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Shoe and Tire Impression Evidence

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Contents

- | | | |
|-------------------------|-----------|--|
| Forensic Science | 2 | Shoe and Tire Impression Evidence
By William J. Bodziak 95347 |
| Legal Matters | 13 | U.S. Information Access Laws:
Are They a Threat to Law Enforcement?
By Stephen P. Riffin 95348 |
| Management | 20 | Analyzing Costs: An Aid to Effective Police
Decisionmaking
By James K. Stewart 95349 |
| The Legal Digest | 24 | The Constitutionality of Drunk Driver Roadblocks
By Jerome O. Campana, Jr. 95350 |
| | 32 | Wanted by the FBI |



The Cover:
Shoe and tire
impression
evidence, when
properly collected,
can be important in
placing a suspect at
the crime scene.
See article p. 2.

**Federal Bureau of Investigation
United States Department of Justice
Washington, D.C. 20535**

William H. Webster, Director

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Director's Message

For the first time since 1960, this country experienced a significant decrease in crime reported to police for a second consecutive year. The 1983 decline in crime was 7 percent, the greatest in any year since 1960.

This may signal that crime, as measured by the Uniform Crime Reporting system, is being managed more effectively by our law enforcement community.

All categories of the Crime Index—murder, forcible rape, robbery, aggravated assault, burglary, larceny-theft, motor vehicle theft, and arson—decreased in 1983; violent crime declined by 5 percent, property crime by 7 percent. In contrast, the volume of reported crime reached an all-time high in 1980, which continued through the following year. But in 1982, decreases in the amount of crime reported were experienced.

During the first quarter of 1983, a decrease of 2 percent was reported. Then, in the second and third quarters, 8-percent declines were recorded. In the last quarter of 1983, there was a 10-percent drop, for a year-long average drop of 7 percent.

While there are many influences affecting the volume of crime, there are indications that the criminal justice system is beginning to function with a higher degree of effectiveness, which is reflected in our crime figures.

Especially noteworthy, too, is the fact that while crime counts for the past 2 years have diminished, the number of persons arrested for crime continues to rise. Recent efforts by law

enforcement to concentrate on the "career criminal," coupled with better prosecutive and judicial handling of those who commit large numbers of crimes, whether to support narcotics habits or for other reasons, have resulted in jail populations reaching new highs, while reported crime has declined.

Increased citizen involvement in community action groups, such as neighborhood watch and similar programs, has also favorably affected these crime statistics, as have the actions of individuals concerned with their potential of becoming the victims of crime.

Attorney General William French Smith noted that today, criminals are more likely to be arrested and incarcerated than they were in 1980. He pointed out the "tighter coordination within federal law enforcement and among federal, state and local law enforcement agencies."

While these crime figures are a sign of hope—larger cities and suburban and rural areas alike recorded similar declines—this trend does not mean that the law enforcement community can relax. Even the statistically valid decline in the percentage of the arrest-prone age group of 15-24 years is not overly reassuring, as the number of older people being arrested for property crimes is increasing.

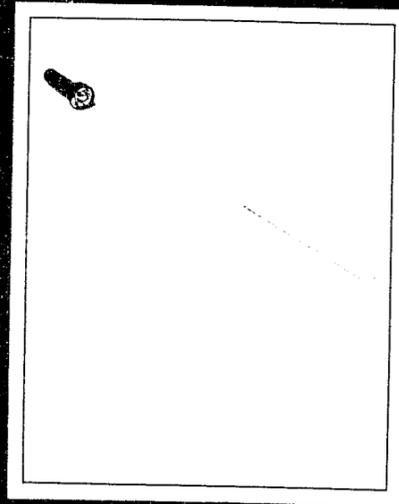
Increased emphasis, by law enforcement and community together, on successful programs that demonstrate the ability to reduce crime is still needed if we are to envisage a time when our children can live relatively free of crime.

