SUBJECT	FORENSIC SCIENCE
Paper No. and Title	PAPER No. 1: General Forensic Science
Module No. and Title	MODULE No.24: Classification of Physical Evidences
Module Tag	FSC_P1_M24

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1. Learning Outcomes

After studying this module, you shall be able to know about-

- The search methods conducted in crime scene investigations
- Classification of physical evidence

2. Introduction

In scientific investigation, physical evidences play an important role in linking the suspect and victim with each other or with the scene of crime. Evidences are recognized, collected from a crime scene and sent to the laboratory for scientific analysis according to the requirements of the investigative officer.

The physical evidences play a significant role in the investigation of crime. According to section 157 of Indian Cr. P. C., the crime scene being the richest source of various types of evidences must be searched thoroughly. In this module various aspects of physical evidence have been discussed to classify on the basis of several different perspectives.

3. Methods of Search

The following different methods are available to conduct a thorough and methodical search to recognize, mark and collect the relevant physical evidences at the crime scene. However, the experienced investigator has to select either of the following appropriate methods individually or some time in combination.

The method can be selected depending upon the conditions existing in terms of size of the crime scene, any obstacle, scope of search and the number of people involved to conduct the search:

- Strip Method
- Grid Method
- Spiral Method
- Quadrant Method

After recovery of physical evidences either from the crime scene or victim or suspect needs to be analyzed scientifically in the lab to establish a common origin of samples.

A large part of the work in a scientific examination consists of making comparisons between *questioned* and *known* samples. In other cases, where matching is achieved after comparison, the conclusions depend on the type of evidence involved. Fingerprints are uniquely individualizing only if sufficient details are available. Normally evidences like bullets and cartridge cases can be connected to a particular firearm, if recovered from the scene of crime. *Physical matches* also establish a common origin with various types of evidences. *Tracks and imprints* can often be attributed to the objects which made them.

The distribution of various parameters of blood, hair and other materials in the given population also made it possible to have even more potential to individualize. These kinds of considerations need to be kept in mind while evaluating *associated physical evidence* comparisons.

Forensic science has proved to be a powerful and effective tool in the investigation and prosecution of criminal cases, if utilized properly at the crime scene. Therefore, in the present module emphasis has been laid on different kinds of physical-evidence and different schemes have been discussed to classify them.

4. Classification of Physical Evidence

To make optimum use of physical evidences, Forensic scientists have tried to classify evidences in different ways on the basis of several different perspectives. Some of the classification systems are more useful than others. But none of the systems, however, can incorporate all the perspectives into account individually.

At first instance, one might wonder why physical evidences are classified; the following points will provide the answer:

- The class or type of evidence can be very important in determining its value
- How has it to be collected?
- What else needs to be collected along with the samples such as controls and exemplars?
- And the most important is what sort of scientific tests should be conducted to draw varied conclusions from them?

Legal distinctions among different types of evidence help to determine their admissibility in the court of law. These schemes apply to all evidence, not only scientific or technical evidences.

The following schemes to classify the physical evidences have been proposed by the scientists, which are comparatively more realistic than others:

- ✓ *General nature of the evidence*
- ✓ *Type of material*
- ✓ *The physical state of the evidence*
- ✓ *The type of crime*
- ✓ *Types of questions to be resolved*
- ✓ *According to the way the evidence was produced, and*
- ✓ *According to the appropriate laboratory approach*

Every scheme is useful in offering a different conceptual perspective related to physical evidence, but some of them are more useful than others.

4.1 General Nature of the Evidence:

According to the general nature of items, the physical evidence can be classified as physical, chemical, or biological (the biological can be related to human, animal or vegetable). In this scheme, the examples of physical would be a paint, plastic, glass, firearm, cartridge case, tool, tool mark, whereas a drug sample would be *chemical. E*xamples of *Biological* would include hair, pollen grains, and bloodstains DNA etc. Besides having limited value, this scheme might serve to remind the investigator the type of precaution required to collect and preserve the items of the biological category, which are perishable.

