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Zbigniew Dąbrowski, Marek Błędowski, Magdalena Zubańska
Sławomir Zubański and Radosław Nawotka

3. SELECTED ISSUES IN FORENSIC TECHNIQUES

Forensic science falls within juridical science. It is an applied, practical science, which adapts developments of different branches of science, technology, art and even crafts to the requirements of the actual investigative practice, which is why it has the status of an interdisciplinary science. It concerns the tactics and technology of committing crimes, the tactics and technology of investigating crimes, and the tactics and technology of preventing crimes. Forensic tactics and technology are the two basic branches of this science. Forensic technology involves the examination of the technical means used for committing crimes and the development of means used by law enforcement bodies and the system of justice when investigating crimes as well as useful means for preventing crimes. The necessity to constantly improve the equipment and means of forensic technology and examination methods results not only from the development of crime but also from the technological developments taking place in our time. This branch of forensic science is aimed at obtaining, securing and using material sources of information, i.e. material evidence. It is useful whenever one deals with identification of a person or an object based on their traces.

From the point of view of the forensic technology, the key term is forensic evidence. It is the point of departure for any procedural and forensic activity. There is no doubt that each crime leaves forensic evidence. In a forensic sense, evidence includes all and any changes in the objective reality which – as discernible signs of events under investigation – form the basis for the recreation of the course of these events as they really happened. This definition of forensic evidence provided by Jan Sehn is most frequently used in forensic science.

One of the criteria for classifying forensic evidence is the evidence type. Classification based on type includes such evidence as: biological, mechanoscopic, trace, dactyloscopic, vermilion border, auricle, weapon use, and evidence subject to physiochemical examination.

3.1. Biological Evidences

Forensic genetics is a subspecialty of forensic biology, just like forensic medicine, forensic entomology, and bloodstain pattern analysis. Biological evidence is any trace coming from/related to a living organism that might be connected with the investigated incident.

Biological evidence may be:

A. Animal evidence: animal DNA (bloodstains, hair, tissues) making it possible to identify the genus, the species or the specimen (depending on the species);

B. Botanical evidence: fragments of conifer needles, plant tissues, remains of trunks etc.; allowing to identify the genus, the species or the specimen (depending on the species);

C. Human evidence:

– Bloodstains at the scene (bloodstain pattern analysis);

– Insect larvae (forensic entomology);

– Body, body fragments, injuries/analysis results being effects of a medical examination (forensic medicine);

– Genetic evidence (DNA), which might be:

- Bodily fluids: blood, saliva, semen (there are initial tests allowing to confirm the presence of these substances in the evidence investigated);
- Discharges and excretions of the human body, i.e. sweat, urine, faeces, tears;
- Hair – discovered at the site as "fibres that look like human hairs" – only human hair with hair root sheath (bulb) preserved is the source of DNA with high discrimination power for the examination of the so-called nuclear DNA;
- The so-called contact evidence or the so-called potential biological material – DNA traces, where the sources of DNA are cells of peeled epithelium on surfaces that could have had contact with the skin of the perpetrator/victim.

3.1.1. Methods of Securing DNA Evidence

– Evidence for DNA testing:

DNA traces might have the form of substances of a specific colour and state of aggregation (e.g. a brown substance that might be human blood) or of the so-called potential biological material (surfaces where one expects to find cells of peeled human epithelium, however, without complete tests one is unable to say whether they are present). When securing evidence, the operator should be wearing the basic personal protective equipment, i.e. a mask, gloves and coveralls, so that they do not transfer their own DNA.

DNA evidence may include:

– **Objects** that can be carriers of biological evidence **as a whole** (within the boundaries of the law and common sense), such as: furniture handles and knobs, bottles, cans, butt ends, cable ends, clothing of the perpetrator or the victim (properly dried), crime weapons etc. Such objects should be secured in air-permeable containers (paper envelopes, paper-foil packaging, wrapping paper, cardboard packaging) and properly immobilised so as not to spoil the evidence that may be subject to comprehensive analyses (e.g. dactyloscopic analysis);

– **Evidence secured together with the base**, e.g.: furniture upholstery, carpet fragments, fragments of furniture veneer etc.; the securing method as above;

– **Swab tests** – performed on handles, surfaces of objects that cannot be secured as a whole, bodies, samples collected during medical examinations (swabs from the reproductive tract, from under the foreskin, from under nails etc.). Swab tests are performed by wiping the examined surface with a sterile swab moistened with sterile distilled water. Thus prepared swabs should be secured in transport containers (protected against foreign biological material, air-permeable), e.g. in paper-foil packaging or paper envelopes.