William H. Webster

William H. Webster
Director
July 1, 1984

Forensic Science

Many impressions not seen under normal lighting conditions can be located by turning off overhead lighting and directing a strong beam of light from a low angle across the surface being searched.



By
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Shoe and Tire Impression Evidence



Special Agent Bodziak

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In many criminal investigations, it is necessary to determine and prove through various types of physical evidence that a particular person was present at the scene of a crime. For this reason, the collection and forensic examination of evidence such as fingerprints, blood, hair, fibers, soil, and glass is routinely practiced. Since criminals must either be walking or driving as they move in and out of the crime scene area, it is not surprising that shoe and tire impressions are also often collected and provide excellent physical evidence.

Criminals frequently wear gloves to avoid leaving fingerprints and don masks to avoid eyewitness identification; however, they rarely are aware of or make an attempt to conceal shoe and tire impressions. Unfortunately, a well-meaning, but hasty or disorganized, search of the crime scene area often results in shoe or tire impression evidence being overlooked or destroyed. Proper collection and preservation of this type of evidence by the investigator, followed by a detailed examination by a laboratory expert, can play an important part in proving the suspect was at the scene of a crime.

Locating and Protecting Impressions

The law enforcement officer or crime scene technician who is first to enter the crime scene plays an important role in preserving areas which may contain shoe or tire impressions. Although responsibilities such as tending to injured victims or apprehending a suspect need to be met immediately, the entire crime scene should be secured as soon as possible until it can be properly and thoroughly searched.

When conducting an exterior crime scene search, investigators should pay particular attention to vehicular tire tread impressions and shoe impressions the subject may have made while entering and leaving the scene. During an interior search, all surfaces in areas where the suspect(s) may have entered the premises should be carefully examined, since most of the residue on their shoes from outside surfaces would be deposited in those areas. Some hard interior surfaces, such as tile floors, broken glass, desk tops, chair seats, and countertops, may contain valuable impressions which are not easily seen under normal lighting conditions. To locate those impressions, all lighting should be turned off and a strong beam of light directed from a low angle across the surface being searched. For some reason, this technique is seldom used; yet, ironically, the residue and dust impressions found this way usually have the best detail and are often the easiest impressions to compare with a suspect's shoe. They are also the easiest impressions to overlook and accidentally destroy. Once located, all impressions should be protected until the crime scene investigator has the opportunity to photograph and cast or lift the impressions.

Sometimes, certain shoe or tire impressions located at the scene appear "worthless" to the investigator when, in fact, they contain sufficient detail and characteristics for a meaningful examination. At other times, numerous shoe or tire impressions will be found, but only a few will be retrieved. In both instances, all impressions should be retrieved for subsequent evaluation by a qualified expert.



Proper positioning of camera when photographing impressions. The camera should be mounted on a tripod and positioned directly over the center of the impression with the camera lens parallel to the surface. Flash is used to provide an oblique light source.

Tire and Shoe Impression Photographs

Once located, all shoe and tire tread impressions should first be photographed. In order for a laboratory examiner to perform the best examination, high-quality, closeup photographs of the impressions are required. These photographs need to be taken from directly over top of the impressions at a distance of 2 to 3 feet. They should not be confused with general crime scene photographs. The photographs will provide a clear and accurate record of the original condition and appearance of the impressions prior to being lifted or cast.



Two commonly used practices but improper ways of photographing impressions. Both result in distorted photographs.



Figure 1

Instructions for Photographing Shoe and Tire Impression Evidence

1) *Select a camera that has the largest size negative format.* Because a natural size enlargement of the photographs will be required for an examination, the original negatives must be enlarged. Since a smaller negative (35mm) must be enlarged more than a larger negative (4" x 5"), a larger negative format camera is preferable.

2) *Use fine grained, slow speed (low ASA) black and white film.* Some examples of good film would be Kodak Plus-X, Kodak Panatomic-X, or Ilford HP-5. In certain cases where color film is desired, it should be used *only* to supplement the black and white photographs.

