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The Role of Physical Clues in Detection of Crimes

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Abstract

In order to appreciate fully the potential value of physical evidence, the investigator must have an understanding of the difference between class and individual characteristics. When the characteristics of physical evidence are common to a group of objects or persons, they may e termed class. Regardless of how thoroughly examined, such evidence can only be placed into a broad category; an individual identification cannot be made as there is a possibility of more than one source for the material found ' Examples of this type of evidence include blood, hair, soil, glass fragments too small to be matched to broken edges, and tool narks or shoe prints in instances where microscopic or accidental markings are insufficient for positive individual identification. Evidence with individual characteristics can be identified as having originated with a particular person or source; it is the ability to establish individuality which distinguishes this type of physical evidence from that possessing only class characteristics.

Keywords: Types of physical evidences, searching method, collection, preservation, laboratory, examination, detection, comparison.

Introduction

It is almost impossible for a person to commit a crime without leaving some kind of evidence of the act. In a great number of cases the evidence that brings a criminal to justice is testimonial in nature. That is, the criminal is identified by the victim or some other eyewitness, the criminal is betrayed by an informer, or the criminal is induced to confess. Since so many routine crimes are quickly solved by such human testimony, many investigators have tended to overrely on it. Indeed, the ability to make sense out of the confused recollections of witnesses and elicit the truth from evasive suspects is one of the most valuable assets an investigator can possess, often, however, testimonial evidence is simply not available. If the victim is dead or if it is a crime against property and there are no witnesses, the only evidence available to the investigator is physical evidence. Also, as our society has become increasingly conscious of the individual rights of suspects, legal constraints on the kinds of testimony that are admissible in court have led investigators to make more and more use of the silent testimony of physical evidence. What do we mean then when we talk about physical evidence? No easy narrow definition is possible because under the proper circumstances almost any object, substance, trace, or impression could constitute physical evidence. It is a matter of things rather than people or words. Anything that proves that a crime has taken place or that serves to identify criminals, trace them, or associate them with their crimes is a form of physical evidence. Evidence which proves that a crime has occurred is *corpus delicti* evidence. *Corpus delicti* is a Latin phrase meaning "the essential elements of the crime." In a homicide the body of the victim would constitute such evidence; in a burglary it might be a rifled cashbox or blown safe.

A person cannot commit a crime without performing some kind of activity. Whether such activity is violent or gentle, there is a good chance that criminals will either leave something at the scene or take something away from it that can help connect them to the crime. Perhaps the best known example of physical evidence is fingerprints, which a person can leave simply by touching something. Tool marks, shoe prints, tire marks, and other impressions found at a crime scene can implicate a suspect if the object that made the impression is found in his or her possession. Similarly, a firearm found in the possession of a suspect can associate the suspect with a murder if the markings on test bullets fired from the firearm match the markings on the bullets taken from the victim's body. Many materials of which the criminal is completely unaware can be transferred between the criminal and the victim or the scene. For example, it is often necessary to break glass to make an illegal entry. If particles of glass are discovered adhering to a suspect's clothing, the glass particles can be compared with the remaining glass of the scene. Chips of paint, splinters of wood, soil, and metallic fragments can be used in the same way. When a person makes physical contact with a victim or an object during the commission of a crime, he or she may pick up hairs, fibers, or traces of blood or other body fluids and take them away from the crime scene. Conversely, criminals may leave similar traces from their own persons at the scene.

