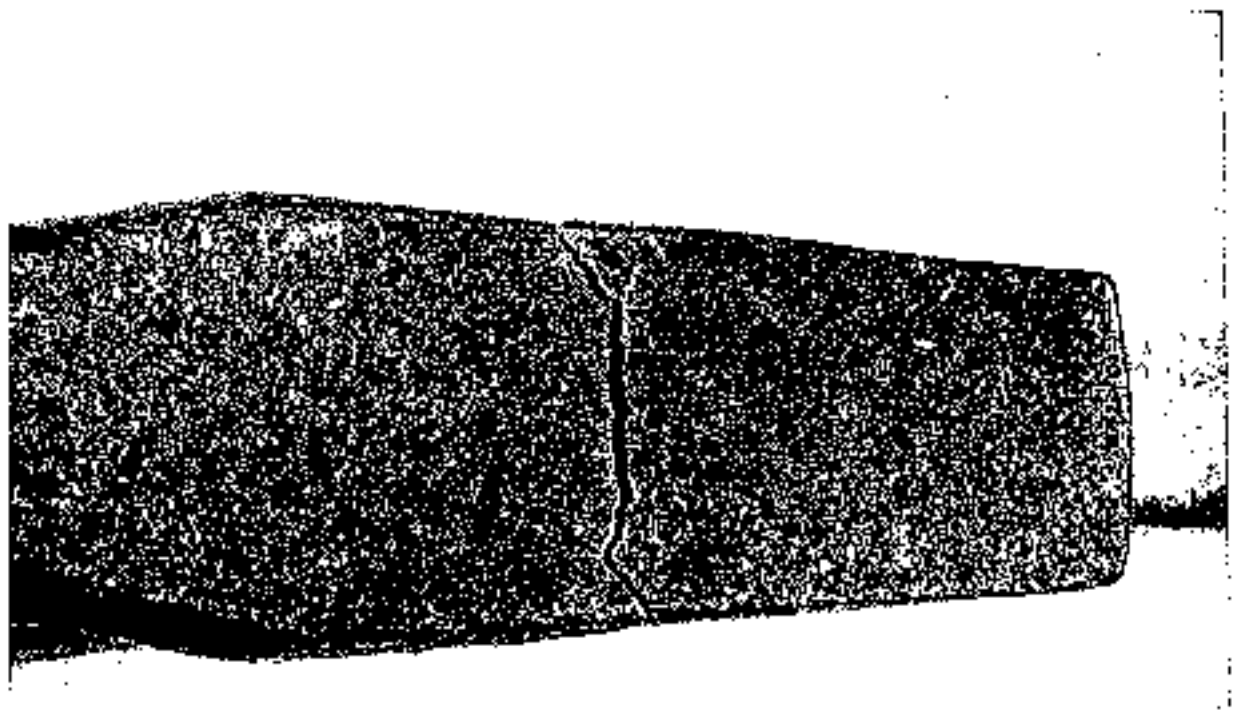


Figure 10. - Physical Match
(Screwdriver Tip)

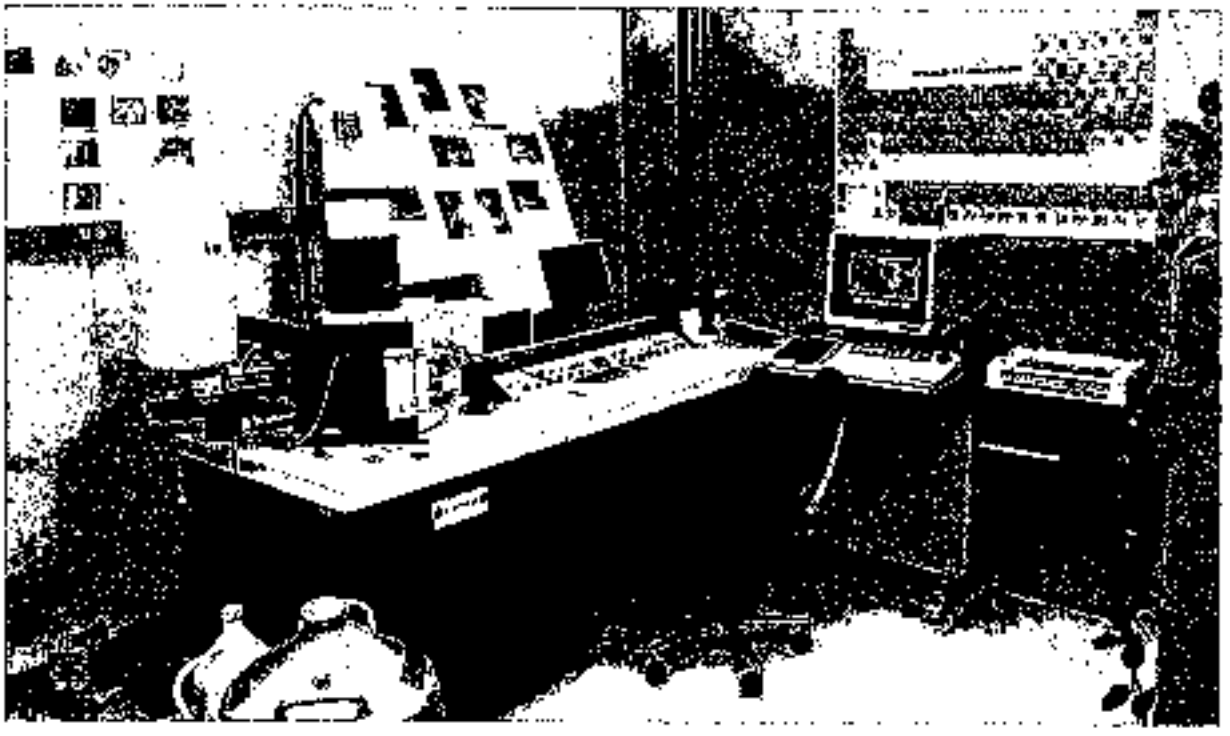


Figure 11. - Scanning Electron Microscope

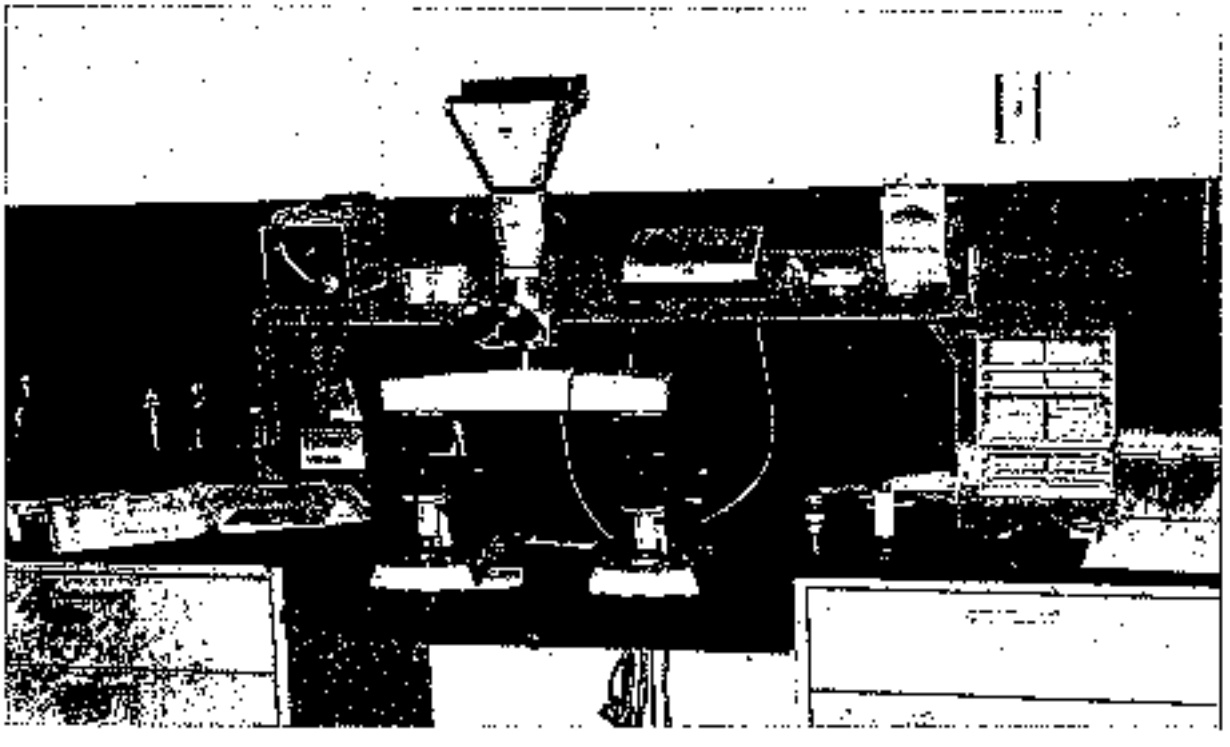


Figure 12. - Hair/Fiber Comparison Microscope

XIV. GLASS

Windows, bottles and headlights are frequently broken in burglaries, robberies, assaults and hit and run cases. Occasionally, sizable pieces are carried away by the suspect that can be physically matched with one of the fragments at the scene. The special value of this type of evidence was discussed previously and will not be elaborated upon here.

It is more common, however, for a transfer of glass slivers and chips to occur between criminal and victim or criminal and crime scene. Glass particles from a broken window at the point of entry in a burglary should be searched for in the heels and soles of the suspect's shoes. NOTE: These fragments may be very small and deeply imbedded in the shoe soles and not evident upon visual examination. The wound of a victim assaulted with a broken bottle should be probed for glass slivers to be compared with the broken bottle where the bottle can be linked to the suspect. Glass particles are frequently found in the clothing of a hit and run victim and in the hair and clothing of the driver of the vehicle when the victim hits the windshield.

COLLECTION AND PRESERVATION OF GLASS EVIDENCE:

Shoes and clothing of victims or suspects to be processed for glass particles should be packaged individually in sealed containers. All broken glass from the scene or suspect's vehicle in the case of a hit and run must be collected. Further breakage of the pieces can be prevented by careful packing with padding. The larger pieces of glass can be marked for identification with a felt tip marker or by placing a small piece of

tape on them to provide a writing surface. Broken glass from different locations should be packaged separately and identified as to the location found.

LABORATORY EXAMINATION OF GLASS PARTICLES:

1. Physical Properties -In the absence of a physical match along a broken edge, two samples of glass cannot normally be identified as having come from a single piece. A number of examinations conducted in the laboratory can, however, establish the two samples to be entirely consistent with having a common origin. Any one of these examinations can show the two to be different and therefore exclude one of the pieces as having the same origin as the other.

   Laboratory testing usually involves a study of the physical properties of the two samples, such as thickness, surface texture, color fluorescence under short and long wave ultraviolet light, and measurement of their density and refractive index. Each of these examinations reveals difference among samples of glass, due largely to its complex nature and the impurities in it. New techniques are presently being explored to augment these tests and increase the value of glass evidence. Although glass particles alone cannot make a case, when combined with blood, fiber and hair or other evidence they establish a convincing link between criminal and crime scene.

2. Direction of Force and Impact Velocity - Occasionally, a question arises as to the side from which a window was broken or shot. Either of two conditions can be used to resolve this question.

   A. Cone Fractures - small missiles that achieve penetration of ordinary window or plate glass produce a cone fracture on the exit side. The length and density of

the radial fractures offer an indication of the relative velocity of the penetrating object; short, dense radial fractures are associated with high velocity breaking forces (bullets) and long, less dense radial fractures with lower velocity penetrations (rocks, golf balls, hammer).

B. Ribmarks - The edges of radial fractures usually possess a series of ribs that are perpendicular to the exit surface and parallel to the entrance surface.

C. Determination of Exterior and Interior Surfaces - A determination of the impact side of a piece of broken glass will be of no use if it is unknown which way the glass was mounted in the window before breakage. Therefore, pieces whose orientation can be determined at the scene by the investigator should be collected and marked accordingly before a direction of force determination can be undertaken.

Figure 13. - Bullet hole in plate glass

XV. PAINT

Paint chips and smears are frequently present on tools used to pry open doors and windows or to strike painted surfaces. Hit and run accidents involving two vehicles often result in a mutual transfer of victim and suspect paints. Particles of paint are commonly recovered from the clothing of pedestrian victims of high speed impacts with automobiles (approximately 40 MPH or greater).

1. Composition - Paints are liquid dispersions or emulsions that are applied either by spraying, brushing or dipping. The basic components of any paint are:

   A. A vehicle which dries or polymerizes to form a film
   B. Pigments and/or dyes
   C. Solvents or thinners
   D. Contaminants/inclusions

   Only the solvent or thinner is lost upon drying. With the passage of time, further character is acquired through fading, scratching, pitting, wearing and surface contamination which serve to make the paint more valuable as evidence. There may be multiple layers of paint which vary in color, thickness and composition.