– Any evidence in the form of fluid or semi-fluid material should be dried completely or stored in cold storage.

B. Reference material for DNA analysis:

– Reference material is biological material as to which one is certain it comes from a specific person/body. Reference material for DNA analysis includes:

– **Cells scraped off the mucous membrane of the inside of the cheek** – the best material (collected in accordance with the law of a given country),

– **Blood:**
- Peripheral blood that might come from the sample tested for alcohol/ other illegal drugs,
- A blood sample taken for the aforementioned purposes or blood secured on a swab/FTA card, taken by a forensic doctor from an open cavity,

– **Hair** – hair pulled out with root sheath (bulb) from the body in case it is impossible to collect reference material in the manner described above,

– **Bones, teeth** – in the case of bodies that are badly decomposed or charred, fragments of prepared bones/teeth might be sources of DNA for a comparative analysis.

3.2. Physicochemical Examination of Forensic Evidence

Forensic physicochemical examination is one of the forensic disciplines that uses the experience of chemistry and partially also physics, and is closely connected with law. The aim of forensic physicochemical examination is to identify unknown substances, to determine the properties of substances, to compare substances, and to identify and determine the properties of traces found in relation to such incidents as explosions, fires, the use of firearms, traffic accidents or illegal production of controlled substances. In the case of the analysis in question, identification and comparative analysis can be distinguished; the difference between them is the type of the issue examined. Forensic identification analysis allows to determine the identity of materials based on their characteristics, i.e. their composition and properties. In the opinion based on such an analysis, the expert witness answers the question "What is it?". On the other hand, comparative analysis is aimed at determining the identity of an object that left the trace by way of comparison. Conclusions from comparative analysis that assesses the degree of similarity between the evidence and the reference material are formulated in terms of probability. Forensic physicochemical examinations only allow for group identification.

The scope of physicochemical identification analysis is broad and it includes:

– Examination of narcotics, psychoactive substances and precursors; the scope of an expert witness's activity in this case involves: qualitative and quantitative analysis, profiling synthetic drugs and their precursors, identifying the methods of production of synthetic drugs and their precursors, and examining contact evidence of narcotics and psychoactive substances;

– Examination of micro-traces, fibres, paints, varnishes, plastic, adhesives, glass, metals and their alloys, and unusual traces;

– Examination of post-fire and flammable substances, irritants, alcohols, and unknown substances;

– Examination of explosive materials and devices and chemically unstable substances;

– Examination of post-explosion remains;

– Examination of contact evidence of explosives;

– Comparative and identification analysis of car paints, and car selection;

– Examination of traces left by a firearm shot;

– Analysis of ethyl alcohol in bodily fluids;

– Qualitative and quantitative analysis of narcotics and psychoactive substances and their metabolites in bodily fluids.

The above examination scope was determined in the Decision No. 16/2014 of the Head of the Central Forensic Laboratory of the Police dated 4 February 2014 on the typical scope of the activity of a forensic expert and specialist.

For the purposes of physicochemical identification, experts use the following methods: chromatography, spectroscopy, electron microscopy, optical microscopy, and combined methods, such as Gas chromatography–mass spectrometry (GC-MS). These methods ensure high sensitivity, which allows to test very small material samples. In the case of some of these methods, the process of preparing the sample for the test is laborious, however, the test itself is fast, results are documented in the form of a graph or digital records, while evaluation and analysis use mathematical and statistical methods. The possibility of physicochemical identification is to a large extent determined by the way the material is secured for examination, which is an absolute principle. Packaging serves a significant function in the technical securing of evidence for physicochemical examination. It should be clean, dry and tight, chemically neutral towards the secured substance, it should be properly mechanically resistant, and its size should be adjusted to the dimensions or volume of the secured evidence. Incorrectly performed collection and securing of the evidence sample, e.g. during inspection, have consequences during laboratory identification analysis.