The items mentioned above are some typical examples of physical evidence that an investigator may encounter. They can be examined with regard to both their *class* characteristics and their *individual* characteristics. The class characteristics serve to categorize the evidence itself. A tire impression may be identified as having been made by a certain make and model of tire on the basis of the tread pattern. A murder weapon may be identified as a caliber.38 special on the basis of the diamoter and weight of the bullet. Neither of these identifies a specific tire or weapon, but it does narrow them down to a limited class within the overall categories of tires and firearms. Individual characteristics are these that identify a specific item or person. Through wear, a tire will develop nicks and irregularities in the tread that will differentiate it from all other tires, and each gun barrel will impart its own unique pattern of striations to the bullets it fires. Although the class characteristics are useful, the greatest value of physical evidence lies in its ability to individualize. The more individual characteristics an item has, the smaller the probability is that it can occur twice in the same form. For example, a bit of white cotton fiber found under a victim's fingernail would be of relatively little value because cotton is present in so many fabrics, whereas a clear fingerprint found on a murder weapon can be of great value because it is unique. The ideal bit of evidence would be one that identifies a specific person as the guilty party. Unfortunately, the ideal case seldom occurs. Even the fingerprint on the murder weapon only proves that a certain individual handled the weapon, not that the individual committed the murder[1].

Types of Physical Evidence

The following types of physical evidence may be found in diverse types of crimes:

Blood, semen and other physiological fluids: All suspected blood, semen, and other physiological fluids, whether liquid or dried, animal or human may be present to suggest a relation to the offence or person involved in a crime.

Fingerprints: All scene of crime chance prints may help to identify the criminal. Fingerprints may also help to identify victims.

Footprints: May establish presence of suspect at the scene of the crime. It may give information on the number of suspects and their identification.

Teeth marks: Teeth marks on the. Fruits or other food or bite marks on the victims may lead to identification criminal.

Impressions: Tyre marks or track marks may make it possible to identify the vehicle suspects in an offence.

Documents: Any handwritten or typewritten document submitted to determine authenticity or source. It will include paper, ink, indented writings, obliterations and burned or charred documents.

Drugs: Include any substance in the form of powder, pill, capsule, vial, etc., seized in cases of poisoning or trafficking and/or violation of laws regulating the sale, manufacture, distribution or their use.

Explosives: Any device containing an explosive substance, as well as all objects removed from the scene of an explosion that are suspected to contain the residues of an explosive.

Fibres and fabric: Any natural or synthetic fibre whose transfer may be useful in establishing a relationship between objects and/or persons. If an adequate piece of a fabric is found, it may be shown to have been torn from a particular garment.

Firearms and ammunition: Any firearm, discharged ammunition such as bullets, shells, wads and pellets or even intact ammunition suspected of being involved in a criminal offence may enable the expert to identify the weapon and the ammunition with the offence.

Glass: Any glass particle or fragment that may have been transferred on a person or object involved in a crime and window panes of buildings or vehicles containing holes made by a bullet or other projectile are included in this category.

Hair: Any animal or human hair present that could link a person with a crime.

Viscera: Body organs and fluids submitted for toxicology examination to detect possible presence of drugs and poisons. This category will include blood for the presence of alcohol and other drugs.

Paint: Any paint, liquid or dried, that may have been transferred from the surface of one object to another during the commission of a crime.

Petroleum products: Any petroleum product such as petrol, kerosene, diesei, grease, thinners on clothings of victim, suspect or from a crime scene which can be identified and compared.

Stains and powder residues: Chemical stains or cosmetic stains on the person or clothing of the suspect can be identified. Firearm discharge residues can be examined for determining range of firing.

Soil and minerals: All items containing soil or minerals could be examined to link a person or object to a particular location.

Tool marks: Any object suspected of containing the impression of another object that was used as a tool in a crime.

Wires, cables: Copper wires, traction wires, electric cables found in possession of suspect can be linked to the source.

Serial numbers: Includes all stolen property vehicles, firearms, etc., submitted to the laboratory for the restoration of erased identification numbers or marks.

Wood, pollens and other vegetable matter: Any fragments of wood, saw dust, shavings, or vegetable matter like pollens, seeds, leaf fragments, etc. discovered on clothing, shoes, tools or vehicles that could link a person or object to a crime scene[2].