2. Collection and Preservation - Items with paint chips or smears adhering to them should be packaged in such a way as to protect the evidence from loss or alteration. Tools must never be placed in the same container with samples of the painted surface.

Evidence or comparison paint chips should be placed in small vials or circular cardboard pill boxes. Envelopes are unsatisfactory containers.

Comparison samples should be collected immediately adjacent to the tool mark or impact area. Samples should be lifted or flaked off the surface by bending the surface or by using a razor blade. There is a possibility of a physical match with intact paint chips, so care must be taken in collection of control samples to keep them intact.

Curls of paint scraped from the surface are <u>not</u> satisfactory for comparison purposes since the layer structure and surface texture are destroyed.

A complete description as to the source and nature of each paint sample collected is necessary before the laboratory can derive meaningful information from the evidence. Inadequate or small samples will preclude a complete analysis. In a two-vehicle hit and run, for example, four separate paint samples must be collected:

A. Suspect's paint from victim's vehicle
   (suspect - transfer)
B. Victim's paint from suspect's vehicle
   (victim - transfer)
C. Victim's paint from the area adjacent to the damaged area on his vehicle
   (victim - control)
D. Suspect's paint from the area adjacent to the damaged area on his vehicle
   (suspect - control)

3. <u>Laboratory Examination of Paint</u> - Microscopic examination of a paint chip reveals a variety of physical properties useful for comparison purposes. Surface examination will

show color, shade, texture, weathering, contaminates and inclusions of the exterior layer. From an edgewise view, the number of layers, their individual thicknesses, colors, shades, textures, and inclusions can be determined. A side by side comparison of the two samples will either show a matching of all these characteristics or an exclusion through any dissimilarities.

Chemical and instrumental tests will reveal the composition and/or elemental structure of the paints for comparison purposes.

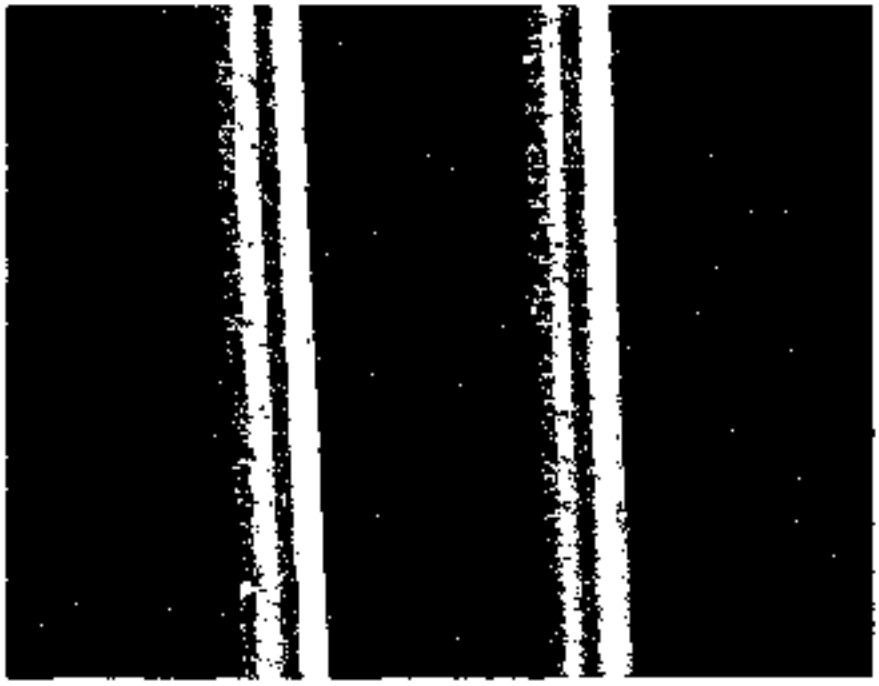


Figure 14. - Multilayer auto paint chip comparison

XVI. SOIL

Areas of exposed soil in or around a crime scene raise the possibility of soil being transferred to the suspect's shoes or tires upon entry or departure. Impacts in hit and run accidents frequently result in the deposition of under-body dirt or mud (on the street).

Two factors are of primary importance when looking to soil as possible associative evidence:

1. The time elapsed from contact with the crime scene soil to apprehension of a suspect.

2. The nature of the soil itself.

Assume the ideal situation of a muddy flower bed below the point of entry in a burglary through which the suspect has walked. Following departure from the scene, the adhering soil will begin to come off and new materials, possibly other soils, will be picked up on the suspect's shoes. The likelihood of success for a soil comparison decreases rapidly with the passage of time after the incident.

Soil is a complex mixture of weathered rock, minerals, salts, organic matter, microorganisms, and moisture. Soils adjacent to places of human habitation have varying degrees of individuality through debris or treatments introduced into the soil. Oil, insecticides, peat moss, sawdust, metal shavings, industrial materials, and colored rock are all examples of possible soil inclusions.

COLLECTION AND PRESERVATION OF SOIL SAMPLES:

1. Shoes with dried mud adhering to them should be marked and sealed in a plastic bag.

2. Soil adhering to objects that are not convenient to impound should be removed, placed in a plastic bag, carton or vial then sealed and marked.

3. Comparison samples from the suspected source should be collected not only from the point of contact but also from a number of adjacent areas. These samples from the surrounding area will enable the laboratory to determine the variability of the soil in that area. They should be collected at comparable soil depths that the questioned soil sample would have been picked up on the shoes or tires.

4. The suspect should be questioned as to the source of the mud or soil adhering to his shoes or tires. In the event he offers an explanation, samples should also be collected from this area for comparison purposes.

LABORATORY FINDINGS:

The value of soil as positive evidence is limited, particularly when no contaminants or unusual features are present. The soil in the Phoenix area is from a large flood plain and is generally similar in composition from one area to another. A soil sample must have a degree of uniqueness from contaminants, soil additives, or industrial components in order for a comparison to indicate a high probability of common origin.

Two soil samples can be excluded as having a common source and such a negative finding can be useful in disproving an alibi. The careful collection of soil control samples from several adjacent areas is essential to any comparison.

XVII. PRINTS AND IMPRESSIONS - FOOTWEAR EVIDENCE

Shoe prints or impressions are frequently present at crime scenes and are one of the most overlooked items of evidence. They can provide a direct positive link between a suspect and the crime scene.

Shoe prints may be deposited on any hard, smooth surface such as linoleum, cement, desk tops, chairs, doors, or loose papers scattered about on the floor. Prints are produced either by:

1. The transfer of substances (dirt, grease, blood, etc.) from the contacting surface of the shoe to a relatively clean receiving surface, or

2. the removal of dust from the surface by the relatively clean contacting surfaces of the shoes.

Shoe impressions are produced <u>in</u> (rather than on) a soft surface and consequently have depth. Impressions are most often in soil, dust, or mud and occasionally soft tar or wet concrete.

<u>LOCATING SHOE PRINTS AND IMPRESSIONS</u>:

1. Prints are often difficult to see particularly with bright, diffuse light such as that produced by modern overhead room lights or by having any windows open to the daylight.

   A shoe print can best be revealed by examining all suitable surfaces with oblique (low angle) light using a bright flashlight or floodlight in a darkened room.

2. Shoe impressions are more obvious due to their having depth and the limited number of suitable receiving surfaces at the crime scene.

PRESERVING SHOE PRINTS AND IMPRESSIONS AS EVIDENCE:

1. Removable objects such as cardboard, loose papers or a chair bearing foot prints should be collected taking care not to damage the print. Prints on surfaces that cannot be collected must be photographed using oblique light to give the greatest possible detail. The appropriate format camera should be used for photographs. A polaroid or 35mm picture is not suitable for comparisons. A ruler must be included in the photograph with the camera positioned directly over the shoe print or impression. Full use of the film area and a film with a low ASA rating are desirable. Only after suitable scale photographs have been taken should a static or adhesive lift of the print be attempted. All laboratory comparisons will be carried out with these scale photographs or the actual print. Lifts of prints are an attempt to collect the print rather than leave it at the crime scene. An adhesive lift or the electrostatic lift may be used. NOTE: An intact or complete shoe print is not necessary for comparison. Many positive comparisons may be made with a partial print.

2. Impressions must also be photographed with a scale included before any further action is taken. Full use of the film area and fine grained films are again recommended. Specialized lighting techniques are necessary to properly record the three dimensional aspect of impressions without loss of essential information.

   Casting of the shoe impression can be attempted, employing plaster of paris or silicone rubber, however, casting is generally not effective in this area due to the alkaline granular soil.

3. Photographs of the soles of the shoes are not suitable for comparison purposes. The shoes themselves must be submitted with the evidence shoe prints/impressions so that test patterns may be made and compared. The manner of walking (angles, weight distribution, etc.) must be duplicated in the laboratory for a complete comparison.

LABORATORY FINDINGS:

Scale photographs of prints or impressions are compared with the suspect's footwear or test prints made from them. First, the size and design are compared in each and if the shoes cannot be excluded, then a search for individual characteristics is begun. Individual characteristics are the nicks, gouges, cracks, and wear pattern that can be seen in all heels and soles once they wear. Depending on the suitability of the receiving surface, a sufficient number of these characteristics may show up in the shoe print or impression to establish an identity.

SUMMARY:

Shoe prints and impressions can be identified as having been produced by an individual shoe.

Visual inspection at the scene will often reveal whether or not information useful for comparison purposes is present in the print or impression. The real effort then becomes one of either transporting the print to the laboratory without damaging it or requesting assistance from the Latent Print Section in obtaining quality scale photographs of the shoe print or impression.

Other prints and impressions such as tire impressions, glove prints, etc., can be treated in a similar manner.

Photograph **all** the shoe prints/impressions at the scene; complete and partial.

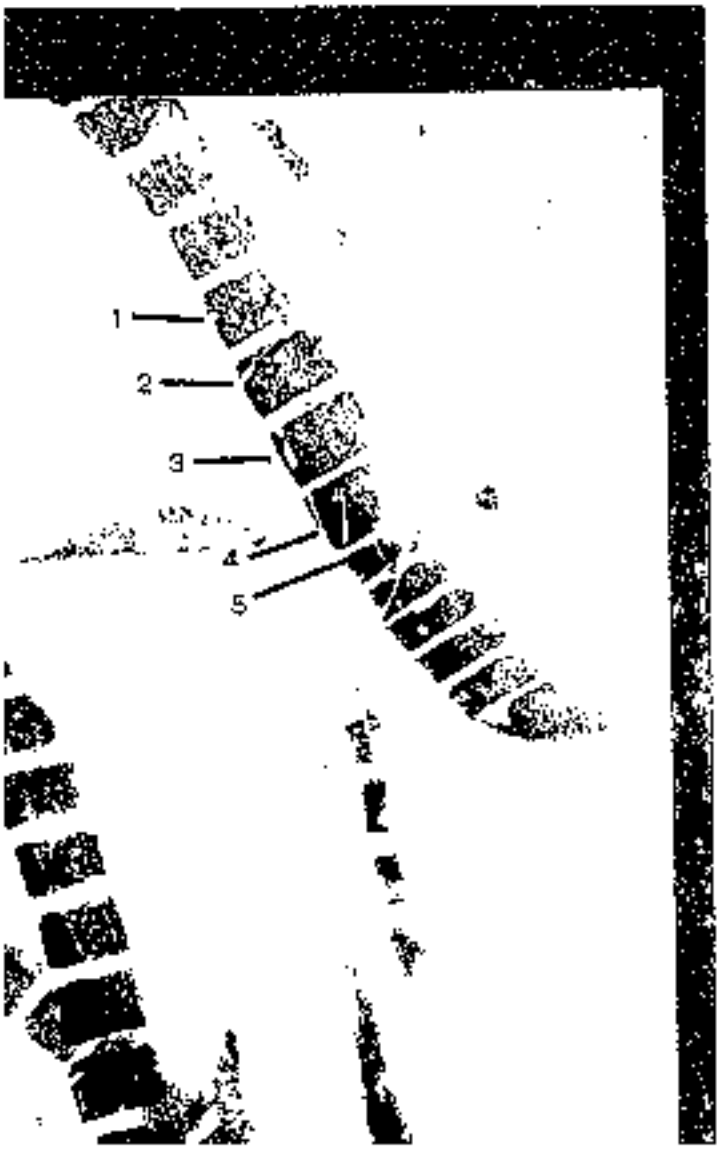


Figure 15. - Partial shoeprint on envelope

Figure 16. - Inked shoeprint from suspect shoe

XVIII. FINGERPRINTS

A large percentage of the Laboratory Bureau Latent Print Section work effort is directed toward the collection, comparison, preservation and courtroom presentation of physical evidence.