4.2 Type of Material:

This classification system of evidence is based on the type of material of which it is composed of *such as paint evidence, blood evidence, wood evidence, metallic evidence, glass evidence, plastic evidence, and paper evidence* etc. This scheme is of limited utility because a fingerprint found on glass, e.g. is handled and examined essentially in the same manner as finger print found on any other nonporous surfaces like paint, polished metal, plastic or a glossy photograph. Similarly, in case of a tool marks found on metal has to be examined and compared more or less in the same way as one found on some other type of materials? In these types of cases, the nature of the material itself is not very significant but the way in which something has interacted with the substrate material and produced the evidence.

But there are some exceptions which are also worth mentioning. If the nature of the material undergoes alteration with the passage of time, proper precautions should be taken to preserve it, or at least to document. Examples includes a bite marks on skin or perishable food, footprint in snow, tool marks or any other evidence that might evaporate, such as petrol.

Individualization of materials can be attained on the basis of subtle differences present in their composition wherever required, almost similar laboratory methods are used for materials that have been grouped together in this classification scheme. Microscopic fragments of glass, for example, would be compared using the same techniques, regardless of the kind of object involved (bottle, window, headlight lamp).

This scheme of classification is generally not much useful except for the above mentioned type of examples.

4.3 The Physical State of the Evidence:

Evidences, like other matter, can be categorized on the basis of its physical state like *solid, liquid, or gas*. Example of *solid state* category includes most types of evidence encountered cartridge case, firearms, glass, tools, clothing, and paper etc. Fewer items of evidence would be placed in the *liquid* or *gas* categories. Important examples of liquid evidences include liquid blood samples (either evidence samples or known controls), alcohol and accelerants collected in connection with the investigation of suspected arson case. Gas samples may occur as evidence more often than one might think, but they are rarely recognized as such and even more rarely collected. Specific types of devices can be used to collect sample of gases and vapors at crime and fire scenes.

This classification scheme is not useful in any general way. However, it can serve important role to remind investigators about the requirements to have secure packaging for liquid and gas samples so that they do not get leaked or evaporate from their containers. This simple precaution is often over looked in cases from where volatile residues collected from fire scenes. Accelerant samples are analyzed in the laboratory where the chances of getting useful results from an analysis of such samples are remote, if not collected and packed properly.

4.4 Type of Crime:

Another system to classify the physical evidence is based on the type of crime from which it has been collected. Thus, for example, the evidences may be related to assaults, rape, homicide, burglary cases, and so on. This scheme might have value in certain situations, but it should be appreciated that any particular type of physical evidence can be found in connection with the investigation of virtually *any* kind of crime. Different physical evidence types cannot be restricted to legally defined crime classifications. For example, the blood/blood stain evidence very frequently found in the investigations of assault and homicide, but bloodstains can also be recovered as important evidence at crime scenes related to burglary and other property crimes also. Similarly, tool mark evidence can be recovered from almost all types of serious crimes like homicide; assaults and burglary. Therefore, there is some correlation existing between the type of crime and the type of evidence, but it is not as perfect as it should be.

Unexpected and unpredictable types of physical evidence could be the most crucial in a particular investigation, and could be overlooked by an investigator with preconceived notions about what to expect and what is likely to be significant.

4.5 By the Types of Question to be Resolved:

In this classification system, evidences are classified according to whether it will be useful in the reconstruction of the event, by proving an element of the crime, in linking a suspect to a victim or to a crime scene, in excluding or exonerating a suspect, or in corroborating or disproving an alibi. Similarly, evidence can be grouped according to whether its analysis will be used to provide investigative assistance and leads or as proof for eventual use in a court of law. These are very useful during the collection of evidence at the scene of crime.

4.6 Classification According to the Way Evidence Was Produced:

In this system of classification, the evidences are classified according to how it relates to the act under investigation. An important thought here is the way the individuals involved in the crime have interacted with the environment and with each other, and the type of evidences produced during these interactions.