3.3. Dactyloscopic Evidences (Fingerprints)

Dactyloscopy is considered a classical branch of the forensic technology. Fingerprints, discovered and secured during procedural and forensic activities (such as an inspection of the site) are treated as evidence of unquestionable identification value due to the possibility of directly identifying an individual. The identification value of fingerprints is based on the use of their properties, such as their immutability, indestructibility (permanence), and uniqueness (individual character). It is commonly believed they they form valuable evidence, which is of significance when establishing a link between a given person and a given crime. Thanks to these possibilities of dactyloscopy, law enforcement bodies and the system of justice obtain irrefutable evidence of the individual's presence in a given place, while the discovered and secured fingerprints might be used to identify persons and bodies, register the images of fingerprint reproductions and images of fingerprint copies in AFIS (*Automated Fingerprint Identification System*) as well as draw conclusions and come up with investigative theories.

A significant benefit of dactyloscopic examination is the relatively simple methodology based on comparative analysis which makes use of evidence (usually in the form of the fingerprints discovered at the site or during visualisation examinations in the laboratory) and the reference material (in the form of fingerprints and/or palm prints taken from a specific person).

Fingerprints at the site come in one of the following three forms: **layered fingerprints** (transferred with sweat and sebum, "bloody" fingerprints, and "greasy" fingerprints), **delayered fingerprints** (left on a hard, non-absorbent surface in dust or a different loose substance, such as spilled flour, icing sugar, coal dust etc.), and **hollow fingerprints, the so-called prints** (left in plastic mass, such as Plasticine®, modelling clay, putty, wax etc.).

3.3.1. Methods of Securing Fingerprints

Evidence

The development method selected must be adjusted to the given type of fingerprints. In forensic science, the most commonly used methods are physical (optical and adhesive), chemical, physicochemical, and biological. The application of a proper method and its effectiveness to a large extent depend on the type of the substance creating fingerprints, the type and properties of the base, the development conditions, and the time lapse. The method for developing fingerprints during an inspection of the site commonly used by forensic scientists is the proven method that has been known for years, based on the adhesiveness of the particles of the dactyloscopic powder to sweat and sebum creating the fingerprint. It is worth highlighting that the development and securing of fingerprints must be performed in accordance with certain principles namely the contrast principle and the principle of the order of developing evidence (i.e. biological evidence first, and then dactyloscopic evidence). What matters a lot when selecting proper dactyloscopic powder is the effectiveness of the development of fingerprints on different surfaces, good quality of the fingerprints developed, and the so-called non-smearing of the base. In the forensic practice, depending on the properties of the prints and the base type, the following dactyloscopic powders are used: **light powders** (e.g. argentorat), **heavy powders** (e.g. ferromagnetic powders) and **fluorescent powders**. Fingerprints developed using light and heavy powders are usually secured on dactyloscopic foil, in accordance with the principle of contrast. According to this principle, in the case of a light base dark powders are used (such as iron oxide black powder, black ferromagnetic powder) and thus developed fingerprints are secured on transparent or white dactyloscopic foil. In the case of a dark base, argentorat is usually used (classified as a light powder), while the developed fingerprints are secured on black dactyloscopic foil. When fluorescent powders are used to develop fingerprints, then they are secured using the photographic method. Its point is to photograph fingerprints in conditions corresponding to the process of their development (which is usually UV light). The best effects when it comes to contrast and legibility of fingerprints are achieved when colour photography is used for their documentation.

However, one has to remember that the above method is effective in cases when fingerprints are developed on relatively smooth, level and clean surfaces and when it is necessary to develop "fresh" fingerprints. The specific character of an inspection of the site proves that the actual conditions of developing fingerprints are far from perfect. Surfaces at the site tend to be uneven, porous, colourful and dirty, while the fingerprints are "old" or poorly visible. In such cases, the physical method usually proves to be insufficient.

