



Trace Evidence: A Versatile Key in Forensic Investigation

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Commentary

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Trace evidence is created when objects contact material is often transferred by heat or induced by contact friction the importance of trace evidence and criminal investigations was shown by Dr. Edmond Locard in the early 20th century. Since then forensic scientists fused trace evidence to reconstruct crimes and to describe the people places and things involved in them studies of homicides published in the forensic science literature show how trace evidence is used to solve crimes trace evidence is important an accident investigation where movement of one part against another will often leave a telltale mark such analysis is of great use in forensic engineering vehicular accident reconstruction relies on such marks to estimate vehicle speed before and during an accident as well as braking and impact forces fabric prints of clothing borne by pedestrians in the paint and/or road grime of the striking vehicle can match a specific vehicle involved in a hit-and-run collision. In this particular we shall understand about the analysis of trace evidence and when we do so we will be studying about what are the trace evidence how to collect the trace evidence then ultimately when you have collected the trace evidence how the forensic examination of the trace evidence is done and then you should also be familiar with the characteristics of the trace evidence.

We have learnt about the management of arson cases which includes an effective arson crime scene management and you have seen that it helps a lot in suitable proceeding of crime scene investigation and you studied that it is based on standard manuals and protocols the role of every concerned person engaged in the arson crime scene investigation and also the responsibilities of investigating officer or the administrator during the arson case management has been explained in detail and that provides a systematic approach for investigation so let us continue with this background and go into trace evidence any tiny fragment of physical evidence such as hairs fibers from clothing or carpeting all the pieces of glass etc. can help tell the story of what happened at the crime scene these are referred to as trace evidence and can

be transferred when two objects they come in contact with each other or then some small particles are dispersed by an action or movement for example paint can be transferred from one vehicle to another when a collision happens.

Similarly another example you can see here can be left on a cloth during a physical attack like especially the rape cases reconstruction of an event can be done with the aid of these evidences or they may indicate that a person or that particular thing was present so these provide very crucial information in solving the cases suspicious collection of materials from a crime scene can yield ample amount of information about various sample came from and how it aids to reconstruct the story scientist analyze the physical optical and chemical properties of trace evidence and use a variety of tools to find and compare samples and then look for the sources or the common origin of each item most test methods require microscopy and/or chemical analysis because they are very any piece of evidence enough of the information can be disclosed about what happened at a scene such as whether an item or body was moved or whether someone was assaulted from rear side or from the side or from front some laboratories consider fire accelerant also as trace and others will include them in chemistry even though the same tests are conducted in both the laboratories a suspect may often interact with the victim while committing crime the environment of the crime scene or both.

So this is very important to keep in mind and that's why the trace evidence become very important during this interaction the exchange of physical evidence can occur the significance of trace evidence in investigation of criminal cases was first discovered by Dr. Edmond Locard a French scientist and he expressed his views on the trace evidence in a philosophical way and this can be read as follows wherever he steps whatever he touches whatever he leaves even unconsciously will serve a silent witness against him not only his fingerprints or his footprints but his hair the

fibers from his clothes the glass he breaks the tool marks he leaves the paint he scratches the blood or semen he deposits or collects all of these and more be a mute witness against him and I add him or her this is evidence that does not forget it is not confused by the excitement of the moment it is not absent because human witnesses are it cannot preserve itself it cannot be wholly absent only its interpretation can are only human failure to find it to study and understand it can diminish its value so you see these words are really giving so much clue that these trace evidence will give you so much information and as for in six scientists it is up to you whether you are able to analyze or not so if you are able to analyze definitely there will be so much crucial information which will help you solve the case so with this background let us try to understand this in more detail with the help of graphics and visuals in last century trace evidence were used by forensic scientists in order to reconstruct crimes or to designate the people places and things tangled in them in order to show the progress and practices of forensic investigations.

Several case studies have been published this includes the use of trace evidence to solve the crime the rule of trace evidence is important in accident investigation as it involves the movement of one part against another hence leave a telltale mark few examples of trace evidences are fibers glass paint chips fingerprints tire impression glove prints hairs cosmetics lipsticks plant fibers soil and botanical materials as the capabilities availability and networking off comparison databases from scientist and manufacturers became more tough samples of items such as paint glass and even soil could be compared against known standards to provide solid and consistent classifications for example the National automotive paint file is a Federal Bureau of Investigation's FBI database containing more than 45,000 sample of automotive paint from manufacturers dating back to the 1930s Sherwin Williams automotive finishes also maintains a large database formula Express which can be very helpful identification of vehicle.