Physical evidences can be looked at as a type of surfaces (substrate or recording medium) on which they are present. Accordingly, laboratory examination and interpretation of evidence allows the forensic scientist to offer an opinion as to what has taken place and how? Thus, in other words, the physical evidences are unintentional and somewhat imperfect record of the interactions of the perpetrator and victim, and with the environment. Considering physical evidences in this way can be very useful and can yield large dividends in any investigation.

Within these general schemes, various subclasses of evidences can be distinguished and their applications can be used in crime investigation.

Location/Geometric:

The apparent movement or disturbance of various objects is observed, documented and interpreted to reconstruct an event.

Imprints and Indentations:

Evidence in these categories includes tool marks in the form of indentations formed by tools, primer marks, breech face marks, pry marks; imprints like track marks formed by tire, gait pattern, fingerprints, footprints and bite marks. Class and individual characteristics of the suspected devices making the imprint or indentation are compared with the details of the specimen marks produced in the selected recording medium as specimens. This particular type of comparison is usually accomplished by first producing a specimen/*exemplar* mark in a suitable material at Forensic Science Laboratory and are then compared inter-se with evidence mark.

Striations:

Striations, another type of tool mark are produced when two surfaces come into sliding contact with each other. The marks resulted from a dynamic process are striations, in contrast to the static process, which results in the production of imprints and indentations.

Striations are marks consisting of numerous lands separated by grooves, randomly spaced, parallel streaks of varying length and width, Examples of striation mark evidence are produced as markings on bullets, marks made by certain cutting tools (machine tools, wire cutters, thread cutters, bolt cutters, knives, and axes), die marks on wires from the drawing operation, and extrusion marks on certain plastic and metal articles.

Striation marks can be produced in many varied situation where the surface of one object marks the surface of another because one of them is in motion relative to the other one. Certain kinds of marks made by prying tools, such as jimmies and screwdrivers, where the tool slips across the surface, fall in this category. Similarly some teeth marks/ bite marks, like those made in biting off a piece of cheese or fruit, for example. Striation markings possess both class and individual characteristics which can be useful in the process of identification and individualization.

Perforation Marks, Tears, Breaks, and Cuts:

This includes another sub-category of the evidence which is often of the greatest interest for potential individualization. Where, one or more pieces or fragments of an article are compared with other articles from which they are thought to have originated. If a sufficient number of individual characteristics are present then it become possible to conclude that the items share a common origin and were part of the same piece. A glass fragment could be the best example to associate it with the particular window from which it was broken by fitting it into the area from which it originated. Physical fits of this kind can be simple but achieved mostly with larger pieces, at times become possible with smaller fragments too. Such physical matches or jigsaw fits are applicable to a wide variety of other materials, including wood, cloth, metal, plastics, paper, and cordage etc. Sometimes, evidence such as paint chips can also fit into this category. If the chips recovered are big enough, it may be possible to fit them into position on the object from which it originated.

Perforation marks:

Another example of Physical fits can be the perforation marks punched in a receipt book to separate the counterfoil.

Breaks and tears normally provide the largest number of details for potential individualization, but success is sometimes possible in cases of cut pieces as well. In some of these cases, the individualization potential depends less on the nature of the cut, broken, or torn surface than on various features on, or within, the body of the article. Examples of such features include writing, printing, designs, surface topography, grain structure, pigmentation patterns, and characteristic irregularities.

Mutual Transfers of Matter:

In an accident case transfer of paint in the form of smear or chip evidence is result of contact between two surfaces and involves the mutual transfer of matter across the contact surface. Other evidences that can be included in this category are dusts particles, clothing fibers, vegetation, hairs, soil, pollens and small glass particles.

According to Locard's principle mutual transfer of matter always occurs when two surfaces come into contact, but the amount of material transferred in some circumstances may be in traces and is practically not significant. But in other cases, the transfer may appear to be one-way rather than mutual, or no transfer in either direction may be apparent.