An inspection of the site allows to uncover objects that might be connected with the incident in question. On the surfaces of these objects, there might be invisible "fresh" and "old" fingerprints, which is why the use of the powder method in order to develop them might destroy or damage the "old" fingerprints. In such a situation, it is justified to secure the whole object, following the applicable procedures of commissioning forensic examination, and to send the evidence to the visualisation laboratory being part of the dactyloscopy laboratory in a forensic laboratory. Under laboratory conditions, an expert in dactyloscopy makes an attempt to develop fingerprints on the surfaces of these objects, using a proper chemical examination method. Selection of this method depends on a number of factors including the surface type (absorbent and non-absorbent bases, thermosensitive paper, adhesive side of adhesive tape) and the type of the fingerprints developed (whether they are bloody fingerprints, layered fingerprints left with sweat and sebum on wet or damp surfaces, or layered fingerprints left with a substance including fats, such as technical maintenance agents, edible fats).

When selecting the method, a significant role is played by the principles the dactyloscopic expert needs to follow when developing fingerprints. Among other things, the point is to apply several complementary development methods and to keep their proper order; to register evidence before the next method is used and, in the case of any doubts about the effectiveness of a given method, to use test evidence; to ensure that the method applied will not hinder or prevent other forensic examinations (this usually concerns DNA testing); and to strictly follow any applicable OHS regulations. When these principles are followed, a properly applied method might not only reveal both "fresh" and "old" fingerprints but also improve the legibility of barely visible or even fragmentary evidence discovered visually during the initial inspection of the object in visible light. Such clear evidence with visible individual characteristics can be used in procedural activities (e.g. comparative and identification analysis as part of the dactyloscopic analysis commissioned by a given body) or extra-procedural activities (e.g. searching the AFIS).

Reference Material

Reference material consists of prints of fingerprints and palm prints that are usually taken using the classical, traditional dactyloscopic method, the so-called ink method. It is based on the use of ceramic ink pads soaked with black dactyloscopic ink. The fact of taking fingerprints is documented using dactyloscopic cards.

The dactyloscopic practice more and more frequently uses the new method of taking fingerprints and palm prints, which is based on an electronic fingerprinting device *LiveScaner*. The device uses an inkless fingerprinting system that allows to quickly create high-quality images of fingerprints. The registration element of the scanner is equipped with a flexible membrane, which makes it easier to copy "difficult" fingerprints, when, for example, one has to fingerprint someone with dry or damaged skin or someone with wet or sweaty hands. In such cases, the traditional "ink" method unfortunately does not produce the expected results.

3.4. Mechanoscopic Evidence

The term "mechanoscopy" is a combination of Greek words *mechane* – tools and *skopeo* – I examine, and it was introduced into the literature by a Czech forensic scientist L. Havlicek in 1939. Traditionally, it is assumed that mechanoscopy is a branch of the forensic science, dealing with examinations aimed at the **identification of tools based on the marks they leave**. According to T. Hanausek, mechanoscopy is a branch of the forensic science covering all methods and means used to identify, secure and examine for identification purposes evidence created as a result of interaction of two or more objects, or the effect one of them had on the other. According to J. Bieniek: "mechanoscopy is a branch of the forensic science, which deals with the examination of evidence created as a result of mechanical interaction between different objects (marks created as a result of the effect of force, after resistance has been overcome) and with the determination of the identity of crime tools based on the marks they left."

Mechanoscopic evidence is trace evidence and it can be found on different bases, such as metal, glass, rubber, wood, plastic, fabric, human and animal bones, food etc. This evidences are divided into evidences in the form of **base deformation**, which are divided into:

– **Static**, created as a consequence of imprinting one object/tool on the material of another (base), without longitudinal translation. These are imprints;

– **Dynamic**, created as a result of depressing one tool into a material and its simultaneous longitudinal translation against the base surface. This group includes: scratches, slips, cuts, processing marks.

Mechanoscopic evidence is usually found on:

1. Objects being security measures the perpetrator had to overcome in order to get inside a room, such as doors, anti-burglary roller shutters, windows, security bars in windows and balconies etc.;
2. Other objects, in places directly acted upon by a force (on vehicles, seals, safes, cabinet safes, trees etc.);
3. The person or the body (e.g. injuries inflicted by a tool);
4. Clothing in the form of wear, tears, cuts, chafes etc.