3) *Use a tripod.* The camera should be mounted on a tripod and should be positioned directly over the center of the impression with the camera lens parallel to the surface being photographed. The lens should be carefully focused. Failure to place the camera on a tripod directly over the impression and correctly focus it will result in distortion which may limit the results of the examination.

4) *Always photograph with a ruler or scale next to the impression.* A suitable scale, such as a flat ruler, must be

placed next to the impression and should be present in each photograph. The ruler should be depressed into the surface until it is at the same depth as the actual impressions. Without a ruler or other suitable scale, it would not be possible to enlarge the photographs to a true and accurate natural size.

5) *Use proper lighting and exposure.*

a. Three-dimensional impressions, such as those found in soil, sand, and snow, require the use of an oblique light source (a light source which is held at a low angle to the ground) to make them more distinct. If the flash of the camera is used as the oblique light source, a flash extension cord will be needed, since the flash will have to be held close to the ground and at least 3 feet away from the impressions to allow for the even distribution of light across that impression.

b. For each impression photographed, an oblique light source should be projected from at least three different sides of the impression to highlight as many points of identification as possible. Several photographs of each impression from each of those positions should be taken. If the impression is very deep, the light source should be held slightly

higher to avoid casting a shadow over part of the impression.

c. Impressions in blood, grease, oil, or other material, which are visible under existing light but are not further enhanced with oblique light, should be photographed using existing light or by using an indirect flash (not aimed directly at the impression).

d. When taking "existing light" photographs of impressions in light colored sand, in snow, or on other highly reflective surfaces, the camera meter receives an incorrect reading from that surface. To correct this reading, take a camera meter reading holding a "gray card" over the impression or manually compensate for the incorrect camera meter reading by "opening up" the lens of the camera by "one to two" operative settings. An example would be a photograph of an impression in the snow, where the camera meter indicates the shutter opening should be F16. Since the camera meter is being fooled by extraneous reflected light, the proper setting would be F11 or F8.

e. In all of these situations, it is advisable to take several extra photographs of each impression and to "bracket" your exposure settings.