Fingerprints are the most frequently encountered type of physical evidence found at a crime scene. Present on the summits of the friction ridges on the skin are very minute sweat pores which are constantly exuding sweat. This sweat, or oil, grease and other foreign substances, which may be present on the hands or fingers, will adhere to the raised portion of these ridges and when an object is touched it will leave a recording of those ridges on the object.

A belief commonly held is that the mere touching of an object deposits fingerprints on it. This is not always true. The reason for this is that there are several conditions that must be met before even a fragmentary fingerprint is left behind. The factors controlling the deposit of fingerprints are as follows:

1. Cleanliness - The process of thoroughly washing and drying hands removes the natural oils and perspiration usually present on them. While this limits the possibility of leaving a latent print, the examiner should keep in mind that when hands come into contact with the face or hair, the oils from these areas can serve as a transfer medium for latent fingerprints.

2. Method of Handling the Object - The firmness of pressure exerted by the fingers in handling an object affects greatly the quality of the latent impression. Holding an object too firmly may result in the pliable ridges of the fingers being pressed flat so that ridge detail is lost rendering the print useless for identification purposes.

3. Method of Releasing the Object - The method by which an object is released can greatly affect the latent fingerprint impression. For example, it is possible to destroy ridge detail by sliding the fingers along the surface of the object. A latent print left by this method is usually smudged and determined to be non usable for identification purposes.

4. Suitability of the Object Receiving the Prints - Smooth surfaces are the most conducive surfaces for securing latent prints. Modern textured kitchen appliances such as refrigerators do not readily lend themselves to latent retrieval. Today, many safe manufacturers often employ a crinkled surface on their products. Safe burglars can often move, push, or otherwise handle such surfaces with little chance of leaving latent impressions of evidentiary value.

While fingerprints are the most common type of physical evidence, they are extremely fragile and often difficult to leave at a crime scene and to locate and retrieve for comparison.

PHYSICAL EVIDENCE:

Evidence processing conducted by the Laboratory Bureau Latent Print Section is directed primarily toward the collection of latent prints, shoe prints and impressions, and tool marks. The Laboratory Bureau works closely with the Office of the Medical Examiner in collecting and recording physical evidence from the deceased.

BLACK POWDER PROCESSING:

1. The sole purpose in "developing" a latent impression is to make it visible so that it may be preserved, compared, and identified. Various powders and chemicals are used for this purpose. No attempt should be made to brush or apply powder to prints in dust or grease or bloody prints, as this will almost surely destroy them. Objects which have been wet or immersed in water may still bear identifiable latent impressions. Before any examination is attempted, however, the object must be dried. Powder brushed lightly over a latent-bearing surface will cling to grease or moisture in the ridges of a latent print, making it visible against the background.

   Many fingerprint powders in various colors and compositions are available from fingerprint supply houses but none are superior to the black.

   A very small amount of powder is placed on the brush for application to the surface. Once the contour of a print is visible, the brush strokes should conform to the direction of the ridges. All excess powder should be brushed from between the ridges. Too much powder and too little brushing are the chief faults of beginners.

2. After cutting a piece of fingerprint tape sufficiently large to cover the entire latent prints, the celluloid covering is removed and the adhesive side applied to the latent. The tape should be pressed evenly and firmly to the surface, taking care not to shift its position. It is then peeled gently from the surface and affixed to a latent print card. The operator should handle the lift in such a manner that he/she will leave no prints of his/her own on the adhesive surface. The name and serial number, date,

and object from which lift was made should be written on the front of the lift card in a permanent, legible manner.

If an excessive amount of powder adheres to the latent prints, a more legible print may sometimes be obtained by lifting a second time (on a new piece of tape).

Special transparent tape with a durable adhesive surface is available in 1" to 2" widths for fingerprint work. The common varieties of transparent tapes ("scotch tape") are not suitable due to the deterioration (drying) of the adhesive surface. The print on a piece of transparent tape is in correct position for comparison purposes. Transparent lifts should be affixed to a department issued Kromcote card. Every effort should be made to avoid air bubbles under such lifts. In no instance should a transparent lift ever be folded back on itself or stuck to another piece of such tape as a backing since, it is generally not possible to determine the correct position of such a print.

Sequential latent prints should be lifted as a unit. Latent print lifts made by officers should be labeled, marked, sealed, and forwarded to the Laboratory Bureau Latent Print Section for examination, evaluation, and preservation.

4. Items of evidence which require specialized techniques should be labeled, packaged, and brought to Latent Print Section with the appropriate supplemental reports.

LATENT FINGERPRINT ANALYSIS:

Laboratory analysis of latent fingerprint evidence employs state of the art physical, chemical, and instrumental techniques. During this testing, every effort will be made to preserve the

officer's identifying marks. The Laboratory finding will be in terms of techniques utilized in the development process and usability of the latents retrieved. Results of comparative analysis with known subjects will be summarized in a clear and concise manner as required for courtroom testimony.

Examples:

1. Officer submits a written request for comparative analysis of a known subject to all the latents in file from a specific departmental report. The result of the comparison is a non-identification. The laboratory report will read "All latent prints in file were compared to the above listed subject with negative results."

2. Officer submits a written request for comparative analysis of a known subject to all the latents in file from a specific departmental report. The result of the comparison is an identification. An example of how the laboratory report will read is, "Latent Print #3, lifted from the broken glass, point of entry was identified as belonging to the right thumb of Jane Doe."

3. Officer submits a request for comparison of the prints of a known subject to all the latents secured from a crime scene. Due to poor quality inked prints of the subject, the comparison is unable to be completed. The laboratory report will read, "Fully and clearly recorded inked impression of (the known subject) are needed for comparison purposes."

4. Officer submits a request for comparison of the victim's prints to all the latents secured from a particular crime scene. In the event of an identification, an example of how the laboratory report will read is, "Latents #1, 5, and 7 lifted from the bedroom door were identified as

belonging to the right index, middle and ring fingers of J. Q. Victim." Latents #2 and #6 remain unidentified.

If the victim's prints are not identified, the laboratory report will read, "all of the latents from the DR were compared to J. Q. Victim with negative results."

CHEMICAL PROCESSING TECHNIQUES:

Paper, cardboard, unpainted wood, or other absorbent surfaces are all typical examples of items that involve more complicated techniques than the use of fingerprint powder.

It is strongly recommended that powders not be applied to articles of the above type for several reasons. Powders cannot be removed from paper, and possibly may interfere with some types of document examination. In this situation, the powders are likely to prevent restoration of the specimen to its original or legible appearance. Powders will not develop as many latent prints on paper or cardboard as do chemicals and in some cases will obscure latent prints subsequently developed chemically.

1. Examples of chemicals used in the development of latent prints or porous surfaces:

   A. Iodine
   B. Ninnydrin
   C. Silver Nitrate
   D. Cyanoacrylate Ester
   E. Zinc Chloride

SUBMISSION OF ITEMS TO THE LATENT PRINT SECTION:

The Latent Print Section provides 24-hour-a-day service. On-duty personnel will accept and log physical evidence turned in for forensic examination. In the event Latent Print personnel

are not readily available to accept evidence, impound lockers are available in the impound room located in the basement of the PPSB located at 620 West Washington.

Due to the fact that many of the processes used in the development of latent prints are destructive by nature, consideration should be given to the following:

1. Other types of trace evidence present on the items being submitted for analysis, i.e. blood, hair, fibers, gunshot residues, etc. Trace evidence should be collected and preserved prior to processing for latent prints.

2. Replacement Cost/Sentimental Value

The following items require special handling for examination by the Latent Print Section:

1. Potential hazardous explosive devices and flammable liquids will not be submitted to the Latent Print Section. Containers, wrappers, etc. must be rendered safe and the hazardous material separated from the item for fingerprinting (drained, unwrapped, repackaged). Only the outer materials are to be submitted.

2. Narcotics - The Latent Print Section does not have the capability to store narcotics. The drugs must be separated from the wrappers/containers. The drugs can be repackaged and submitted to the Drug Analysis Section for analysis and the outer wrappers/containers submitted for fingerprinting.

AUTOMATED FINGERPRINT IDENTIFICATION SYSTEMS (AFIS):

In order to cope with the increasing number of inked and latent fingerprints collected by the Phoenix Police Department, it became necessary to implement an automated fingerprint identification system. The identification algorithm is based on the

matching of minutiae data obtained from individual fingerprints. Pattern features such as minutiae, positions, directions, and relationships are detected by a fingerprint reader. For fingerprint matching, minutiae data stored in our database is compared against the fingerprint requiring identification. Matching is accomplished by selecting possible minutiae from search prints and database fingerprint minutiae. In the final stage, the similarity between the search fingerprint minutiae and the database fingerprint minutiae is precisely examined. A similarity score is then calculated to rank the similarity of search and file fingerprints.

The AFIS system does not make an identification but provides a ranked candidate list for the Latent Print Examiner to compare.

Although AFIS technology will revolutionize crime scene investigations, it should be viewed as an additional tool to supplement a complete investigation. AFIS is not able to search palm prints, finger joints, or difficult latent prints.

LASER:

Laser is an acronym for Light Amplification by Stimulated Emission of Radiation. Laser examinations conducted by Laboratory Bureau Latent Print personnel are directed primarily toward high profile cases. This state of the art equipment enables examiners to obtain viable ridge structure on surfaces previously considered impossible, such as styrofoam, crumpled aluminum foil, and highly textured surfaces such as leather. The laser emits a non-destructive beam of light which, when shown on a chemically pre-treated surface, will cause latent prints to luminesce. The two types of lasers utilized by the Phoenix Police Department, Latent Print personnel are:

1. Copper Vapor Laser - A 16 Watt mainframe laser, used to examine physical evidence in the Laser Lab and vehicle examination areas.

2. Argon Laser - A portable laser used to examine physical evidence in the Laboratory Bureau facility and at crime scenes. The laser is an additional tool in a forensic investigator's arsenal to recover physical evidence. The laser does not replace conventional processes.

ANALOG DIGITAL IMAGE ENHANCEMENT:

The Laboratory Bureau's personnel, in conjunction with the vendor, have designed applicable software capable of high resolution photodigitizing. This software has the capability of seeing 256 levels of gray and can differentiate between each one. (The human examiners' visual acuity is limited to 16-32 shades of gray.) The current software programs were designed to extract additional detail from faint impressions and, at the same time, maintain a high degree of resolution and image fidelity.

COMPARATIVE ANALYSIS OF FINGERPRINTS:

Fingerprints are recognized throughout the criminal justice system as an infallible means of identification for the following reasons:

1. The ridge structures that make up fingerprints differ from individual to individual, and also from finger to finger.

2. Fingerprints are permanent. The ridge formation is formed prior to birth and does not change naturally until decomposition after death.

3. For an identification of prints to be effected, the two prints must possess a sufficient number of unique points of identification in a unit relation.