Searching for Physical Evidence

The search for physical evidence at a crime scene must be thorough and systematic- Where to search and what to search for will be determined by the particular circumstances of the crime for a factual, unbiased reconstruction of the crime, the investigator, through his graining and experience, must not overlook any pertinent evidence. Even in those cases in which suspects are immediately seized and the motives and circumstances of the crime are readily apparent, it is imperative that a thorough search for physical evidence be conducted at once. Failure in this, even though it may seem at the time to be unnecessary, can lead to accusations of negligence, or charges that the investigative agency knowingly "covered up" evidence that would be detrimental to its case. Assigning those responsible for searching a crime scene is a function of the investigator in charge. Except in major crimes, or where the evidence is very complex, it is usually not necessary to have the assistance of a forensic scientist at the crime scene; his or her role appropriately begins with the submission of evidence to the crime laboratory. As has already been observed, some police agencies do have trained field evidence technicians to conduct the search for physical evidence at the crime scene. They have the equipment and skill to the photograph the scene and examine it for the presence of fingerprints, footprints, tool marks, or any other type of evidence that may be relevant to the crime.

The actual technique of a search depends to a large degree on the size of the crime scene and the circumstances of the crime. Before starting a search, the crime scene investigator surveys the scene, nothing its dimensions and all probable areas of entry and exit that perpetrator(s) may have used. Then all major evidence items are photographed, sketched to show relationship to the crime scene, and recorded in notes kept by the investigator, before being appropriately packaged for laboratory examination. In the case of a homicide, all obvious evidential material on or near the body is processed before the body is removed for medical examination. After processing the more obvious evidence, the search for and collection of the less obvious trace evidence begins. When and how search for physical evidence often determined by the type of evidence the investigator is seeking. For example, in the case of homicides the search will be centered on the weapon and any type of evidence left as a result of contact between the victim and assailant. For a burglary the point of entry must be established and then examined for possible tool marks. In most crimes a thorough and systematic search for latent fingerprints is required. The investigator may choose to subdivide the scene into segments and search each segment individually. The search may start at a central location and move outward in an ever-widening circle, or it may move from one end of the room or segment to the other, until the entire area has been covered[3].

Vehicle searches must be carefully planned and systematically carried out. The nature of the case determines how detailed the search must be. In hit-and-run cases the outside and undercarriage of the car must be examined with care. Particular attention is paid to I looking for any evidence resulting from a cross-transfer of evidence between the car and the victim—this includes blood, hair, fibers, and fabric impressions. Traces of paint or broken glass may be located on the victim. In cases of homicide, burglaries, kidnapping, etc., all areas of the vehicle, inside and outside, are searched with equal care for physical evidence. Physical evidence can be anything from massive objects to microscopic traces. Often, many of the items described in the previous section are obvious in their presence, while others c: n only be detected through examination in the crime laboratory. For example, minute traces of blood may be discovered in garments only after a thorough search in the laboratory; or the presence of hairs and fibers may be revealed in vacuum sweepings only after close laboratory scrutiny. For this reason, it is important to collect *possible* carriers of trace evidence in addition to more discernible items. Hence, it may be necessary to take custody of all clothing worn by the participants in a crime. Each clothing item should be handled carefully and wrapped separately to avoid loss of trace materials. All of it should be sent to the laboratory for examination. In the case of a deceased victim, arrangements must be made with the medical examiner or coroner to obtain such things as clothing, fingernail scrapings, and blood, head, and pubic hairs if the nature of the case warrants it. Additionally, critical areas of the crime scene should be vacuumed and the sweepings submitted to the laboratory for analysis. The -sweepings from different areas must be collected and packaged separately A portable vacuum cleaner equipped with a special filter attachment is suitable for this purpose.

In recent years many police departments have gone to the expense of purchasing and equipping "mobile crime laboratories" for their evidence technicians. However, the term "mobile crime laboratory" is a misnomer. These vehicles carry the necessary supplies to protect the crime scene, collect and package physical evidence, and perform latent print development. They are not de-signed to carry out the functions of a chemical laboratory. "Crime-scene search vehicle would be a more appropriate, but perhaps less dramatic name for such a vehicle[4].