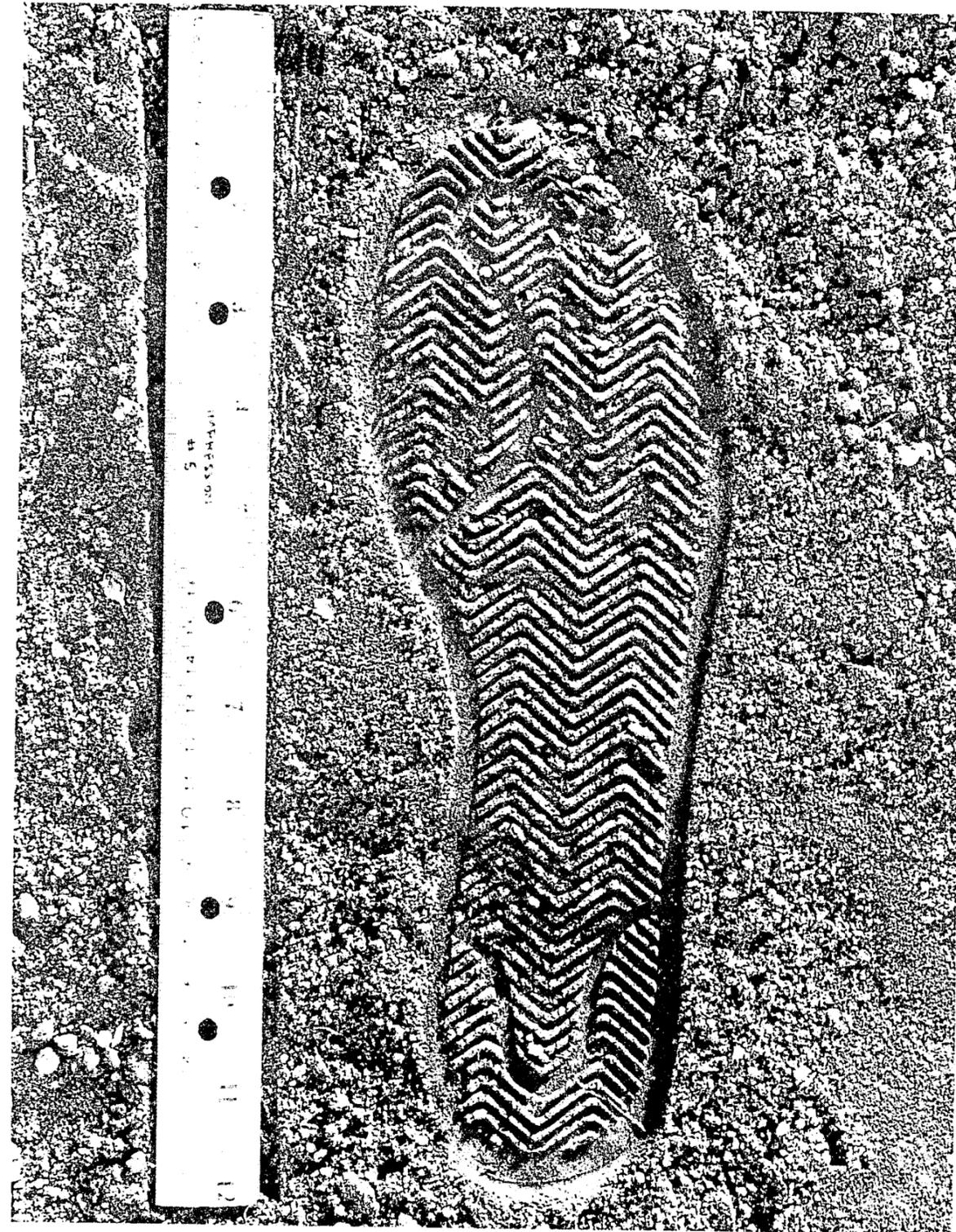
They often provide the examiner with more detail than may be possible to achieve through the subsequent casting or lifting process, the success of which cannot always be predicted. Again, the importance of these photographs cannot be overemphasized. The instructions in figure 1 should be adhered to while photographing shoe and tire impression evidence.

Casting an Impression

In footwear or tire tread impressions on soft surfaces, the raised areas of the shoes and tires which contain the most wear characteristics and identifying characteristics make the depressed areas of the impressions. These areas are not always represented well by a photograph, but are reproduced effectively by a cast.

Therefore, after photographing, casts should *always* be made of three-dimensional impressions such

as those found in soil, mud, sand, and snow. A cast will provide a three-dimensional record of the impression and will supplement the photographs of the impression, enabling the examiner to make a more complete examination.



“ . . . in no instance, should an attempt be made to remove debris if that debris is part of the impression or if there is any possibility of destroying part of the impression by removing it.”

Prior to casting an impression, it may be necessary to remove leaves, twigs, or other loose debris which may have fallen into the impression; however, in no instance, should an attempt be made to remove debris if that debris is part of the impression or if there is any possibility of destroying part of the impression by removing it. A form should be placed around the impression. This will contain any excess casting material and also help give the cast extra thickness.

Class I dental stone and plaster of paris are two forms of gypsum which can be used for making casts of shoe and tire impressions. Class I dental stone is stronger, easier to use, more durable, and superior to plaster of paris and is available from most local dental supply houses. (R&R castone is one brand of class I dental stone and available from Dentsply International, Inc., P.O. Box 905, Toledo, Ohio 43691) However, in the absence of class I dental stone, a suitable cast can be made with plaster of paris. It is important that only "class I" dental stone be used, since other types of dental casting materials contain "hydrocolloid alginates" which shrink excessively and must therefore be avoided.