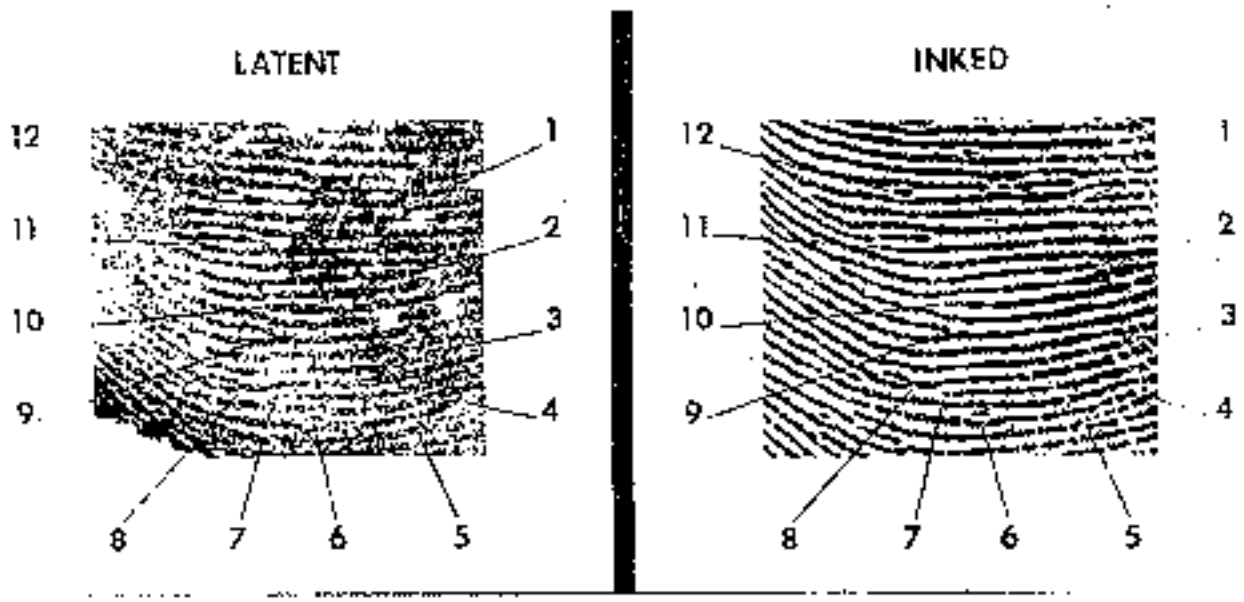


Figure 17. - Latent fingerprint comparison

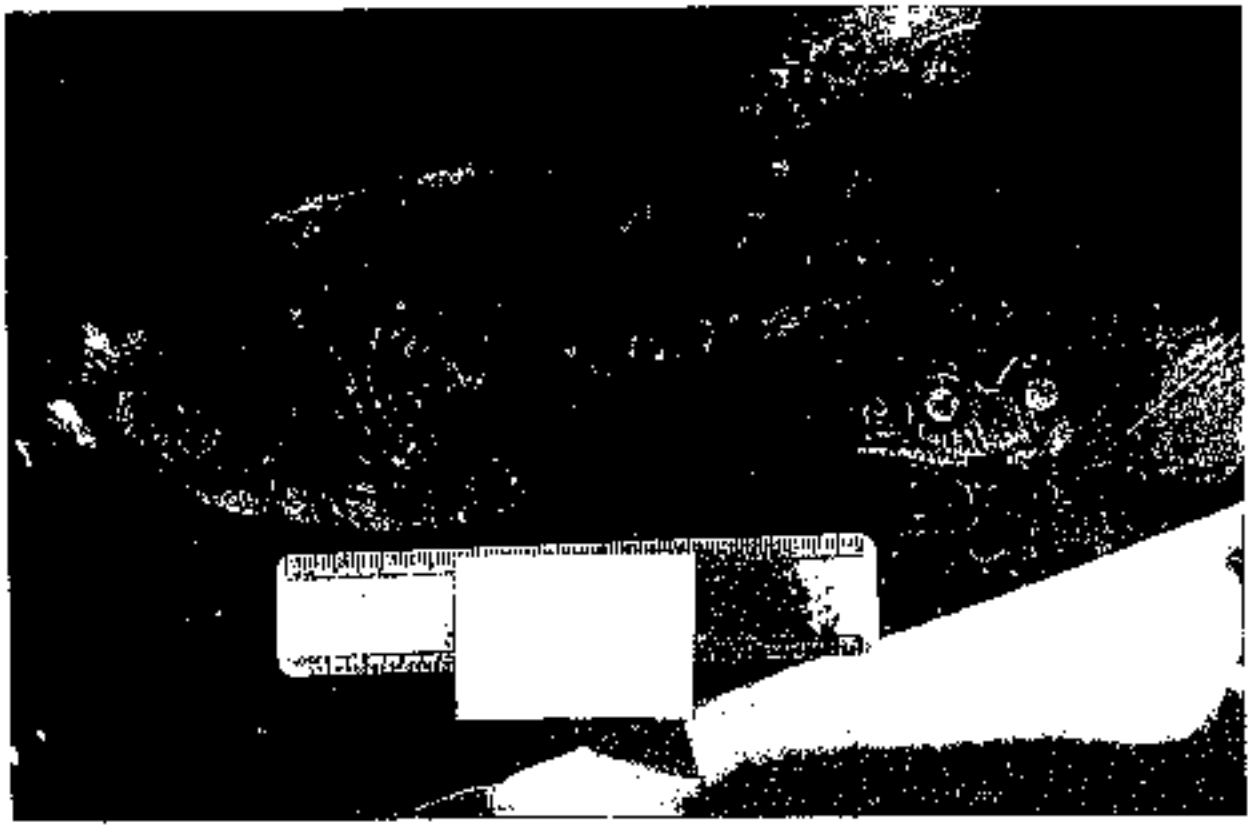


Figure 18. - Electrostatic shoeprint lift

XIX. PHOTOGRAPHIC SERVICES

Photography is an essential portion of almost every crime investigation. It allows the investigator to document the condition of a crime scene, describe a sequence of events, preserve evidence, confirm placement of items of physical evidence, and record information for later evaluation. Photography will record injuries on victims for evidence of violence. Photographs of selected items of evidence (stolen goods, shoe prints, etc.) can be used in the active investigation to show to potential witnesses. Photographs supporting the investigation are utilized in most legal proceedings.

The Laboratory Bureau specializes in crime scene and forensic photography. The Latent Print Section provides 24-hour availability of a trained photographer on major cases. For crime scene processing, documentation photographs of victims' injuries or unusual situations can be arranged as necessary. In the event that more detailed or unusual photographs (closeups, macro-microscope) are necessary, the items of evidence can be transported to the laboratory where specialized photographic and lighting equipment is available.

CRIME SCENE PHOTOGRAPHS:

Crime scene photographs are investigative photographs which are made to record an object or event, or to clarify a point which is related to a particular investigation. For the photograph to be of evidentiary value and to have the highest quality as evidence, it must accurately depict the scene, persons, or objects precisely as they were found. The set of crime scene photographs should include overall photographs of, for example, a room or yard, a photograph of any given item of interest

demonstrating position in the scene and a close-up of the item itself. The scene photographs should not include personnel working within the scene or extraneous objects such as police equipment. The appropriate camera and film must be used to record the item or event. In many situations, a 35mm or polaroid camera is not adequate. Photographs are admissable in court if testimony can establish that they are a true and accurate representation of the crime scene. They must be in focus, not distorted, and to scale. Color photographs need to be color correct. Identifying information item numbers and/or scales (rulers) may be necessary in the photographs. Photographs of evidence on walls, etc. (bullet ricochet, blood splatter patterns, vehicle scrapes) must be horizontal (level).

FORENSIC PHOTOGRAPHS:

The object of forensic photography is to reproduce, preserve, and record evidence and to improve the detail of latent images such as fingerprints and shoe prints. This is accomplished by judicious use of filters, different lighting techniques and specialized photographic equipment and films. The position of trace evidence (hairs, fibers, blood droplets, etc.) can be recorded on weapons and other items of evidence. Photographs for courtroom presentation can be prepared.

Forensic photography has its widest degree of latitude when used in a controlled environment. Forensic photography for the Phoenix Police Department normally is limited to the laboratory facility. It includes such specialized techniques as infrared, ultraviolet, micro-photography, macrophotography, barrier filters, and special lighting techniques.

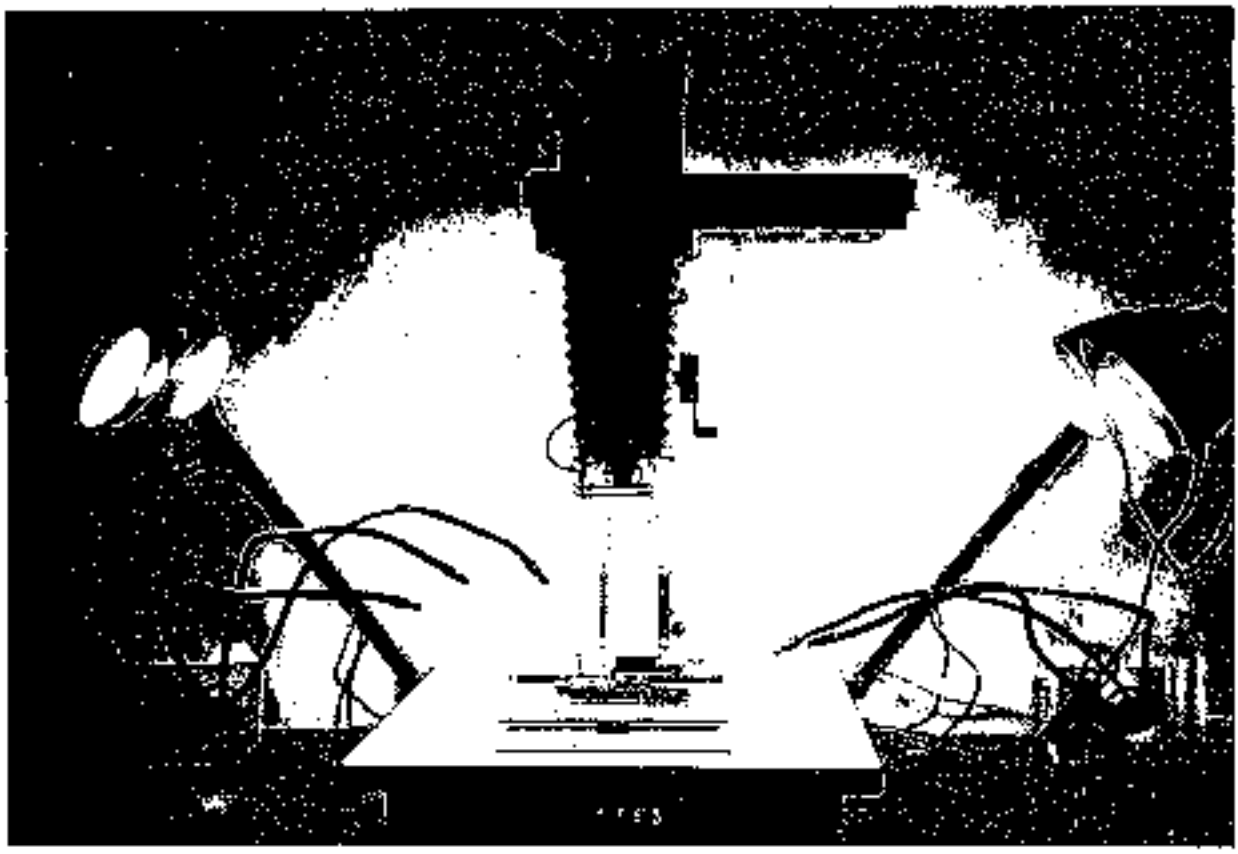


Figure 19. - MP-4 Camera with pistol

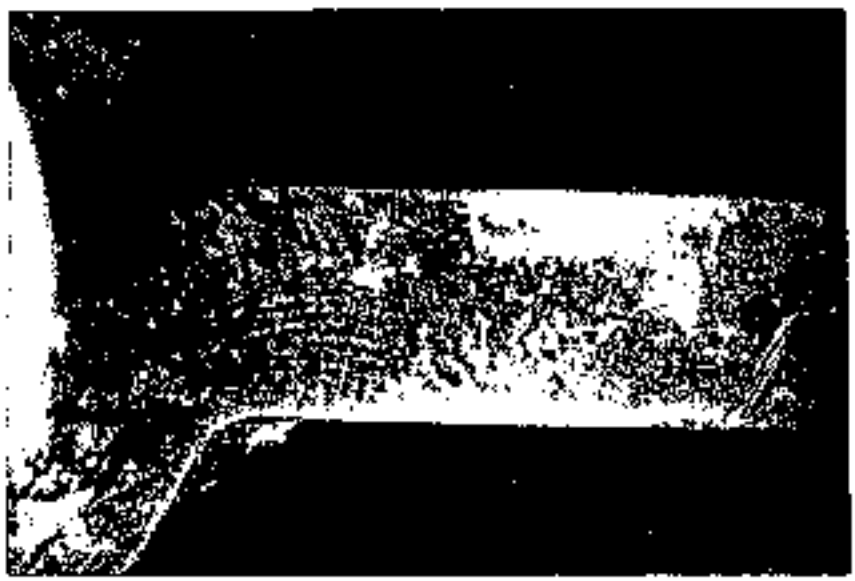


Figure 20. - Latent fingerprint on pistol

XX. TOOL MARKS

Tool marks will most often be found in burglaries, thefts from vehicles, wire thefts, and illegal entries. The marks will either be:

1. An impression due to a prying or battering action, or

2. A striated tool mark due to a sliding or scraping action of the tool across a receiving surface.

The impression-type tools marks are usually produced by pry bars, screwdrivers, pliers, bolt cutters, and hammers.

Striation marks can also be produced by pry bars and screwdrivers when they begin scraping across a surface as pressure is being applied. Bolt cutters, tin snips and pliers frequently leave striated tool marks on cut locks, hasps, and wire. Knives used to cut insulated wires or rubber hoses leave identifiable tool marks in the insulation or rubber.

Both of the foregoing types of tool marks can be identified as having been made by a particular tool if the object surface is capable of registering the individual characteristics present on the contacting surface of the tool.

There is a third type of tool mark that cannot be identified. This is a compound tool mark typically produced by saws, files, and grinders. Multiple scrapes of a screwdriver or pry bar on the same area will also produce a compound tool mark.

PRESERVATION OF TOOL MARKS:

Every effort must be made to get the entire object to the Crime Laboratory. If this is not possible or practical, then the area containing the tool marks should be removed or cut out after orientation photographs are taken. Finally, if the object cannot be collected nor the area cut out, then a rubber or silicone cast of the tool marks should be made and, again, orientation photographs taken. Multiple casts should be made of each tool mark.

In the absence of the actual object, these photographs will aid the laboratory in determining the approximate angles employed with the tool and are necessary for the preparation of test marks. Package or protect the tool marks in such a way as to prevent alteration or damage during transportation to the laboratory.