Procedural Securing of the Above Evidence Includes:

1. Description in the inspection report considering:

– The evidence type and characteristics (marks given by the manufacturer, shape, dimensions, individual characteristics resulting from, for example, wear, damage etc.);

– Location;
– The revealing and securing method;
– Description of other forensic activities undertaken in connection with the evidence (e.g. dismantling method, marking of the sides);

2. Photographic documentation of the evidence including photographs of the evidence taken using the scale technique, and of its location – situational photographs. The evidence is photographed with a centimetre or millimetre scale and a number. Lens axis should be perpendicular to the evidence surface;
3. Description and the securing of the packaging into which the evidence has been put;
4. Evidence information sheet attached to the packaging;
5. Marking of the evidence location on the site layout drawing.

Methods of the Technical Securing of Evidence:

1. Securing together with the base (or its part) on which the evidence is located;
2. Modelling, creating a replica (cast) of the evidence using special mass (usually silicone of different colours and densities);
3. Collecting from the base and placing in a proper container;
4. Photographic documentation.

Drawing Conclusions Based on Mechanoscopic Evidence:

1. The evidence allows to recreate the appearance of the tool and to classify it into a specific group;
2. Location and the order of creation of mechanoscopic evidence allow to conclude about the place where the perpetrator entered the site, to retrace their steps, and to determine the place they left the site;
3. The type, methodology and time of use of certain tools allow to select potential perpetrators.

The reference material is usually obtained during searches of rooms, stops and searches of persons, vehicle controls, and inspections of different sites. Working parts of tools need to be particularly protected as they might bear substances from the base upon which the given tool was used.

Sources of reference material can also be forensic collections including broken lock cylinders installed in doors in apartments, counterfeit circulation and collector coins, counterfeit hallmarks etc.

Reference materials can be reference marks made with the tool selected. Reference marks should be made on a base the properties of which are the same as or similar to the properties of the material bearing the evidence marks.

The technique of making the reference marks should be similar to the technique of creating the evidence.

3.4.1. Types of Mechanoscopic Examinations

1. Identification of evidence, which allows to:
   - Determine the properties of the evidence examined;
   - Conclude about the way it was created;
   - Select the tools used;
   - Highlight the usefulness of the evidence for further examinations.
2. Such examinations use forensic templates in the form of, for example, catalogues with data and original products provided to expert witnesses by their manufacturers.
3. Comparison making it possible to determine whether the characteristics of the evidence and reference material are the same or different, which is done by comparing the evidence with the reference material. Such examinations usually make use of a stroboscopic microscope.
4. "Analysis of the whole", making it possible to determine whether the given parts, elements, pieces or fragments used to form one object (a whole) before they were separated.
5. What is examined is the concordance of the parts compared in terms of their shape, thickness, fracture structure, processing method, micro- and macro-roughness of the external surfaces of splits etc.

3.4.2. Scope of Mechanoscopic Examinations

Such examinations include:

1. Object identification based on the analysis of:
   - Marks of mechanical impact of an object on the base;
   - Secured fragments of the objects;
   - Reconstruction.
2. Determination of the cause-and-effect relationship between the object and the incident including the determination whether the damage is the cause or the effect of the incident.

Mechanoscopic Examinations Include:

1. Identification of tools allowing to determine the type of the tool used, its shape, dimensions, and production technology etc. (group identification).
2. Group characteristics include tool characteristics that are created in the course of most manufacturing processes, the so-called manufacturing characteristics. They include casting, embossing, threading, and all kinds of processing, except for grinding and polishing.
3. Trace the mark back to a specific tool (individual identification of the tool).
4. Individual characteristics include characteristics created in the course of some manufacturing processes and all characteristics created during use, such as

damage, and as a result of repair, e.g. sharpening. Manufacturing processes that give tools individual characteristics are grinding and polishing.

5. Determination the mechanism of the creation of the mark (whether it was created as a result of one-time or multiple uses of the tool; determination of the direction, the force and the place where the tool touched the base).

3.5. Tools as Subjects of Forensic Examinations

In the forensic practice, tools are divided into:

1. Cutting tools:
   - One-blade tools, the blade of which can act upon the base with one side;
   - Two-blade tools, the blade of which can act upon the base with both sides;
   - Glass cutters.

2. Cutters used for processing objects by removing a certain layer of material from their surface.

3. Two- and multi-jaw tools, with two fixed or movable jaws for gripping, clenching, crushing and turning objects of different section shapes (e.g. vices, crowbars). Working surfaces of jaws can be smooth, grooved or notched.