Collection and Preservation of Physical Evidence

The major theme of this text concerns the proper handling of physical evidence. Two of the main areas that must be considered in any discussion of the proper techniques of collection and preservation of physical evidence are the legal and scientific issues concerning collection and preservation of physical evidence. Although laws regarding physical evidence vary from state to state, they have many similarities. Before any evidence is seized, the need for a search warrant or court order should be considered. Case law is constantly changing, so investigators should keep abreast of the latest developments. Depending on circumstances, court orders may be required for searching the crime scene and collecting evidence, such as blood samples, hair specimens, medical tests, and teeth impressions, from a suspect. The prosecutor's office should be consulted if there is any doubt. Failure to secure a search warrant may result in severe legal sanctions by the court. In some cases, the physical evidence seized at a crime scene may be inadmissible in court for lack of a warrant. In fact, a legal doctrine called *fruit of the poison tree* provides that any subsequent information derived from illegally seized physical evidence is inadmissible in court and cannot be used.

Stated simply: if unsure of the situation, consult with the prosecutor's office. Mistakes in this area can be costly and cases have been lost for lack of search warrants or court orders to seize evidence. The concept of a "chain of custody" or "chain of evidence" is important to understand. A court will require proof that evidence collected during an investigation and the evidence ultimately submitted to the court are one and the same. To prove that the integrity of the physical evidence has been maintained, a chain of custody must be demonstrated. Thu *chain* shows who had contact with the evidence, at what time, under what circumstances, and what changes, if any, were made to the evidence. Typically, evidence is put into a container with a label or tagged. Identifying information pertaining to the case is written on the container or tag as well as in reports and logs to establish the chain. Police department policy may dictate which information is required, but usually following types of information are needed to establish the chain of custody: i. Name or initials of the individual collecting the evidence and each person subsequently having custody of it , ii. Dates the item was collected and transferred, iii. Agency, case number, and type of crime, iv. Victim's or suspect's name, v. Brief description of the item.

This information serves to prove the chain of custody to the court and assists in admitting the items into evidence. Storage of physical evidence has legal implications. Evidence must be held in a secured area prior to transportation to court. Evidence reasonably assumed to have been tampered with by unauthorized persons because it was kept in an unsecured area may be inadmissible in court. Evidence should be maintained in a specific secured area, with limited access by authorized persons. Several scientific issues of proper collection and preservation of evidence require discussion. Sufficient material should be collected. Judging the amount of specimen to gather is largely a matter of experience. As a general rule, however, as much material as is reasonably possible to collect should be taken. Generally, it is impractical and sometimes impossible to return to a crime scene at a later time to collect more material if more physical evidence should be needed. As a general rule, more is better than less. Many forensic science laboratory examinations compare a known specimen with a questioned specimen. Known or control exemplars are needed for these comparative laboratory analyses. For example, if a bloodstained shirt is submitted to a crime laboratory, the DNA typing results must be compared with something in order to provide useful information. A known biological sample from the victim and suspect is needed. (Some labs will use a swabbing from a subject's mouth while others may use a blood specimen). Similarly, if an automobile paint specimen is submitted for laboratory analysis, a known sample of paint from the questioned vehicle must be submitted for comparison. Blank samples may be important. Consider an arson investigation. An issue may be raised that heat from a fire may cause wood or carpeting to give off products that might be confused with combustible material. Unburned samples of wood or carpet can be collected for testing to clarify this contention. Blank samples are used to verify that the uncontaminated samples do not interfere with the analysis. Physical evidence should be handled as little as possible. Too much handling may obliterate fingerprints, dislodge minute trace evidence such as hair, fibers, and debris, break apart brittle evidence, or contaminate evidence. Forceps, latex gloves, and special containers may be necessary for handling physical evidence.