Photographs, even close-ups of the tool marks, are not suitable for scientific comparison. The identifying characteristics are usually microscopic and require specialized lighting techniques to examine them.

COLLECTION AND PRESERVATION OF TOOLS:

Two considerations should be reviewed by the officer before a tool is submitted to the laboratory for examination:

1. The tool is capable of having produced the marks. The marks must be consistent with having been made by that type of tool. This determination is made by visual inspection only. Do not place a tool in the tool mark to see whether it fits.

2. The tool can be linked to the suspect. This requires that it either be in his possession, his vehicle, or home; or if found at the scene, that it bears his fingerprints.

Tools that pass these two tests should be marked, packaged, and transferred to the laboratory.

PHYSICAL MATCHES IN TOOL MARK CASES:

The possibility for a number of types of physical matches exists in most cases where tool marks are found. The type of evidence is often superior to the tool mark aspect of the case and should not be overlooked. Some typical examples are:

1. Broken tips of tools at the scene.
2. Cut radiator hoses on a stolen engine.
3. Cut battery cables on stolen batteries.
4. Paint chips from the tool mark adhering to the tool.

LABORATORY COMPARISONS:

The laboratory's task involves:

1. A search for mutual transfers of paint, grease, metal between tool and tool mark (trace evidence).
2. The determination of angle, position, and direction of movement of the tool that produced the mark.
3. The preparation of various test marks with the tool.
4. Microscopic comparisons between the tool mark and test marks with a forensic comparison microscope.

LABORATORY FINDINGS:

From the comparison microscopic examination, the criminalist will arrive at one of four possible opinions:

1. The tool produced the tool mark.

2. The tool could not have produced the tool mark and can be excluded.

3. The tool is consistent with having produced the tool mark. A number of matching characteristics were found but were insufficient to constitute an identification.

4. The tool could not be excluded. Insufficient information was present in the evidence tool mark to establish an identification or exclusion.

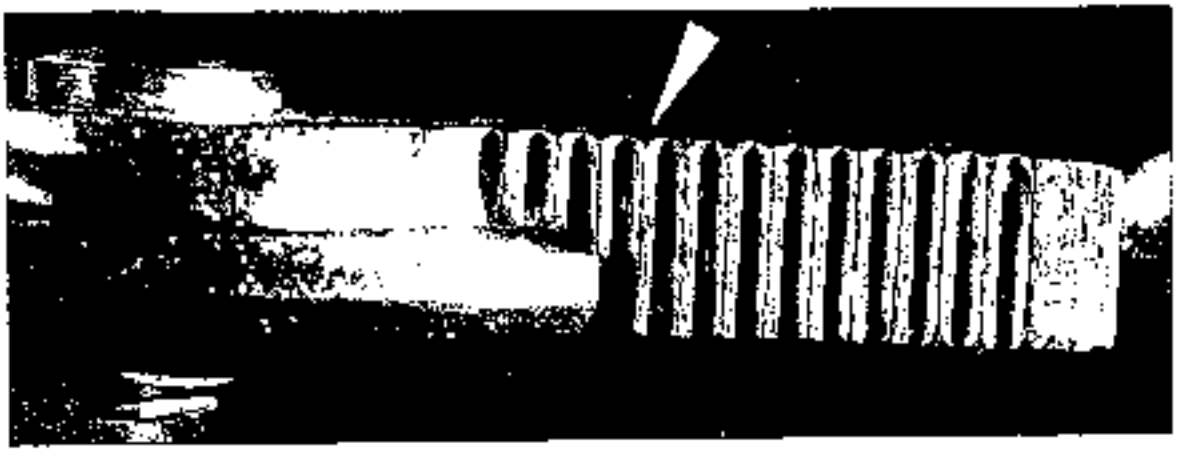


Figure 21. - Channel lock pliers (lower jaw)

Figure 22. - Toolmark comparison of one tooth impression

Figure 23. - Bullet identification with a comparison microscope

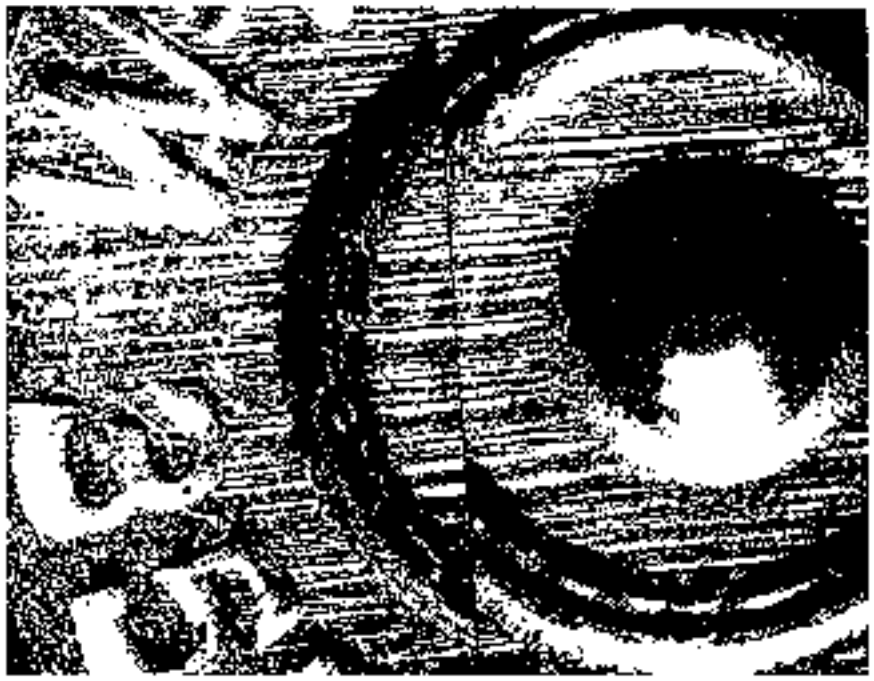


Figure 24. - Cartridge casing identification with a comparison microscope

XXI. FIREARMS

The use or possession of firearms arises in a significant number of crimes. An officer should know the legal definition of a firearm, how to properly collect fired bullets, expended cartridges, associated evidence, secure weapons, and have a fundamental knowledge of ammunition, the rifling characteristics and the basic operation of common revolvers, auto-loading pistols, rifles and shotguns.

The majority of the laboratory's work in the area of firearms examination falls in three categories:

1. Determining whether a particular weapon fired a recovered bullet or expended cartridge casing.

2. Providing investigative information as to the possible makes or types of weapons that could have fired a particular bullet or expended cartridge.

3. Other areas of investigation include muzzle distance determinations from powder residues around bullet holes, gunshot residues on hands, function testing of weapons, ammunition performance, bullet impact sites, trajectory of bullets, and serial number restoration.

RECOVERY AND COLLECTION OF FIRED BULLETS:

Rifling characteristics and identifying striae are engraved on the sides of the bullet by passing down the barrel of the weapon. Much of this information will survive passage through

a body, glass, wood, plasterboard, and even metal. It is imperative, therefore, that this area of the bullet not be marked nor contacted with any probe, tongs, knife, or forceps. Never dig bullets out of a wall or ceiling. Instead, cut out the area containing the bullet and carefully work or break away the surrounding material or submit it to the laboratory still imbedded. Once recovered, the bullet should be wrapped in tissue paper, sealed in a pill vial, and the container adequately marked for identification purposes. Do not disturb any adhering material since such debris may be evidence of a ricochet or contact with other objects, and have an important bearing on interpreting the evidence in the case. The use of cotton is not recommended. Multiple bullets should be wrapped and packaged separately, then itemized as to the location or source of each.

RECOVERY AND COLLECTION OF EXPENDED CARTRIDGES:

Autoloading pistols and rifles, as well as multiple shots from other types of rifles or shotguns, make the presence of expended cartridge casings at the scene a strong likelihood.

Once found and their location recorded, the cartridge casings should be placed in suitable containers and the containers sealed and marked for identification purposes.

Identifying markings can be imparted to cartridge casings by the weapon during loading, firing, extraction, and ejection by various surfaces and parts of the particular weapon. Nearly all of this information will be located on the lower half of the expended cartridge casing.

FIREARMS:

The position and location of discarded or hidden firearms should be recorded or photographed before handling.

The position of the weapon, whether recovered at the scene or taken from a suspect, should be carefully noted before it is unloaded or manipulated. Do not handle a firearm unless you understand its mechanisms. Trace evidence on the weapon (hairs, fibers, blood, etc.) can be easily lost, so minimum manipulation is essential.

A revolver should be checked for:

1. The position of the hammer (full down, partially or fully cocked).

2. The arrangement of cartridges in the cylinder. Mark the cartridge under the hammer as to whether fired or not and proceed around in a clockwise fashion numbering each. Keep track of brands and bullet types in sequence. Note the direction of rotation of the revolver cylinder in normal operation.

3. The position of the cylinder at the time found. Make an index mark above the cylinder chamber that was lined up with the barrel.

Autoloading pistols, rifles, and shotguns should be checked for:

1. The position of the hammer and any safety mechanisms.

2. The number of cartridges remaining in the magazine. These may be left in the magazine as long as the magazine is removed from the weapon.

3. The presence or absence of a cartridge in the chamber.

Record the serial number and make of the weapon and tag it with identifying information for subsequent courtroom identification. No attempts should be made to clean the firearm nor should it be handled by inserting objects in the barrel. Large evidence

envelopes or paper bags are suitable for packaging pistols once they have been secured. These containers should be marked and sealed.

AMMUNITION:

An effort should be made to obtain any unused ammunition from the suspect, his home, or vehicle. This will aid the laboratory's work by providing comparable ammunition for test firing purposes and for comparison to bullets and cartridge casings from the scene. If the ammunition is of an unusual type, this can provide a further link between the suspect and the victim.

POWDER RESIDUES - MUZZLE DISTANCE DETERMINATIONS:

Residues from firearms discharges on the victim serve as a means for determining the approximate distance from which the weapon was fired. Such determinations are useful in many suicides and deaths resulting from an alleged struggle over a gun.

Clothing with bullet holes to be examined for gun powder residues should first be air dried if they are wet with blood.

Once dry, they should be carefully rolled up in clean paper so that any powder residues will not be transferred to other areas of the garment. These residues are on the surface of the clothing and may be easily lost or dislodged by handling.

Visible spoting and unburned powder particles can often be seen with muzzle to target distances of 1-2 feet. Chemical analysis techniques may extend the detection limits to approximately 3+ feet with certain types of ammunition and firearms.

Muzzle to target distances can also be determined from gun powder tattooing (stippling) on exposed skin or from the spread of shotgun pellets.

Before requesting that the laboratory determine the actual muzzle to target distance in a particular case, the officer must have the following:

1. The actual weapon used.
2. The evidence bullet; see (4).
3. The ammunition used or unfired ammunition from the weapon.
4. In the absence of the actual bullet, expended casings will be needed to determine the bullet or shot shell type.

LABORATORY FINDING - SUMMARY:

Gunshot residues on the hands of a person who has handled or fired a firearm can be determined from hand swabs. The hand swabs should be collected by a trained officer. It must be collected within a few hours of the incident. The residues are on the surface of the hands and are easily lost by washing or rubbing.

1. Recovered bullets and occasionally bullet fragments can be identified as having been fired from a particular firearm. The success of the determination will depend on the survival of certain class and individual characteristics on the bullet and the reproducibility of these characteristics by the weapon.

2. Expended cartridge casings can be identified as having been fired in a particular weapon through the firing pin impressions, ejector marks, extractor marks, and occasionally by chamber marks or magazine lip marks.

3. The functioning of firearms may be tested to determine the trigger pull, operation of any safety devices, and the capability for accidental discharge.

4. Muzzle to target distances can be approximated by means of powder residues, powder tattooing, or shotgun pellet spread when the weapon and ammunition are available for test firing and comparison. Where no patterns or residues are detectable, a minimum muzzle to target distance can be established. Such a determination is useful in ruling out suicide as a possible cause of death or to answer questions regarding a struggle for the firearm (self defense, etc.).

5. Crime scene reconstruction can involve bullet trajectories, trace evidence on bullets or weapons, bullet impacts/ ricochet, entrance/exit in walls, glass, etc.; and other types of comparative analyses can be performed by the laboratory. These examinations can assist in determining the shooting situation, participants' positions in the scenes, substantiate or contradict stories, and explain events.