Therefore investigators and analysts must consider the potential that a product may have a new or updated version available collection of trace evidence figure one trace evidence collection too the collection process begins with documentation of crime scene and analysis of evidence location several materials are used for collecting evidence items these materials include containers made up of paper wood and glass bags and envelope non-breakable and Lea proof containers are used for transportation of liquid items evidence such as blood and plants which are moist or wet are collected in plastic containers and sent back to the area where evidence is stored once evidence reaches in secure location it is removed and allowed to dry completely this is then repackaged in a new dry paper container note that the evidence should not be packed in plastic or paper

containers for more than two hours because microorganism start growing in it and destroy the evidence the investigator responsible for packaging and caring should take care on the following issues take precautions to prevent contamination package fragile items carefully freeze are immediately transport items containing soil to the laboratory transport all volatile samples to the laboratory in a timely manner comply with shipping regulations analysis of trace evidence trace material analysis starts with visual examination of the evidence using macro photography followed by microscopic analysis there are different analytical method based on different type of material available for analysis such as stereo microscope scanning electron microscope SEM it is used in x-ray analysis for selected sample area it is important in situations where chemical residue shows presents of unusual elements that indicates chemical attack of the product the gunshot residue can be identified using elemental analysis or scanning making use of energy dispersive spectral.

Several analytical method such as Gas chromatography mass spectrometry and infrared spectroscopy IR are used to identify small amount of explosives volatile hydrocarbons and other chemicals similar comments apply to damaged items from an accident scene but care is needed in ensuring that the sample is not damaged by the testing or sampling for testing such non-destructive testing must always be used first before considering destructive methods which taking small samples from the item for more detailed tests Forensic examination of few of the trees evidences are discussed below hair structure of hair follicle hair examination helps in determination of origin whether animal or human if animal the species and possibly read of the animal can be determined but in case of humans racial characteristics length an area of body and any treatment or damage to the body can be determined samples can be tested to determine the color shape and chemical composition of the hair the presence of toxins dyes and hair treatments are noted this information can assist investigators in including or excluding particular individuals if the hair still has a follicle root attached DNA testing may be used to identify an individual otherwise hair from all parts of the head and four pubic hair the area should be combed for foreign hair prior to sample collection hair samples are primarily collected using tweezers analysis hair samples are tested primarily by microscopic comparison and chemical analysis microscopic comparison identifies the shape color texture and other visual aspects of the sample file chemical analysis indicates the presence of toxins drugs dyes and other chemicals.

In some cases hair is subjected to DNA analysis fiber fibers are thread like elements from fabric or other materials such as mattress fibers fall into three categories natural animal or plant fibers like wool cotton or silk synthetic completely man-made products including polyester and

nylon and manufactured containing natural materials that are reorganized to create fibers such as rayon fiber examination helps in determination of origin of fiber whether natural or synthetic fibers are useful in crime-scene investigation because their origin can be identified a carpet fiber on a person shoe can indicate the individuals presents at a crime scene however fibers are very mobile and can become airborne get brushed off or fall from clothing this mobility makes timely collection crucial to prevent loss of material or cross contamination unknown fibers can be compared to determine its consistence from that source unknown fibers can be related to another known fibers in order to determine their origin as their source is not known collection fibers cling to other fibers and hair but may be easily brushed off when approaching a scene investigators will try to pinpoint the most likely locations for deposited fibers for example clothing from the victim or a suspected weapon are likely places to find fibers.

Trace evidence can also be gathered by tape lifting however this is not an ideal method of collection due to the destructive nature of adhesives sample that potentially hold fibers should be separately bagged to prevent cross-contamination analysis trace evidence analysis often have only mere strands to work with from these trans fiber testing is done using high-powered comparison microscope to compare texture in a side-by-side assessment chemical analysis can determine the chemical composition of the fibers in the case of synthetic fabric or carpet this information can be used to trace the product to the manufacturer using standard databases further enhancing the probative value of the evidence glass type source determination requires the comparison of a known with the questions to identify the tie and source of the questions glass variety of material is used in making off glass these materials make it easy to differentiate one glass sample from another the properties of glass really with exposed temperature during its manufacturing some basic properties are color thickness and curvature that can also help in identifying different samples of glass just by visualizing them.

On the other hand optical properties depend on methods of glass manufacturing glass is also used to gather evidence for example collecting fingerprints or blood from a broken window broken glass fragments are very small and can be found in shoes clothing hair or skin gathering glass fragments from a crime scene can be valuable in determining and use or connecting people and objects to places for example when shields have a different color and composition than a drinking glass or electro still vast so glass fragments on an individual's clothing could be compared to those collected at a hit-and-run scene to determine if that individual was present collection trace examiner's may use magnification and light to find glass fragments on clothing an individual or

at a crime scene and extract those using tweezers tape may also be used to collect large samples but the residue left from the adhesive makes this a less desirable collection method glass fracture analysis glass can yield valuable information from fracture marks lines and patterns testing for unique characteristics such as color optical properties and density can determine the type of glass for example of bottled glass a detailed elemental analysis can be done using laser ablation mass spectrometry induction coupled mass spectrometry x-ray fluorescence or other instruments reflective index or RI of Lars determines the passing of light through it RI is measured for any fragment of glass this property helps in determining the status of two glass.