If proper casting supplies are kept on hand, the process is relatively quick and simple. A container of water, a few zip-lock bags of dental stone or plaster of paris, a small rubber container or a small bucket for mixing, a stirring stick, some materials for a form, and if plaster of paris is

used, materials such as hardware cloth to reinforce the cast are all that are needed.

In preparing the casting material, approximately 3 pounds of dental stone will be needed for each shoe impression. For every 3 pounds of dental stone, place approximately 14 ounces of water in a container. (A discarded soda can is suitable for making approximate measurements of the water.) Then pour enough dental stone into the container to allow it to "cone up" a couple of inches of the water. Allow to stand for 1 to 2 minutes. During this time, the casting material will settle into the water. Stir the

mixture, which will be watery at first, until the dental stone has completely dissolved. Continue to stir every 30 seconds. When the mixture approaches the consistency of thin pancake batter (in 8 to 10 minutes), it is ready and should be poured before it becomes thicker. Pour the mixture into the form by pouring it onto a flat stick or spoon held close to the surface of the ground and slightly to the side of the impression so as not to wash away portions of the impression. The mixture must be allowed to flow evenly over the impression.

In approximately 30 minutes, the cast may be carefully lifted. If soil or



Left: A ruler or suitable scale should be placed next to an impression before photographing so that enlarged prints will show natural size for examinations

Right: Supplies needed to cast an impression properly



Above: Add dental stone to water until it "cones up," then allow to stand for 1 to 2 minutes before stirring.

Right: When casting mixture is the consistency of thin pancake batter, pour mixture onto a spoon or flat stick held close to the surface of the ground and slightly to the side of the impression, allowing mixture to flow over the impression.



debris from the impressed area is adhering to the cast, no attempt should be made to clean it. The cast should be allowed to air dry for 24 to 48 hours. The cast should never be placed in an airtight container or wrapped in plastic.

If plaster of paris is used, approximately 5 pounds will be needed for each footwear impression and will require approximately 15 ounces of water for each pound. Otherwise, the procedure for mixing and pouring the plaster of paris and dental stone is the same. Because plaster of paris is not as strong as class I dental stone, reinforcement material will have to be placed in the cast. This is accomplished by first pouring half of the plaster of paris mixture into the form until the impression is covered, laying the reinforcement material over the poured plaster, and then pouring the remaining plaster mixture over the reinforcement material.

Impressions in snow can be cast with the dental stone technique described; however, a small amount of snow or ice should be added and stirred into the dental stone mixture to keep the temperature low. The mix should be allowed to become slightly more viscous than the thin pancake batter consistency. When cold, it will take the mixture longer to reach that consistency. Be careful not to pour the mixture when it is too thin or it will pass through the snow.

A new product called "snow print wax" is a spray wax product which provides considerable help in casting snow impressions. (It is available through the Kinderprint Company, P.O. Box 16, Martinez, Calif. 94553)

Directions are provided with the product; however, best results are obtained when each snow impression is sprayed with three or four coats of snow print wax and then carefully filled by allowing a mixture of dental stone or plaster of paris to flow indirectly into the wax-covered impression.