Crime scene investigators should have an assortment of envelopes, containers, and packaging on hand to properly collect and preserve physical evidence. Plastic bags are generally avoided. This is particularly true when preserving biological evidence such as bloodstained articles because plastic bags accelerate deterioration. However, if it is necessary to transport blood-soaked articles that cannot be air-dried at the crime scene directly to the laboratory for processing, plastic containers may be used in limited circumstances and for short periods. Airtight containers are desirable for volatile materials such as gasoline. Clean glass jars with lined screw-cap lids or clean metal paint cans with wide-mouth openings make excellent containers for arson evidence. Burned debris that is to be checked for combustible materials should never be packaged in plastic bags or plastic jars because volatile evidence will pass through most plastics. It is good practice to double-wrap very small items such as hair, fibers, or glass fragments. These items should first be folded up in a sheet of paper and then placed in an envelope. Careful packaging of minute items of evidence will ensure that they are not lost. Contamination is a concern for proper preservation of evidence. Items of evidence should be packaged separately in individual containers. Each piece of evidence should be completely segregated from other evidence[5].

The main objectives of this article are: i. To understand the importance of physical evidences, ii. To know the types of physical evidences, iii. To know the searching method for physical evidences, iv. To understand the collection and preservation method of physical evidences, v. To know the laboratory procedure in examination of physical evidences, vi. To know the comparison method of physical clues, vii. To understand the detection of crime through physical evidence

The Crime Laboratory

As an introduction to forensic science, one should be knowledgeable of the interactions, concepts, functions, and limitations that generally exist within a crime laboratory. A crime laboratory can be conveniently divided into seven functional areas.

The Crime Scene Field Team is the mobile laboratory unit that reports to the scene of a serious crime to search and to find latent fingerprints, tool marks, spent bullets, guns, broken glass particles, paint specimens, footprints, body fluids, pertinent clothing, paper, hair and fibers, and any other items thought to have evidential value to the investigation. This mobile unit is structured to have quick response time and is staffed by laboratory generalists who recognize, correlate, and take possession of all types of evidence. These articles are then taken to the laboratory (all evidence handling guides being observed) and distributed to the appropriate, more specialized individuals in other sections of the laboratory. In performing their assigned functions, photography assumes a major role in recording and documenting the actual crime scene and its artifacts. A high degree of curiosity and keen observation are necessary personal qualities for these individuals.

The Firearms and Toolmarks Section examines articles of evidence to determine whether in fact a specific bullet or firearm can be related to a particular crime. The restoration of serial numbers, from all types of metal objects, are attempted in this section. In addition, tool-mark examinations are made in an effort to determine if a relationship exists between a particular tool (screwdriver, pry bar, pliers, pipe cutters, etc.) and the crime scene location at which the toolmark was found. The compound comparison microscope is a most valuable instrument in this type of examination and microphotography is used to document, if necessary, the observations of the expert.

The Wet Chemistry Section involves the extensive use of chemicals, analytical instruments, and microscopes to determine qualitatively and quantitatively the identity of all dangerous drugs. Such techniques as color and crystal tests, thin layer chromatography, gas chromatography, infrared and ultraviolet spectrometry, and mass spectrometry are major techniques used by these experts.

The Instrumentation Section is made up of specialists who conduct in-depth analysis using X-ray diffraction, infrared and ultraviolet spectrometry, emission spectrophotometer, atomic absorption, and the more general techniques used in the wet chemistry section. Poison cases, accident investigations, explosives, arson cases, lock examinations, gunshot residue cases, and all types of physical comparisons are conducted here. Standard macro- and microphotography, as well as comparison microphotography, are important techniques used by these individuals.

The Serology Section requires special expertise to identify blood, semen, and other body fluids and to compare hair, fibers, and other trace evidence found at any crime scene. The compound microscope is a major instrument used in this area. Perhaps the most tedious of all laboratory examinations are performed by the serology section.