4. Seals and sealing pliers which are mechanical security devices the aim of which is not to directly protect the building but to register marks of forced entry by unauthorised persons.

5. Blunt and blunt-edged tools, objects and fixed surfaces.
   - Blunt tools are the ones that leave marks of their surface unlimited by any edge, of cylindrical section, such as reinforcing bars.
   - Blunt-edged tools leave marks of their surface limited by at least one edge, such as crowbars, hammers, planks etc.

6. Mechanical security devices and skeleton keys, divided into:
   - Locks;
   - Blocking mechanisms (cylinders);
   - Padlocks.

7. Examinations of mechanical locking devices (padlocks, locks, blocking mechanisms) and keys, allowing to:
   - Determine the device effectiveness;
   - Determine the method of opening based on the traces left on locking device elements;
   - Identify tools used by perpetrators for forced entry;
   - Determine the originality of keys sent for examination.

8. Examination of broken panes and glass. The extensiveness of breakage is usually influenced by the following correlated factors: type and dimensions

of the tool used, the size, thickness and internal structure of the glass sheet (tempered or non-tempered glass, bulletproof including wired glass etc.), its fixtures, setting in a frame, and the method and force of the strike. When determining the side from which the glass was broken, the following issues are considered:

- Radial fractures extend along relatively straight lines outward from the point at which the glass was struck (the hole). They suggest that the glass was struck with a small pressure force;
- Concentric fractures form circles around the point at which the glass was struck, and cross radial fractures;
- In the case of small holes in glass, one can determine the direction from which the force was applied;
- If the hole has the shape of a truncated cone – the force was applied from the side of its shorter base;
- On the dividing surface of the broken glass (shard fractures) there are multiple short curves, ribbed or arched, in the shape of fan-like "waves";
- These waves always widen from the side of the application of the force.

9. Examination of separated objects in order to see whether before separation they formed a whole, e.g. pieces of glass, wood, parts of tools or different objects, fragments of paint, examination in terms of the whole. Identification in terms of the whole most frequently concerns: chips of toothed blades of hacksaws; fragments of fabrics; glass shards; fragments of paint; splinters of wood. Examinations of wood also cover characteristics of its morphological structure and defects.

10. Examinations of counterfeit coins in order to establish the production technology and to identify the tools used. The main elements protecting coins against counterfeiting:

- Rare material the coins are made of;
- Precise image;
- Proper dimensions with very low tolerance (additional elements of the image on coins frequently include colours);
- Additional security features, e.g. grooves on the edge, inscriptions including convex inscriptions etc.;
- Narrowly defined magnetic properties of coins;
- Company's logo.

11. Identification of punches, seals and sealing pliers, number punches and markers used for the permanent marking of vehicles, machines, technical devices, cut down trees.Seals consist of an element on the surface of which identification marks are pressed using sealing pliers, and wire (sealing wire). On the surfaces of sealing pliers matrices there are identification marks including letters, numbers and graphic designs. Marks indicating seal breakage can be found inside the seal and on its outside surfaces.

12. Examination of identification marks of different objects in order to determine the authenticity, alteration method, and the content of the original marking;

13. Technical examinations of the way different objects and bases are damaged;

14. Metal science - elements of steering systems, suspension, tow hooks of vehicles, pressure cylinders and containers, and gas fittings;

15. Identification of devices used for the production and copying of CDs and DVDs and writers installed on computers (burners). These examinations include identification of parts of injection moulding machines used in production processes – injection moulding machine mirror, and to determine whether the records sent for examination, secured as part of operational or procedural activities, were produced using the same devices. This allows to link those selling illegal records to their producer.

Experts in mechanoscopy also answer questions about whether car bulbs were on during the crash. This is possible thanks to the analysis of a tungsten filament which heats to over 2000 Celsius degrees when the bulb is glowing.When a glowing bulb is broken, oxygen from the air reacts with tungsten producing tungsten oxides in characteristic yellow colour.

After touching the heated filament, glass shards from the broken bulb melt and stick to it, while the ends of the divided filament become cylindrical. A cold filament is elastic, which is why during the crash it is temporarily deformed but then returns to its original shape.