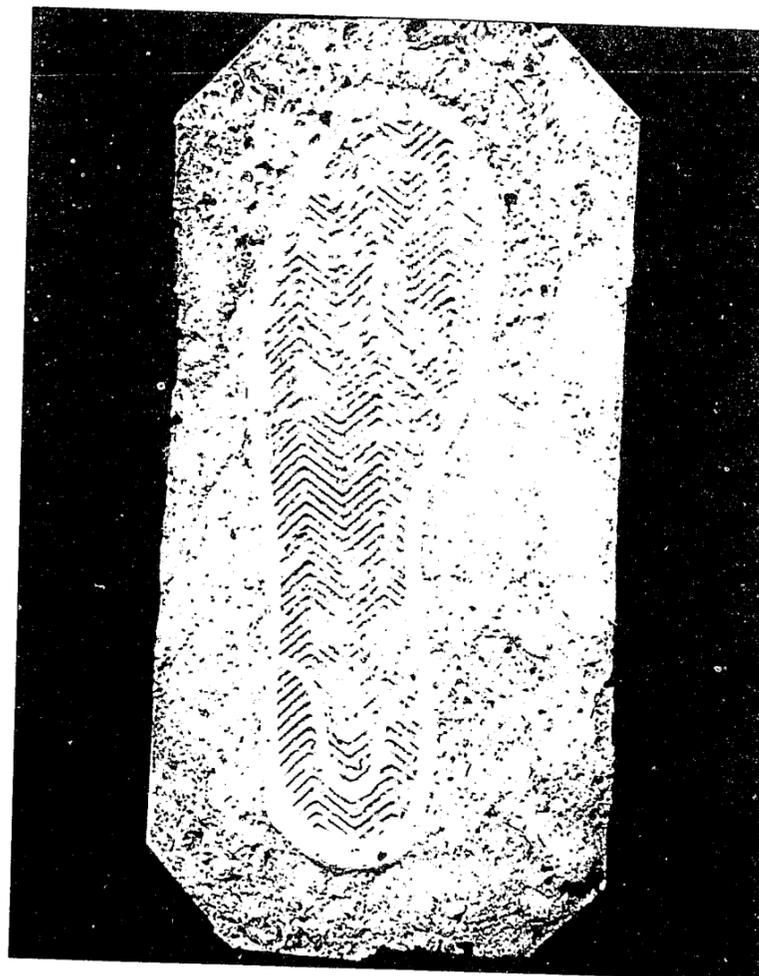
Hard Surface Impressions

"Hard surface" or "two-dimensional" impressions include impressions on tile floors, bank counters, glass, doors, windowsills, paper, concrete, and virtually any hard surface which will retain an impression of a shoe or tire. The majority of these impressions are shoe impressions which are found inside and are, therefore,

particularly useful in linking the suspect with the crime scene. The impressions fall into two categories—dust impressions and residue impressions.

Dust impressions occur when a shoe or tire comes in contact with a surface heavily coated with loose material, such as dust or grit. As the shoe or tire strikes the surface, the dust or grit clings to its surface and a negative impression of the shoe or tire remains. Dust impressions should be photographed first with the proper oblique lighting technique. The item which contains the impressions should then be preserved and submitted to the examiner in the laboratory. If the item cannot be submitted to a laboratory, the impression should be "lifted" by using a commercially available footprint lift.

If possible, avoid using makeshift footprint lifting materials, such as cellophane tape, rubber fingerprint lifters, and contact paper. Instead, a quality footprint lifting material large enough to lift the entire impression should be used. (One product that is excellent for lifting impressions is called "handprint" and is available from the Kinderprint Company, P.O. Box 16, Martinez, Calif. 94553) Carefully place the lifting material over the impression from one end to the other. Using a clean fingerprint roller will make this easier and will help eliminate trapping air bubbles. If a clear lifting material such as cellophane tape is used, it should be transferred to white paper, again using a roller to eliminate air bubbles. Dust impressions should



Above: After 30 minutes, lift cast and allow to air dry thoroughly. Soil will be cleaned from cast in laboratory.

Left: A clean cast.



A clean fingerprint roller should be used to apply footprint lifting material over a footwear impression.

never be dusted with latent fingerprint powder since this will most likely destroy the impression.

Residue impressions are those resulting from residue being deposited from the shoe to the surface. They include impressions made by the transfer of ordinary residue which shoes accumulate or impressions made after stepping in blood, grease, and liquids. Many of these impressions will not transfer back off of the surface to a lifting material with sufficient detail to enable them to be lifted successfully. For that reason, after each impression is photographed, the item containing the impression should be preserved and submitted to the laboratory. If it is not possible, the photographs should be checked before that evidence is lost or the crime scene is "cleaned up."