Deposits and Residues:

In this category the matter is transferred without any contact between the surfaces from where that matter originated and the surface on which it is transferred. GSR gunshot residues, explosive residues, fallen hairs, blood, glass fragments, oil drippings, and airborne particles are examples of this category. Such evidence may possess both class and individual characteristics and play important role in reconstructions of an event.

4.7 Classification According to the Appropriate Laboratory Approach:

All the sample which are referred to the laboratory must accompanied by the list of query related to the examination in the lab. In this scheme, the evidence can be categorized on the basis of the type of the following examination required:

- Identification
- Individualization
- Reconstruction

The evidence is examined which is relevant to the investigation.

Identification

This process is dependent on the class characteristics of the physical evidences. In some cases, only identification of a certain physical-evidence item is required. But individualizations and reconstructions may become necessary in other cases to prove the charge of possession of a prohibited substance. The laboratory tests are used to establish an element of the crime. A similar situation confronted in some of the rape investigations, where the element of *penetration* has to be established by demonstrating the presence of seminal fluid in the vagina of the victim. In other rape investigations, other types of evidence like hairs, soil and fibers may be found, and more analyses may be required to tests the body-fluid evidence. These represent the class characteristics. Criteria for the identification of physical evidence include morphological, physical, and chemical properties, some of which are given in Table-1. However, combinations of some of these properties can provide useful information in achieving individualization also.

Individualization

After Identification of the material with class characteristics, Individualization is attempted based on the individual characteristics of the physical evidence like fingerprints, broken glass, tool marks, paint chip and markings on bullets etc. The direct physical comparisons and physical matches (jigsaw fits) techniques can also yield persuasive individualizations under favorable circumstances. In addition, other comparative techniques may be applied in evaluating the likelihood of common origin.

Table-1 Showing Various Properties of the Physical Evidences

Chemical Properties	Physical Features and Patterns Markings	Physical Properties Non-Optical	Physical Properties Optical
• Chemical composition • pH • Reactivity toward known chemical reagents • Solubility	• Markings on evidences like bullet • *Morphology* • *Size* • *Texture*	• Density • Hardness • Melting Point • Boiling Point • Surface Tension • Viscosity • Radioactivity	• Refractive index • Dispersion • Birefringence

Reconstruction is a final step of any criminal investigation. It refers to the process of putting together the "pieces" of a case or situation with the objective to reach an understanding of a sequence of past events. It can be achieved on the basis of physical evidence that has resulted from the events. Reconstructions are regularly desired in criminal cases where bloodstains or blood spattering patterns, gunshot residue patterns, shotgun pellet patterns, and relatively large fragments of broken glass are involved. Other evidence can also play major role in reconstruction. A bullet hole through a material would probably provide adequate information about the bullet's trajectory.

Similarly, relationships among several other items of physical evidence can play useful role in reconstruction.

4.8 Workable Classifications:

It is evident from the undergoing discussion that all the classification schemes suggest that the understanding of physical evidences and their utilization is the most important. This classification schemes are probably the most useful and practical for those evidences that does not fit neatly into anyone of the above mentioned schemes under every circumstance may be because of their nature.

5. Summary

1) Different methods are available to conduct a thorough and methodical search to recognize, mark and collect the relevant physical evidences at the crime scene.

2) Forensic science has proved to be a powerful and effective tool in the investigation and prosecution of criminal cases, if utilized properly at the crime scene.

3) According to the general nature of items, the physical evidence can be classified as physical, chemical, or biological.

4) Evidence in these categories includes tool marks in the form of indentations formed by tools, primer marks, breech face marks, pry marks; imprints like track marks formed by tire, gait pattern, fingerprints, footprints and bite marks.

5) Individualization is attempted based on the individual characteristics of the physical evidence like fingerprints, broken glass, tool marks, paint chip and markings on bullets etc.