In the Document Section, trained individuals conduct handwriting comparisons to establish a forgery, make ink comparisons and typewriter identifications, and determine the presence of erasure marks or other covert alterations of any document, check, money order, credit card, etc. The processing of burned paper evidence, detection of counterfeit bills, and the processing of all these paper articles for latent fingerprints are done by the experts in this section. Useful techniques in this area are ultraviolet light, infrared luminescence,' low-powered microscopy, and microphotography.

The Polygraph Section completes the laboratory as the unit that utilizes the subjective reactions of a person as registered on the polygraph instrument. (Blood pressure, respiration rate, and perspiration are interpreted by an examiner against a "normal" control previously recorded on the same individual.) This instrument is an excellent investigative aid in interviews and interrogations in attempting to determine whether an individual is being truthful.

As a general rule, a neophyte may begin a career in any section of the laboratory except the Instrumentation Section. Having mastered the first discipline, it is beneficial to the individual as well as to the organization to be "cross trained" in several other appropriate areas. By doing so, the individual can gain great insight into the various disciplines within the laboratory and observe how, in specific cases, many areas can be interdependent. Such experience should stress that, unlike any industrial analysis, the forensic scientist usually handles small samples of evidence that are of very limited quantity, absolutely irreplaceable, usually unknown substances, and often contaminated. Such training should obviously stress that only knowledgeable persons should be allowed to scrutinize evidence in an attempt to determine the guilt or innocence of the accused. Having this in-depth understanding of the various laboratory activities, the employee has gained a great deal professionally, and has increased job security, job satisfaction, and overall worth to the organization. Such a person can be entrusted with greater responsibilities in handling the more complicated cases. Having one well-trained individual perform the complete analysis keeps the "chain of evidence" as strong as possible by being as short as possible. From the ranks of these dedicated people should come the future laboratory supervisors.

The Criminal Justice System

In order to have a complete and balanced view of a crime laboratory, it is necessary to understand how such a unit interacts with other agencies of the criminal justice system. Once a crime has been reported to the local police, members of designated agencies of the criminal justice system respond by going to the crime scene. Each representative is a specialist in his or her own right. Although each agency functions independently, these units are interrelated. Cooperation, coordination, and communication are prime factors in the smooth functioning of the system. Each unit brings many disciplines to bear in the investigation; each unit has an indispensable role to play. In each specialty observations are made, data are gathered, and theories are proposed, all directed toward identifying the innocent and the guilty. As the sequence of events changes, as the case moves from the investigatory stage to the accusatory stage, each special unit has its input to the prosecutor. From the facts presented, the prosecutor develops the entire legal approach for criminal prosecution. Through established procedures, the rights of the accused and the needs of society are acknowledged in a court of law. The accumulated facts concerning the reported crime are presented to the court in an orderly manner. This presentation is the culmination of the efforts of everyone. The guilt or innocence of the accused now rests in the hands of the jury. The needs of society have been met[6].

Comparison

A comparative analysis subjects a suspect and a control specimen o the same tests and examinations for the ultimate purpose of determining whether or not they have a common origin. For example, the forensic scientist may assist in placing a suspect at a particular location by noting the similarities of a hair found at the crime scene to hairs removed from a suspect's head. Or a paint chip found on a hit-and-run victim's garment may have to be compared with paint removed from a vehicle suspected of being involved in the incident. The forensic comparison is actually a two-step procedure: first, a combination of select properties are chosen from the suspect and the control specimen for comparison. The question of which and how many properties are to be selected will obviously depend on the type of materials being examined. (This is a subject that will receive a good deal of discussion in forthcoming chapters). The overriding consideration must be the ultimate evidential value of the conclusion. This brings us to the second objective: once the examination has been completed, the forensic scientist must be prepared to render a conclusion with respect to the origin of the specimen. Do they or do they not come from the same source? Certainly if one or more of the properties selected for comparison do not agree, the analyst will not hesitate in concluding that the specimens are not the same, and hence could not originate from the same source. Suppose, on the other hand, that all the properties do compare and the specimens, as far as the examiner can determine, are indistinguishable. Does it logically follow that they come from the same source? Not necessarily so':