Because dusting residue impressions with latent fingerprint powder is usually unpredictable, it is not generally recommended. However, it may be worth trying as a last resort in cases where the impressed item cannot be submitted to the laboratory and the evidence would be "cleaned up" anyway. One particular situation where dusting with latent fingerprint

powder is occasionally successful are those instances where a wet shoe comes in contact with a waxed surface, such as a waxed bank counter-top. If a shoe impression is developed or enhanced with the powder, it can be rephotographed and then lifted as previously described.

Packaging and Submitting Impression Evidence to a Laboratory

In criminal cases, the FBI Laboratory will conduct evidence examinations for all law enforcement agencies and will furnish expert testimony, provided no other expert in the same scientific field will be used by the prosecution. This testimony, as well as the examination in the FBI Laboratory, is provided at no cost to the requesting agency.

All communications transmitting impression evidence to the FBI Laboratory should list the name of the suspect(s) and/or victim(s), the type of violation and the date it occurred, a description of the evidence being sub-

mitted, the types of examinations desired, and any background information that would be of assistance to the examiner or pertinent to the examination requested. Reference should also be made to any previous correspondence or reports and as to whether any of the evidence has already been subjected to any previous examination. The communication should be submitted in duplicate with additional copies of that communication accompanying any evidence which is sent under separate cover. All evidence should be sent by registered mail. (See fig. 2.)

What examinations can be made and what conclusions can be reached?

Footwear Impressions

In situations where a footwear impression is left at the scene and no suspect or known shoes exist, a laboratory can offer assistance in possibly identifying the make and full design of the shoe. The laboratory can also make a permanent record of the evidence by photographing casts, impressions, and impression lifts which are submitted and can often enhance the detail in those impressions.

When known shoes of suspects are obtained, comparisons can be made which may determine whether a particular impression corresponds in size, design, and wear characteristics with the respective portion of the suspect's shoe. If the known shoe contains identifying characteristics such as cuts, abrasions, or tears which have occurred randomly as a result of the use or abuse of the shoe, and these same individual identifying characteristics are evident in the questioned impression, it is possible that shoe can be "identified" as the particular shoe that made the impression.

Figure 2

Instructions for Submitting Evidence to the FBI Laboratory

CASTS—

Casts should be allowed to air dry thoroughly for 24 to 48 hours, longer if necessary. No attempt should be made to remove soil from the casts or to clean the casts. When dry, each cast should be wrapped individually in shock absorbent, porous packaging material. **DO NOT WRAP OR PLACE IN PLASTIC.**

KNOWN SHOES—

If wet (water, blood, etc), shoes should be air dried thoroughly before wrapping. Do not dry shoes with artificial heat, such as a heat lamp or hair dryer, and do not wrap in plastic. Identify the wearer of each pair of shoes and the date obtained. If shoes are to be examined for soil, glass fragments, safe insulation, fibers, or other microscopic evidence, they should be wrapped individually in a manner to avoid their being

contaminated or contaminating other evidence in the same package.

TIRES—

Tires should be left mounted and should be shipped by the best method locally available, ensuring that the tread surface is protected during shipment. Furnish the make, model, and year of the car from which they were obtained, along with their position on the car (left front, right front, left rear, right rear, and spare).

EVIDENCE CONTAINING IMPRESSIONS AND IMPRESSION LIFTS—

Lifts of impressions and individual items on which there are impressions should be preserved and individually wrapped so that the impressions will not be destroyed or erased during shipment.

PHOTOGRAPHS—

Negatives should accompany all photographs of impression evidence so that quality "natural size" enlargements for examination purposes can be made. All photographs and negatives taken of impressions should be submitted, regardless of their apparent quality. Too often, it is discovered that some photographs were not submitted only to find out later that they would have been of additional value to the examiner.

CRIME SCENE SKETCH AND GENERAL CRIME SCENE PHOTOGRAPHS—

In cases where a crime scene sketch or general crime scene photographs concern themselves with impression evidence, copies of these items should also be submitted, along with the impression evidence to assist the examiner.