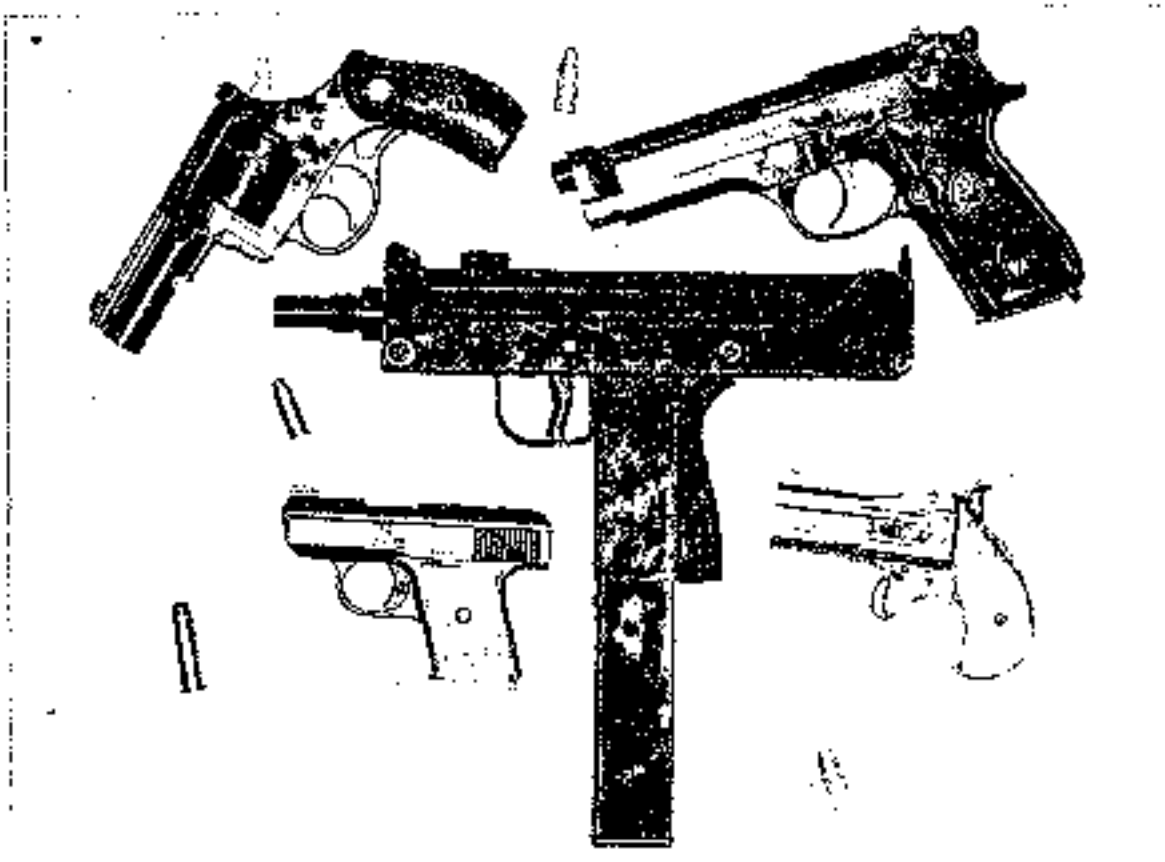


Figure 25. - Assorted handguns from the laboratory weapon reference collection

XXII. SERIAL NUMBER RESTORATION

Firearms, electric tools, cameras, engines, bicycles, electronic equipment and motor vehicle body frames are all typical examples of items which have serial numbers. These items are often taken in burglaries and thefts and are sold or fenced with the serial numbers obliterated or removed in some manner. In some cases the serial numbers can be restored.

There are several methods of placing serial numbers on items:

1. Cast numbers (raised) - engine blocks
1. Stamped numbers - firearms, vehicles, tools
2. Engraved numbers - jewelry, electronics
3. Inked numbers (on plates or labels) - electronics

Cast, engraved, or inked serial numbers cannot be easily restored if they have been physically removed or obliterated. Microscopic examination combined with oblique light and other techniques may reveal partially removed numbers. This also applies to engraved identification numbers or markings placed on the items by the owners. If the numbers have been covered over in some manner (paint, etc.), the laboratory can often remove the covering to reveal the serial number.

Stamping - letters and numbers on metal objects produce underlying strained areas in the metal which projects deeper into the metal than the stamped letters/numbers. These strained areas will often survive the removal of the serial number by grinding or filing.

Chemical etching solutions can be used to visualize the obliterated serial number. The area is first sanded with progressively finer grain sandpaper until the surface is

"mirror" smooth. The etching solution will attack the metal in the strained areas at a different rate than the adjacent, unstrained areas. The different rate of attack will cause the number/letter to become visible. Different etching solutions are used for different metals or metal alloys.

Stamped serial numbers which have been welded, heated with a torch, or struck repeatedly with a punch can seldom be restored. This obliteration methods relieve the original metal strain produced when the serial number was stamped and the chemical etching solutions cannot restore the numbers/letters.

SUBMISSION OF ITEMS TO THE LABORATORY:

Items of evidence to be submitted to the laboratory for serial number restoration should be marked and packaged in an appropriate manner. No special instructions on packaging are necessary.

The laboratory provides different chemical etching solutions to trained officers who work with stolen vehicles, etc. The obliterated serial numbers on vehicles, engines, and bicycles are normally restored by these officers.

Officers submitting evidence to the laboratory should consider the following questions before submission:

1. Does the item have a serial number? (Pre-1968 firearms often do not as well as many mass produced electronic items.)
2. Is it a type of serial number that can be restored? (e.g., stamped.)
3. If restored, is the serial number traceable?

The officer should indicate, if known, the location(s) of any serial numbers as well as the style (# digits, numbers versus letters, etc.). If the potential serial number is known, it should be included with the request.

LABORATORY FINDINGS:

The laboratory will report partially restored as well as fully restored serial numbers. If a particular number or letter in a serial number cannot be clearly determined, the most likely numbers/letters will be indicated for that space.

For example in this partially restored serial number:

A 75 - (3) 67
(8)

\- = could not be determined
(3) or (8) = possible numbers

XXIII. DOCUMENTS

The present scope of the laboratory's document work consists of restoring obliterations, erasures, and writing on charred documents; deciphering indented writings; conducting chemical tests and comparisons on inks and paper, making comparisons between typewriters and typewritten materials, and examining xerox copies of documents.

The comparison of handwritten documents or signatures is <u>not</u> undertaken by the laboratory at this time.

<u>COLLECTION AND PRESERVATION OF DOCUMENT EVIDENCE</u>:

Most documents such as stick-up notes, threatening letters, correspondence, etc. require no special handling procedures other than to mark them in a suitable location and seal them in an evidence envelope.

In the comparison of a typewritten document with a typewriter, it is not always necessary to submit the questioned typewriter. Exemplars can be prepared by the suspect at the request of the officer and the evidence note dictated rather than shown to him. In this way, grammatical errors and peculiarities, spelling errors, variable key pressure (with manual typewriters), and general format in both samples can be compared.

If the suspect does not wish to cooperate, then the investigator can copy the note several times on similar paper or impound the typewriter. The upper and lower case of the entire keyboard should be included as well. Initial and date all exemplars and record the make, model, and serial number of the typewriter.

The typewriter ribbon or ribbon cartridge often retains information relating to what was previously typed and should always be submitted and examined.

The possibility of a physical match between the evidence paper torn from a pad and the corresponding piece in the suspect's home or office should not be overlooked.

LABORATORY EXAMINATIONS AND FINDINGS:

1. Obliterations, erasures, overwriting and charred documents can often be restored by infrared examination or other techniques.

2. Inks can be shown to be comparable in dye content or to be dissimilar and therefore not from the same pen.

3. Typewriters acquire individuality during use through two distinct means:

   A. Mechanical defects such as horizontal and vertical misalignment, slant, and tilt of various type fonts.

   B. Damage to type fonts such as bent or broken serifs. With a sufficient number or combination of these individual characteristics, a typewriter can be identified as having produced a certain document.

Modern typewriters utilizing the ball head, daisy wheel, dot matrix or laser printing techniques rarely exhibit mechanical defects and are therefore very difficult to identify.

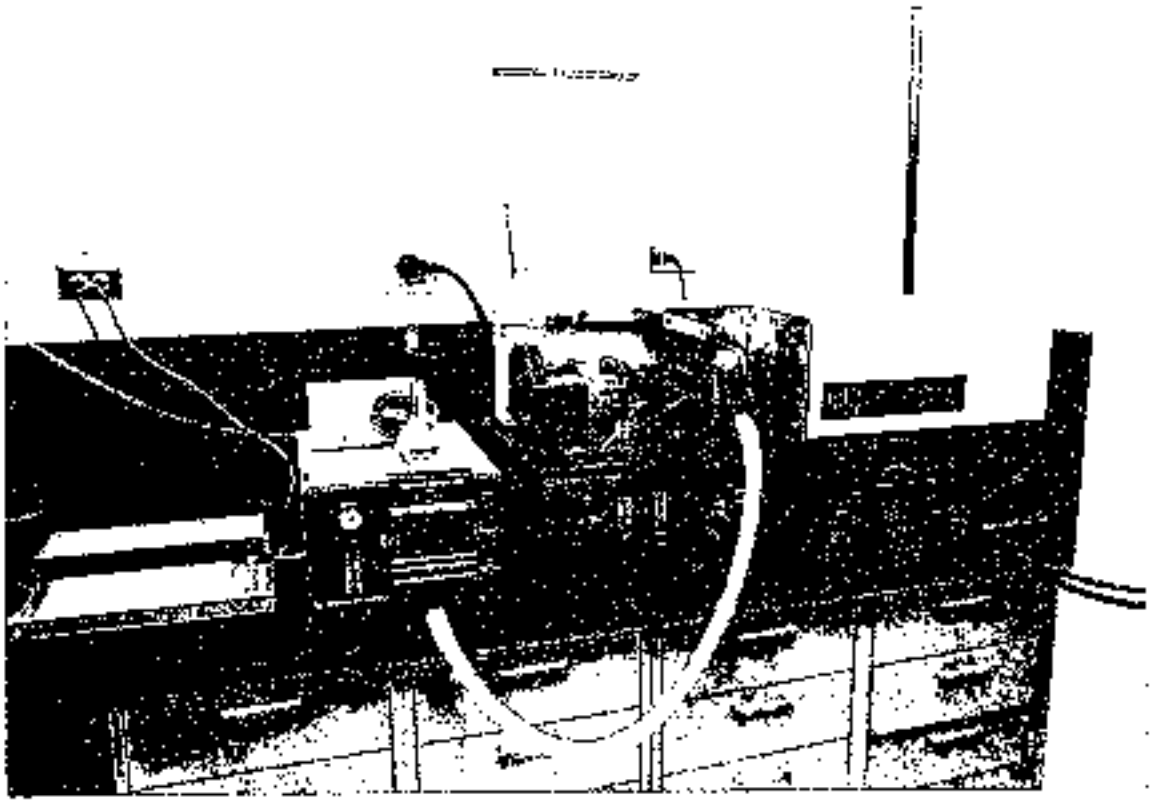


Figure 26. - Flameless Atomic Absorption Spectrophotometer for detecting gunshot residues on hands

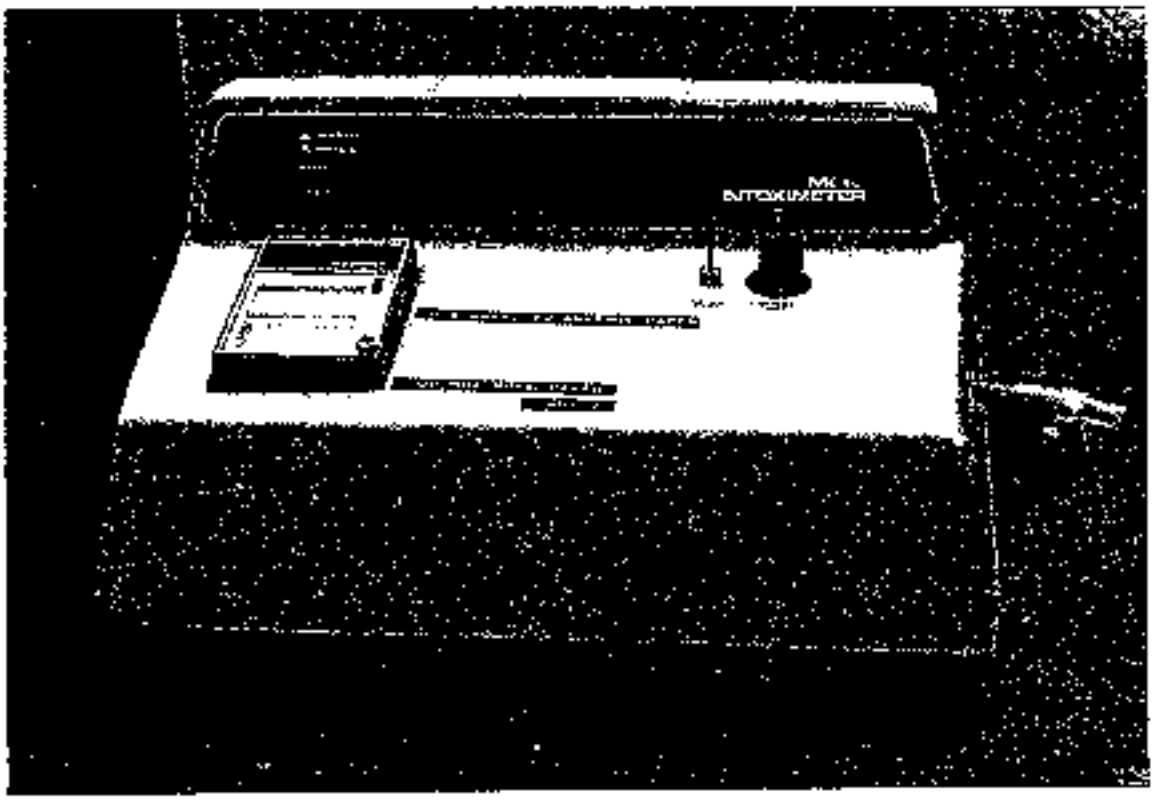


Figure 27. - Gas Chromatograph Intoximeter (GCI) for measuring blood alcohol levels

XXIV. ARSON

Suspicious fires and fire bombings account for most of the requests to determine the presence or absence of accelerants and their identity when possible.