3.6. Methodology of Revealing and Securing Traceological Evidence

Traceology – is a branch of forensic science dealing with the mechanism of creating reproductions in the form of prints and imprints as a result of walking or running of people or animals, the movement of vehicles, for example, on wheels, tracks, skids, and of moving and dragging objects.

Traceological evidence – this is evidence created as a result of the movement of people, animals and objects being means of transport.

Types of Traceological Evidence:

1. Footprints:
   - Bare;
   - With shoes on;
   - Clothed on hard and soft surfaces.
2. Vehicle tracks of:
   - Wheels (rubber and iron);
   - Skids;
   - Caterpillars on hard and soft surfaces.

3. Tracks left by animal legs:
   - Hoofs;
   - Paws on hard and soft surfaces.
4. Tracks of tools used by people to move e.g. stilts, crutches, skateboards, wheelchairs.

Traceological evidence also includes tracks of dragging, for example, a body or a killed animal, marks of shoes on human skin in the form of bruises (called internal evidence), and a shoe or a pair of shoes (lost, abandoned).

The Division of Traceological Evidence by Location of the Evidence on the Surface

1. Surface evidence (prints):
   - Layered, visible – colourful, not requiring development;
   - Layered, invisible – requiring development using different means;
   - Delayered – visible, colourless, not requiring development using any means.
2. Hollow traces (imprints):
   - Left in;
   - Loose base;
   - Cohesive base;
   - Snow;
   - A different plastic base.

Mechanism of Creation of Traceological Evidence (Location)

Human and animal footprints are created when a foot (e.g. a hoof) touches the ground, which might be soil (clayey, sandy or other), snow (loose/dry, compact/wet) or a hard surface (asphalt, concrete, floor or other). If the surface accepting the trace is soft, usually hollow tracks are created - imprints, and if it is hard, surface marks are created - prints. Prints can be layered or unlayered.

Tracks of vehicles are created in static and dynamic conditions. In static conditions, they are created in the form of reproductions: prints and imprints. In dynamic conditions, tracks of blocked wheels or skids are created: the object creating the tracks moves on the surface. In this case, longitudinal elements of treads are reproduced on the base.

Vehicle tracks should be found on roads or nearby surfaces, and on victims.

Tracks found on roads and shoulders are most frequently:

– Driving marks;
– Braking marks;
– Blocking marks;
– Skid marks;
– Marks of wheel rims;
– Fishtailing marks;
– Drag marks;
– Stopping marks.

Methods of Technical Securing of Traceological Evidence

- Plaster or silicone cast;
- Securing together with the base (e.g. a sheet of paper with the shoe's sole copied);
- Transfer onto black gel foil measuring 13x36 mm;
- Photographic documentation of traceological evidence in accordance with the scale technique;
- The use of MES device, applying the electrostatic method, and transfer onto black gel foil.

3.7. Revealing and Securing Methods

Evidence is revealed visually. When revealing invisible prints, layered with such substances as fats or oils, light falling at an angle on the observed surface and a magnifying instrument, such as a magnifying glass, are used. Sometimes, fluorescent properties of the substance creating the print (fat) can be used in UV light. Invisible marks are developed using dactyloscopic powder. In order to develop footprints on carpets or flooring, the phenomenon of changing the electrostatic charge (pouring fine plastic particles on the surface from a certain height) can be used.

Each developed mark should be **documented photographically in accordance with the scale technique.**

Figure 1. Hollow print of a shoe sole in a soft base

1. Forensic securing:

Hollow marks are secured through modelling. For this purpose, plaster, silicone mass, metal alloys, sulphur, or paraffin are used. The technical securing method depends on the surface on which the mark has been developed (heavy soil, loose soil, loose snow, compact snow) and the agent applied.

2. Surface marks are secured:

– Together with the surface on which they are found, e.g. marks on paper, polystyrene foam, cardboard etc.,

– By transferring them onto traceological foil,

– Using the electrostatic method, with a MES kit producing static electricity, transferring the mark onto black gel foil.

Evidence should be secured in procedural terms by describing it in detail in the inspection report, giving their dimensions, location and marking. For each developed and secured evidence, information sheet should be drawn up, filled in and attached to the packaging, thus becoming a procedural document.

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