In cases where the impression lacks sufficient characteristics or detail to result in an absolute identification, examination results concerning the size, design, and wear characteristics still offer significant evidence that contributes to placing the suspect at the crime scene. On today's market, there are thousands of different shoe designs, each of which comes in numerous sizes. Therefore, any particular shoe design in a particular size represents an item which is owned and worn by far less than 1 percent of the population. Any addi-

A partial impression left at the crime scene when the subject's "bloody" shoes came in contact with a piece of paper. A "test impression" made with the subject's shoe shows several characteristics (marked with arrows) which identify that shoe as the one which made the bloody impression. With an enlarged version, an expert examiner could testify in court explaining to the jury the basis for the identification.

Fewer Bombings in 1983

According to preliminary figures compiled by the FBI's Uniform Crime Reporting Program, the number of bombing incidents in the United States and Puerto Rico totaled 687 in 1983, a decrease of 14 percent from the 795 bombings reported in 1982. Also showing a decline was the total of actual and attempted bombings attributed to terrorist groups—from 38 in 1982 to 22 in 1983.

Last year's bombings included 519 explosive and 168 incendiary incidents, with actual detonation or ignition occurring in 569. Actual explosive bombings were down 9 percent in volume; incendiary incidents, 35 percent.

As in previous years, the most frequent targets of the bombings in 1983 were residences and commercial operations and office buildings, accounting for 46 percent of the incidents. Vehicles (17 percent)

and schools (5 percent) were other leading targets. Sixteen attacks were directed at law enforcement facilities or equipment.

The 1983 incidents resulted in 12 deaths, 100 injuries, and property damage estimated at over \$6 million. The number of fatalities declined from 16 in 1982 to 12 in 1983, while injuries rose 1 percent. Among those killed, 10 were the perpetrators themselves, and 2 were the intended victims. Of the 100 injured, 36 were perpetrators, 27 were innocent bystanders, 22 were intended victims, 10 were firemen, and 5 were law enforcement officers.

Regionally, the Western States recorded 204 bombings; the North Central States, 185; the Southern States, 184; and the Northeastern States, 107. Puerto Rico reported 7 incidents.

tional characteristics, such as specific wear characteristics or random manufacturing characteristics, make that shoe an item which is owned and worn by even fewer people.

In many instances, footwear impressions determined to have been made by a suspect's shoe can have further significance in connecting a suspect to a particular crime. Impressions in the victim's blood, made when the blood was wet, impressions on objects which were misplaced or broken during the commission of a crime, and impressions in unusual places, such as a roof or bank countertop, cannot only place a suspect at the crime scene but can show a degree of involvement in the crime or demonstrate those impressions were made within a certain time frame.

Tire Tread Impressions

In situations where tire tread impressions are left at a crime scene and no suspect or known tires exist, the laboratory can examine the design

of the impression and possibly determine the style and/or manufacturer of the tire. Photographs making a permanent record of the impression and possibly enhancing the impressions can also be made.

When known tires are obtained, comparisons can be made with the questioned impressions which may determine if those impressions and tires correspond in tread dimensions, design, and wear characteristics. Tires can also be positively "identified" as having made a particular impression if sufficient identifying characteristics are present.

Additionally, if multiple tire tracks with different designs and tread dimensions are found at the scene and can be determined to correspond in design and tread dimensions with each of the respective tires found on the known car, the significance of this evidence is greater.

Summary

Law enforcement officers and crime scene technicians should be alert for shoe impressions and tire impressions at the scene of a crime. Once located, the proper collection and preservation of that evidence is accomplished by properly photographing the impressions, and then, either retaining the impressed item, making a cast of the impression, or lifting the impression. This evidence should then be submitted to a laboratory where a qualified expert can compare these impressions with the suspect's shoes or the suspect's vehicle tires. In many cases, positive identifications are possible. Evidence which is only sufficient to show similarities in size, design, and wear is still very significant and important, when considered with other items of evidence, in placing the suspect at the scene of the crime. **FBI**

END