SUSPICIOUS FIRES:

In cases of home or automobile fires, the officer will need to work closely with a fire investigator who can determine the point of origin of the fire and can better recognize possible incendiary devices.

EVIDENCE COLLECTION IN SUSPICIOUS FIRES:

The odor of debris, any suspicious containers, and the material at the point of origin should be noted. These materials, particularly the soil, carpeting, or flooring below the point of origin must be placed in airtight containers and submitted to the laboratory as soon as possible. Plastic bags are not suitable for this purpose.

Material of the same type from an area adjacent to the point of origin will also be needed by the laboratory for a "background" determination. Generous samples should be collected.

FIRE BOMBS:

Such devices are sufficiently obvious that they seldom need to be pointed out by a fire department investigator.

The basic types are described below:

1. Simple or Straight Fire Bombs - These must be thrown by the suspect and either contain a burning wick (molotov cocktail) or burst into flame upon impact (hypergolic combinations).

2. Hidden or Delayed Fire Bombs - These incendiary devices utilize chemical, mechanical, or electric delay mechanisms and therefore allow the suspect to be miles away before they go off.

EVIDENCE COLLECTION IN FIRE BOMBINGS:

Only extinguished or dud molotov cocktails are reasonably safe to handle by the field officer.

Hypergolic devices contain highly corrosive acids and oxidizing agents which spontaneously burst into flames upon contact with one another. Some of these materials survive burning and should be handled by bomb squad personnel only.

Unexploded devices of any type must never be placed in police property or laboratory evidence lockers. Department policy requires that they be transported to the Police Academy for storage.

Only smaller samples of the contents in sealed vials are to be sent to the laboratory for analysis.

Exploded incendiary devices recovered from the scene should be placed in a suitable airtight container and stored at the range until it can be personally brought to the laboratory for examination.

LABORATORY EXAMINATIONS AND FINDINGS:

Flammable hydrocarbons such as gasoline, kerosene, and paint thinner can often be recovered from the substrate at the point of origin of a suspicious fire where sufficient sample has been collected. Although only a few drops are generally recovered from several pounds of debris, this is sufficient for identification purposes using sophisticated instruments.

The volatile contents or residues from fire bombs are also examined by instrumental analysis. In the case of a sample from an unexploded device, the gas chromatographic profile of the contents can be compared with other devices or ingredients in the possession of the suspect. Such comparisons often approach fingerprint specificity and allow the fuel in the device to be directly linked back to another container or storage tank. Good control samples are essential in this type of comparison.

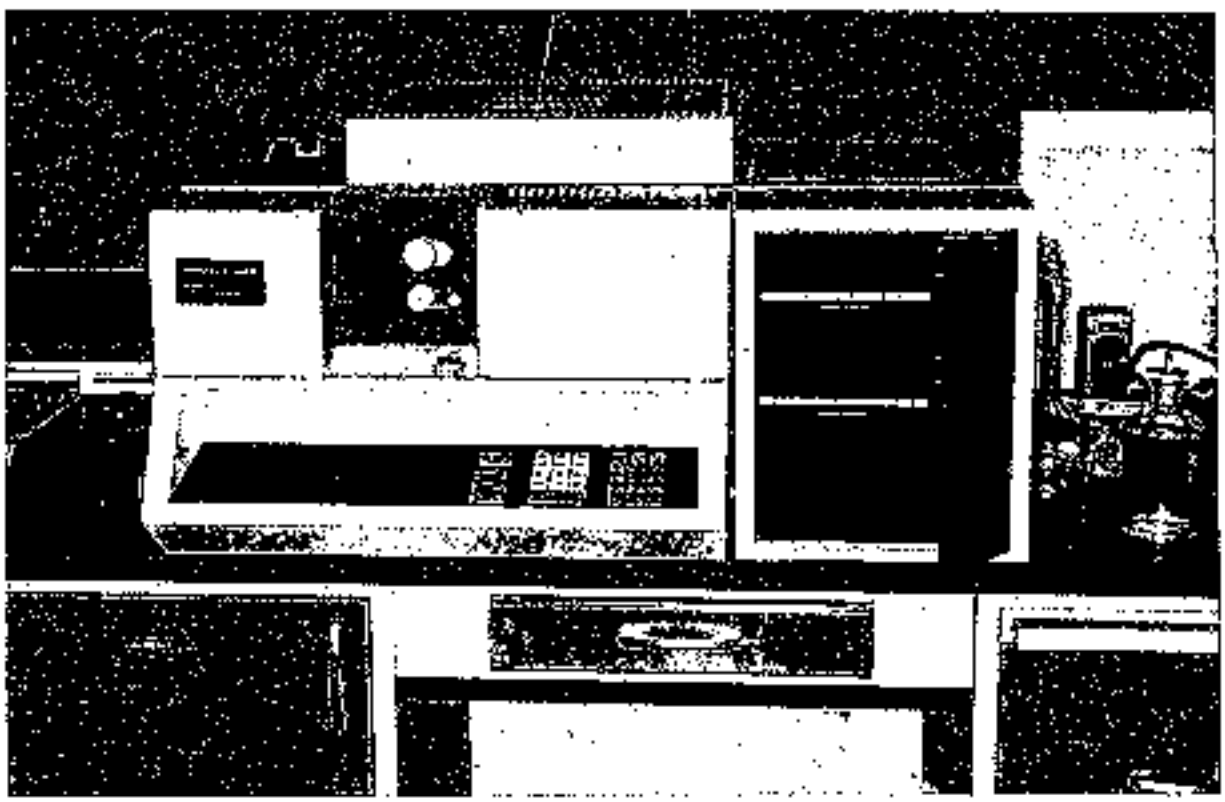


Figure 28. - Gas Chromatograph for identifying arson residues

XXV. HEADLIGHT EXAMINATION

The investigation of nighttime traffic accidents frequently will result in conflicting statements between the drivers and bystanders. An examination of the vehicle headlights and other light bulbs (running lights, tail lights) will often demonstrate if the lights were on or off at the time of the accident. These lights may be intact or broken.

Where breakage of the headlights in question occurs, laboratory examination of the recovered filaments and glass can usually determine if the lights were on or off. This is also true of the other automotive light bulbs.

EVIDENCE COLLECTION:

Definitive laboratory findings depend primarily on the recovery of filaments. The filaments will often be twisted around the supports or found amid the debris at the bottom of the lamp.

All the headlights and bulbs should be collected at the scene. If the headlight or bulb is broken, collect all of the remaining glass, filament supports, and plug portion. Be sure to collect the running lights and tail light bulbs. Their lighter weight filaments will often exhibit thermo shock (distortion) when the headlight filaments are missing or not obviously distorted.

FIELD EXAMINATIONS:

1. The position of the light switch in the vehicle should be recorded.

2. Every attempt must be made to determine whether the driver or anyone else has been in the vehicle and touched any of the controls.

3. Do not perform on-the-spot testing of the unbroken lights until any broken lamps are removed from the vehicle.

LABORATORY EXAMINATIONS AND FINDINGS:

Microscopic examinations of the recovered filaments, in conjunction with the filament supports and adjacent glass, will reveal the following:

1. The broken headlight was on at the time of impact. This determination is evidenced by the findings of tungsten trioxide (yellow powder) deposits and molten glass beads on the filament.

2. The broken headlight was not on at the time of impact due to a complete lack of tungsten trioxide deposits.

3. The broken headlight is consistent with having been burned out prior to impact and therefore incapable of operation at the time of the accident. The filament exhibits a burnout break and no molten glass beads.

4. The filament was not burning at impact but survived and was oxidized later by the deliberate or accidental operation of the light switch.

   Gross tungsten trioxide deposits will be present on the filament and on the glass or surface immediately above the filament. No molten glass beads will be present on the oxidized filament.

5. Examination of the running lights/tail light bulb(s) indicates that the headlights were on/off at the time of the accident. This information is valuable in the absence of intact headlight filaments for examination.

The smaller, lighter, filaments in the auxiliary vehicle bulbs may exhibit thermo shock if on in cases where the collision is less severe and the headlight filaments do not show any distortion.

NOTE: Tungsten trioxide deposits can often be seen with the unaided eye on the filaments, filament supports, and mirrored glass around the filament. Depending on their thickness and rate of production, they will vary from an off-white fogging to minute canary yellow powder on the actual filament.

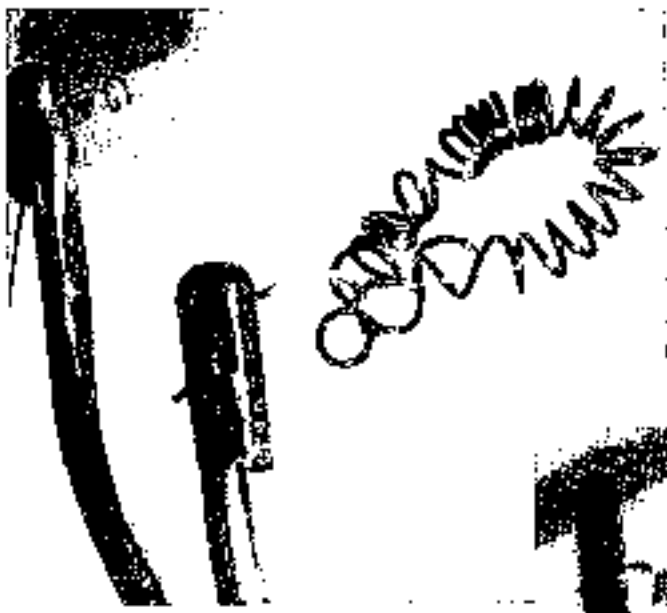


Figure 29. - Auto brakelight filament with thermo shock from an accident

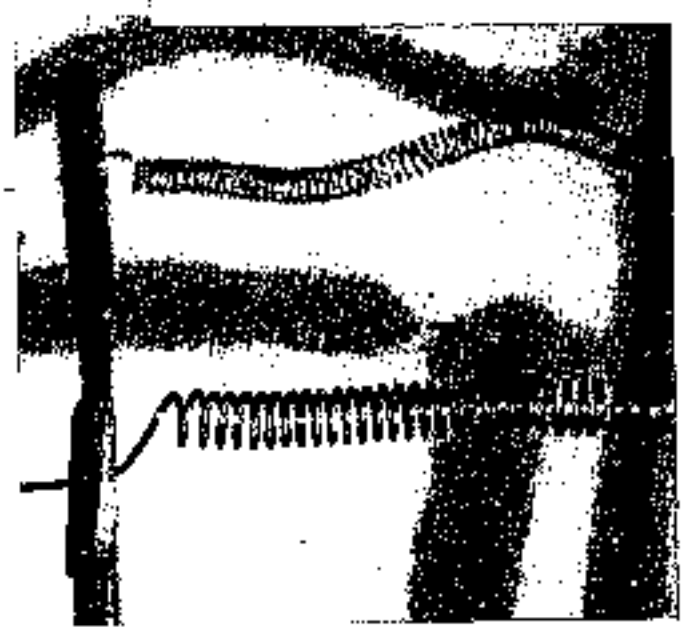


Figure 30. - Auto brakelight filament with no coil distortion

XXVI. SUBMISSION OF EVIDENCE FOR SCIENTIFIC ANALYSIS

Items of evidence that have been collected, marked and packaged and are to be submitted for scientific examination need to be brought to the basement area of the Police and Public Safety Building (PPSB) at 620 West Washington. The exception to this is small amounts of non-arrest drugs/narcotics, drug paraphernalia, and blood alcohol kits which can be impounded at the precinct stations and will be transported to the laboratory by Property personnel.

Officers not directly involved in a specific investigation who take custody of and transport the evidence between its initial collection and the time of its introduction in court become involved in the chain of custody.