Sample paint painted surfaces are ubiquitous and the large range of lead colors laughter's and types often make paint high value as evidence transfer of paint is possible in situations where one vehicle hits another vehicle a pedestrian or a building in a property crime where a tool is used to break into a building pane transferred to or from the tool can connect the tool to the location paint films are characterized by a number of physical and chemical features physical characteristics are color thickness layer sequence surface and layer features weathering and contaminants chemical components may include pigments polymers and additives various methods are used to determine and evaluate these features as the sample size and preservation of sample caused these meth to be applied in a proper sequence in order to strengthen the power of an analytical scheme forensic science is mainly concerned with determining the difference between known and unknown samples used for analysis this difference can be in the appearance layer thickness or sequence size shape or other physical or chemical feature of sample it is of value for a forensic examiner to understand the significance of observed differences absence of these significant differences may lead to missing of important clues regarding the origin of the paint samples collection to collect paint peel off or remove small amounts of paint from the source careful while collecting all layers samples are small as one square millimeter can be used for testing for a car crash scene paint samples from the point of contact would be photographed collected and stored in such a way so as to protect it for carrying out further examination this is particularly important in cases of examining fracture matches paint samples are typically collected by scraping small sections down to the metal or original surface or using tweezers to collect chips already dislodged analysis powerful comparison microscopes are used to compare colors thickness and layer patterns and luster or to match fragments and tears chemical testing such as Pyrolysis Gas Chromatography (PGC) can be used to determine chemical composition colors and pigments and other qualities analyzing automotive paint can identify the make model and sometimes the year of a vehicle soil.

Forensic soil scientist are concerned with soils as it can be replaced by human activities scientists compare them with natural soils or soils databases in order to locate the scene of crimes the soil samples are obtained from crime scenes by investigator the soil may be transported by vehicles shoes or shovel the properties of soil are diverse in nature therefore forensic soil scientists use it as evidence in environmental investigations collection soil samples can be collected in different ways depending on where the sample is being collected from if samples are being collected indoors or from a vehicle vacuuming is generally used if the sample is outdoors it is collected by placing a teaspoon of soil into a plastic vial when found on a tool it is wrapped in plastic and then sent to the lab for testing collecting soil samples of her body isn't difficult than collecting a sample from anywhere else but it takes more work and care so that evidence doesn't get contaminated when collecting samples from a body samples should be taken at regular intervals and different spoons should be used each time once the soil samples are collected they are sent to the laboratory at the laboratory samples should be separated from the victim and the suspect analysis to examine the samples the examiner will first do the microscopic analysis so as to perform testing of the mineral content of the soil another test used for identification of the origin of soil is the density test the density test is called the density gradient tube this tests consists of adding liquid to two glass tubes the leak in both tube is the same but the ratio are different this represents two different densities the soil sample is added to both liquid samples.

Tests can also be used to test the soil reaction and electron microscopes can be used to examine the structure of the minerals in the soil during examination. If biological evidence is found in the sample the whole soil sample should be sent to the laboratory for testing Gunshot residue (GSR) this is also called cartridge discharge residue (CDR)

or firearm discharge residue (FDR) it is deposited on hands and clothes of person discharging a firearm it contains both burnt and unburned particles the propellant and possibly fragments of bullet cartridge case and the firearm investigators test people's cloth and skin for GSR in order to determine whether they are involved in crime or not or their presents at the time of crime suppose if they are near the gun GSR may be deposited on the skin or clothes it is estimated that gunshot residue can travel over three to five feet from the gun few traces may be found in distance exceeding this parameter

Finally summarize we have learned that trace evidences include very small pieces of evidence which are found at the scene of crime and that can be used to identify or link a suspect to a crime the collection of sample we have studied can be done by either picking or vacuuming or clipping or swabbing and lifting we also studied that the investigators are responsible for packaging and carrying and so that should be done with proper care and what are these skills let us revise again that is you have to take precautions to prevent the contamination careful packaging of items have to be done immediate transfer of items containing soil should be done to the laboratory and all volatile samples should be transported to the laboratory in time we also studied that several instrumentation and visualization tools are used by analysts during evidence analysis and these includes the scanning electron microscopy stereoscopic microscopy ultraviolet light microscopy polarized light microscopy gas chromatography mass spectrometry ion chromatography FTIR that is the Fourier transform infrared spectroscopy pyrolysis gas chromatography and micro-spectrophotometer. At the end I am sure that after going through this you are now knowledgeable in trace evidence how to collect and how to do the analysis.