In order to comprehend the evidential value of a comparison, one must "appreciate the role that probability has in ascertaining the origin of two or more specimens. Simply defined, probability is the frequency of occurrence of an event. If a coin is flipped one hundred times, in' theory we can expect heads to come up fifty times. Hence, the probability of the event (heads) occurring is fifty in a hundred. In other words, probability defines the odds at which a certain event will occur.

Individual and Class Characteristics: Evidence that can be associated with a common source with an extremely high degree of probability is said to possess individual characteristics. Examples of this are the matching ridge characteristics of two fingerprints, the comparison of random striation markings on bullets or toolmarks, the comparison of irregular and random wear patterns in tire or footwear impressions, the comparison of handwriting characteristics, or the fitting together of the irregular edges of broken objects in the manner of a jigsaw puzzle In all of these cases it is not possible to state with mathematical exactness the probability that the specimens are of common origin; it can only be concluded that this probability is so high as to defy mathematical calculations or human comprehension. Furthermore, the conclusion of common origin must be substantiated by the practical experience of the examiner. For example, the French scientist Victor Balthazar has mathematically determined that the probability of two individuals having the same fingerprints is one out of $1 \text{ X } 10^{60}$, or 1 followed by 60 zeros. This number is so small as to exclude the possibility of any two individuals having the same fingerprints. This contention is also supported by the experience of fingerprint examiners who, after classifying millions of prints over the past seventy years, have f never found any two to be exactly alike[7].

One of the disappointments awaiting the investigator unfamiliar with the limitations of forensic science is the frequent inability of the laboratory to relate physical evidence to a common origin with a high degree of probability. Such evidence possesses class characteristics, because it can only be associated with a group and never with a single source. Here again probability is a determining factor. For example, if we were to compare two one-layer automobile paint chips of a similar color, the chances of their having originated from the same car is not nearly as great as when we compare two paint chips each having *seven* similar layers of paint, not all of which were part of the car's original color. The former will have class characteristics and could only be associated at best to one car model (which may number in the thousands), while the latter may be judged to have individual characteristics and to have a high probability of originating from one specific car. Blood offers another good example of evidence that has class characteristics. For example, two blood specimens are compared; both are found to be of human origin, and both are typed as O. The frequency of occurrence in the population of type O blood is 43 percent—hardly offering a basis for establishing the common origin of the stains. However, if other blood factors are also determined in each stain and are found to compare, the probability that the two stains originated from a common source increases. The following types may be used as an illustration:

Type	Frequency
O	43%
D	85%
PGM 2	5.5%
AK 2-1	9%
N	22%
EAPA	13%

The product of all the frequencies shown above will determine the probability that any one individual will possess such a combination of blood types. In this instance, 0.005 percent or 5 in 100,000 would be expected to have this particular combination of blood types. Although the forensic scientist has still not individualized the bloodstains to one person, data has been provided that will permit the investigator and the court to better assess the evidential value of the two stains.

One of the present weaknesses of forensic science is the inability of the examiner to assign exact or even approximate probability values to the comparison of most class evidence. For example, what is the probability that a red nylon fiber originated from a particular sweater, or that a glass chip came from a particular window broken during the commission of a burglary, or that a red paint chip came from a suspect car involved in a hit-and-run accident? There is very little statistical data available from which to derive this information, and in a society that is increasingly dependent on mass-produced products the gathering of such data is becoming an increasingly elusive goal. One of the primary endeavors of forensic scientists must be to create and update statistical data bases for class evidence. Of course when such information that the population frequency of blood types-is available, it is utilized; but for the most part the forensic scientist must rely on personal experience when he is called upon to interpret the significance of class evidence. Nevertheless, its value must not be underestimated. In an era in which criminal investigators have come to rely less on suspect interrogation and more on physical evidence, scientifically evaluated evidence can provide corroboration of events that is as nearly as possible free of human error and bias.