Since all individuals handling the evidence may have to testify and they should be able to identify the item(s). It is likely that the chain of evidence will be thoroughly examined by the defense attorney in an effort to bar the introduction of the evidence.

There are only two acceptable means of submitting evidence to the laboratory:

1. By direct, hand to hand transfer from the officer to one of the criminalists at the Crime Laboratory on weekdays during the hours of 8:00 a.m. to 5:00 p.m. All required forms are available at the laboratory and can be filled out there.

   The Latent Print Section is open 24 hours a day, seven (7) days a week; and evidence for fingerprinting can be submitted directly to a Latent Print Examiner.

2. By depositing the evidence with the required forms in one of the specially marked lockers for laboratory analysis at the evidence impound room located in the PPSB basement at 620 W. Washington. These lockers are self locking and can only be opened by the criminalists. These lockers are emptied on a daily basis, Monday through Friday.

Evidence left at precincts or in the regular property impound lockers will not be taken to the laboratory by the criminalists with the exception noted above. The appropriate forms must accompany all submissions. The basic requirements for any type of laboratory examination are:

1. That it be submitted in one of the three ways described above (preferably by personal delivery).

2. That the items are submitted with a Departmental Report (DR) number. All laboratory records and reports are on the basis of DR numbers. The only exception to the DR requirement is a preliminary examination of evidence for evaluation or investigative purposes when it is brought to the laboratory by the officers.

   Only verbal reports are normally given on these types of examination. A complete analysis or written report will require a DR number and a formal submission of the evidence.

The forms to accompany evidence are:

1. Request for Scientific Analysis form (1 copy only).
2. Property Invoice form (original only).

If evidence was previously impounded and has been signed out of Police Property for submission to the laboratory, a copy of the property invoice should be submitted with the Scientific Analysis form.

The following pages depict typical scientific analysis requests and property invoices as they would be filled out by an officer for submission to the laboratory with his evidence. The examples are for a narcotics case and a comparative type analysis.

The remaining portion of the Request for Scientific Analysis is filled in by the laboratory staff. This includes a description of all items received, the date, time and place received, the findings made by the Criminalist and the *disposition of the evidence.

The laboratory report is then typed in quadruplicate. The original copy is placed in the Records and Identification Bureau file under that particular DR.

Officers or deputy county attorneys desiring copies of the laboratory findings should obtain them at the Records and Identification Bureau.

Copies of the laboratory report are used for stipulation purposes at preliminary hearings and, therefore, should be in the possession of the prosecutor at the time of the hearing if possible. The justice courts have been allowing the submitting officer to contact the laboratory, talk to the criminalist who analyzed the evidence and, on the basis of a verbal report, testify as to the analysis result for the purpose of the preliminary hearing.

* Evidence once processed is <u>not</u> kept by the Laboratory but is placed in the police property room for long term storage where the officer may sign it out for court appearances.

NOTE: FILL IN EVERY SPACE UNLESS THE INFORMATION IS NOT AVAILABLE. PRINT LEGIBLY IN INK.

TYPE OF PROPERTY (CIRCLE ONE ONLY): (EVIDENCE) SAFEKEEPING PRISONERS FOUND

DATE AND TIME OF INCIDENT: 3-10-90 0430

NAME OF VICTIM OR OWNER (LAST, FIRST, MIDDLE): True Dollar Pawn Shop
ADDRESS: 16th St. & Washington
TELEPHONE:
D.R. NUMBER: 09-098765

NAME OF RESPONSIBLE PARTY OR NEXT OF KIN:
ADDRESS:
TELEPHONE NUMBER:

NAME OF SUSPECT (LAST, FIRST, MIDDLE): Jones, John F.
DOB: 6/20/48
ADDRESS: unknown
ARREST NUMBER: 765432

NAME OF SUSPECT (LAST, FIRST, MIDDLE): Smith, William (NMN)
DOB: 12/3/50
ADDRESS: unknown
ARREST NUMBER: 765433

NAME OF FINDER OR PERSON REPORTING FOUND PROPERTY:
ADDRESS:
TELEPHONE NUMBER:

TYPE OF OFFENSE IF KNOWN: Burglary
LOCATION OF OCCURRENCE: 16th St. & Washington
DISTRICT:

BRIEF SYNOPSIS OF OCCURRENCE: (ALSO USE THIS SPACE FOR ADDITIONAL SUSPECTS OR VICTIMS)
SEARCH WARRANT ☐

Suspects were arrested in vicinity of burglary after officers responded to alarm. - Screwdriver found on Suspect Jones Shoe impressions at point of entry, appear similar to suspect's shoes. Photographs taken of shoe impressions by Latent Print Examiner.

ITEMIZE AND DESCRIBE PROPERTY. - LIST ONLY ONE ITEM PER LINE. NUMBER EACH ITEM ON THE FORM, TAG, AND CONTAINER. TAG ALL ITEMS NOT IN SEALED ENVELOPE. WHEN ITEMS ARE SEALED IN AN ENVELOPE, PRINT A BRIEF DESCRIPTION OF THE CONTENTS, APPLICABLE DATES, TIMES, D.R. NUMBERS, OFFICERS NAMES AND SERIAL NUMBERS ON THE ENVELOPE.

ITEM	AMOUNT	SERIAL NO OF ITEM	
1	1	---	Screwdriver found in pocket of Susp. Jones
2	1		Door latch assembly removed from door
3	1 pr		Shoes from Suspect Jones
4	1 pr		Shoes from Suspect Smith

Original Only

TOTAL AMERICAN CURRENCY: $ Ø

OFFICER: M.C. Rider SERIAL: 1001 PAGE 1 OF 1

DISPOSITION OF PROPERTY: (CIRCLE ONE ONLY)

PROPERTY ITEMS WERE: RETURNED TO OWNER LEFT AT 429 W. JACKSON PLACED IN BIKE RACK @ STREET No. ____ TURNED OVER TO CUSTODIAN IN PERSON LOCKED IN LOCKER No. L-21 TAKEN TO POLICE RANGE

FOR CUSTODIAN USE ONLY:

PREPARED BY DATE TIME

BOOK PAGE LINE:

REMARKS

LAWFUL DISPOSITION AUTHORIZED BY

CITY OF PHOENIX, ARIZONA POLICE DEPARTMENT PROPERTY INVOICE AND RECEIPT 81-130 (REV. 10-83)

REQUEST FOR SCIENTIFIC ANALYSIS

SUSPECT NAME (LAST, FIRST, MIDDLE)	O. R. NO.
Jones, John F.	09-098765
SUSPECT NAME (LAST, FIRST, MIDDLE)	TYPE OF REPORT
Smith, William N.M.N.	Burglary
LOCATION OF OCCURRENCE	ARREST NO. OR P.R.O. NO
16th Street & Washington	765432, 765433
OFFICER REQUESTING ANALYSIS - SERIAL NUMBER	DATE & TIME OF OCCURRENCE
M.C. Rider #1001	3-10-90 0215
VICTIM NAME (LAST, FIRST, MIDDLE) FIRM NAME IF BUSINESS	DATE & TIME OF THIS REQUEST
True Dollar Pawn Shop	3-10-90 0430

ANALYSIS REQUESTED: ☐ MARIJUANA ☐ DRUGS ☒ OTHER (DESCRIBE)

Determine if screwdriver(#1) was used to make marks on doorlatch (#2). Compare shoes (#3 & #4) to photographs of shoeimpressions

DO NOT WRITE BELOW THIS LINE

The undersigned is prepared to testify that he is a criminalist employed by the City of Phoenix and that he did on the _____ day of _____, 19____ obtain from _____

☐ INVENTORY AS PER PROPERTY INVOICE ☐ EVIDENCE CONSISTING OF:

Original Only

That he did make an examination and analysis of this evidence and in his opinion:

At the conclusion of the analysis the evidence on the _____ day of _____, 19____ was:

☐ RELEASED TO POLICE PROPERTY ☐ RELEASED TO

SIGNATURE OF CRIMINALIST	DATE & TIME TYPED CLEAR	O.R. NUMBER

60-1440
REV 9/84

NOTE: FILL IN EVERY SPACE UNLESS THE INFORMATION IS NOT AVAILABLE. PRINT LEGIBLY IN INK.

TYPE OF PROPERTY (CIRCLE ONE ONLY): (EVIDENCE) SAFEKEEPING PRISONER'S FOUND

DATE AND TIME OF IMPOUND: 3-17-90 1430

NAME OF VICTIM OR OWNER (LAST, FIRST, MIDDLE): State of Arizona

ADDRESS: TELEPHONE:

D.R. NUMBER: 09-123456

NAME OF RESPONSIBLE PARTY OR NEXT OF KIN:

ADDRESS: TELEPHONE NUMBER:

NAME OF SUSPECT (LAST, FIRST, MIDDLE): Doe, Jane DOB: 2-29-72

ADDRESS: 0000 N. 19th Ave, Phx.

ARREST NUMBER: 765431

NAME OF SUSPECT (LAST, FIRST, MIDDLE): DOB:

ADDRESS:

ARREST NUMBER:

NAME OF FINDER OR PERSON REPORTING FOUND PROPERTY:

ADDRESS: TELEPHONE NUMBER:

TYPE OF OFFENSE IF KNOWN: Ill. Poss. of Narcotics

LOCATION OF OCCURRENCE: 620 W. Washington

DISTRICT:

BRIEF SYNOPSIS OF OCCURRENCE: (ALSO USE THIS SPACE FOR ADDITIONAL SUSPECTS OR VICTIMS)

SEARCH WARRANT ☐

Suspect was arrested on outstanding warrent - Items found in purse of suspect.

ITEMIZE AND DESCRIBE PROPERTY—LIST ONLY ONE ITEM PER LINE. NUMBER EACH ITEM ON IT-E FORM, TAG, AND CONTAINER. TAG ALL ITEMS NOT IN SEALED ENVELOPE. WHEN ITEMS ARE SEALED IN AN ENVELOPE, PRINT A BRIEF DESCRIPTION OF THE CONTENTS, APPLICABLE DATES, TIMES, D.R. NUMBERS, OFFICERS NAMES AND SERIAL NUMBERS ON THE ENVELOPE.

ITEM	AMOUNT	SERIAL NO. OF ITEM	
1	1	—	Glass Vial Containing White Powder
2	1		Small metal spoon

Original Only

TOTAL AMERICAN CURRENCY: $ Ø

OFFICER: J.L. Smith SERIAL: 1000 PAGE 1 OF 1

DISPOSITION OF PROPERTY: CIRCLE ONE ONLY

PROPERTY ITEMS WERE: RETURNED TO OWNER LEFT AT 439 W. JACKSON PLACED IN BIKE RACK (DISTRICT) NO. _____

CRIME LAB

(TURNED OVER TO CUSTODIAN IN PERSON)

PLACED IN LOCKER NO. _____ , _____

TAKEN TO POLICE RANGE

FOR CUSTODIAN USE ONLY

RECEIVED BY DATE TIME

BOOK PAGE LINE

REMARKS

CAMP JL DISPOSITION AUTHORIZED BY

CITY OF PHOENIX, ARIZONA POLICE DEPARTMENT PROPERTY INVOICE AND RECEIPT 80-13D REV 10-80

REQUEST FOR SCIENTIFIC ANALYSIS

SUSPECT NAME (LAST, FIRST, MIDDLE): Doe, Jane	D. R. NO.: 09-123456
SUSPECT NAME (LAST, FIRST, MIDDLE):	TYPE OF REPORT: Ill. Poss. Narcotics
LOCATION OF OCCURRENCE: 620 W. Washington	ARREST NO. OR P.P.D. NO.: 765431
OFFICER REQUESTING ANALYSIS - SERIAL NUMBER: J.L. Smith # 1000	DATE & TIME OF OCCURRENCE: 3-17-90 1350
VICTIM NAME (LAST, FIRST, MIDDLE) FIRM NAME IF BUSINESS: State of Arizona	DATE & TIME OF THIS REQUEST: 3-17-90 1430
ANALYSIS REQUESTED: ☐ MARIJUANA ☒ DRUGS ☐ OTHER (DESCRIBE): Determine if white powder is cocaine	

DO NOT WRITE BELOW THIS LINE

The undersigned is prepared to testify that he is a criminalist employed by the City of Phoenix and that he did on the _____ day of _____, 19____ obtain from _____

☐ INVENTORY AS PER PROPERTY INVOICE ☐ EVIDENCE CONSISTING OF:

Original Only

That he did make an examination and analysis of this evidence and in his opinion:

At the conclusion of the analysis the evidence on the _____ day of _____, 19____ was:

☐ RELEASED TO POLICE PROPERTY ☐ RELEASED TO

SIGNATURE OF CRIMINALIST	DATE & TIME TYPED	CLERK	D.R. NUMBER

AD-1443
REV 3-84