Physical evidence may also serve to exclude or exonerate a person from suspicion. For instance, if type A blood is linked to the suspect, all individuals that have types B, AB, and O blood can be eliminated from consideration. Because it is not possible to assess at the crime scene what value, if any, the scientist will find the evidence collected, or what significance such findings will ultimately have to a jury, it is imperative that the thorough collection and scientific evaluation of physical evidence become a routine part of all criminal investigations. Just when physical evidence crosses the line that distinguishes class from individual is a most difficult question to answer and is often the source of heated debate and honest disagreement among forensic scientists. How many striations are necessary to individualize a mark to a single tool and no other? How many color layers will individualize a paint chip to a single car? How many ridge characteristics individualize a fingerprint, and how many handwriting characteristics will tie a person to a signature? These are all questions that defy simple solutions. It is the task of the forensic scientist to find as many characteristics as possible to distinguish one substance from another. The significance that is attached to the findings is a matter that is decided by the quality of the evidence, case history, and the examiner's experience. Ultimately, the conclusion can range from mere speculation to near certainty.

There are practical limits to the properties and characteristics the forensic scientist can select for comparison. Carried to the extreme, no two things in this world are alike in every detail. Modern analytical techniques have become so sophisticated and sensitive that the criminalist must be careful to define the limits of natural variation *that* exist among materials when interpreting the data gathered formula comparative analysis. For example that two properties, density and refractive index, are best suited for comparing glass. Yet the latest techniques that have been developed to measure these properties are so sensitive that they can detect small variations over a single pane of window glass. Certainly, this: goes beyond the desires of the criminalist who is just trying to determine whether two glass particles originated from the same window. Similarly, if the surface of a paint chip is magnified 1600 times with a powerful scanning electron microscope, it is apparent that the fine details that are revealed could not be duplicated in any other paint chip. Under these circumstances no two paint chips could ever compare in the true sense of the word. Therefore, practicality dictates that such examinations be conducted at a less revealing, but more meaningful, magnification.

Distinguishing evidential variations from natural variations is not always an easy task. Learning how to properly use the microscope and all the other modern instruments in a crime laboratory is one thing; gaining the proficiency needed to interpret the observations and data is another. As new crime laboratories are created and others expand to meet the requirements of the law enforcement community, many individuals are starting new careers in forensic science. They must be cautioned that merely reading relevant textbooks and journals is not and cannot be a substitute for experience in this most practical of sciences[8].

Conclusion

Physical-evidence analysis is concerned with identification of traces of evidence, reconstruction of events from the physical-evidence record, and establishing a common origin of samples of evidence. In every forensic science investigation, the aim is to provide useful information that helps to make the facts of the case clear. Physical-evidence analysis and interpretation can provide a number of different types of information. The clue materials or the physical evidences collected from the scenes of crime, like, fingerprints, marks, biological materials for DNA analysis and trace evidences etc. have if not always, a number of times proved infallible evidence in the process of crime investigation and the administration of justice. It is thus apparent that the role of Forensic Science and the scientist at the scene of crime is of utmost importance for criminal investigation as forensic science is a fact finding agency through the aids of science. It is more so, when the horizons have been ever expanding and have been tested with proof in respect of it's all tools and techniques. Examination of scenes of crime *in situ,* by a trained forensic scientist with legal backing and well defined role, is the need of hour in the contemporary society. This will avoid miscarriage of justice and shall help providing speedy justice to the society. The society has tasted the role of forensic sciences at the scene of crime in the past in a positive way and hence demanding the presence of forensic scientist at the scene of crime in so many cases today[9].

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