COMPOSITION OF FINGERPRINT SECRETIONS

(Note: For simplicity in the following discussion it is assumed that 'fingerprint' includes impressions of palms and soles.)

A deposited fingerprint may be composed of naturally secreted materials, such as sweat, sebum or lipids, foreign materials picked up on the hands or a combination of any or all of them. The actual blend that forms any particular impression is always unknown. This may appear to make the choice of development techniques an insoluble problem.

However, having an awareness of the potential physical properties of a fingerprint will enable an intelligent choice to be made among the development techniques.

Two types of natural secretion glands are of interest in Forensic Identification work:

- eccrine sweat glands
- sebaceous glands

ECCRINE SWEAT GLANDS

These glands are found all over the body, but in greater density on the palmar and plantar surfaces. The activity of these glands is controlled by the autonomic nervous system that responds to thermal, emotional and medical stimuli. These glands cannot be consciously controlled by the individual.

Composition of Eccrine Sweat

Because of the many variables involved, the authorities vary slightly with respect to exact proportions, but is generally agreed that the composition of eccrine sweat is approximately as follows:

Water	98.5%	to	99.5%
Solids	0.5%	to	1.5%

The solids are approximately 1/3 to 1/2 inorganic salts and 1/2 to 2/3 various organic substances.

The Inorganic Salts

Chloride, bromide, iodide and fluoride form the inorganic salts, sodium chloride being the most abundant.

The concentration of salts in the sweat is subject to the following factors:

- rate and duration of sweating
- intermittent versus continuous sweating
- diet
- age and sex

The skin is one of the routes used by the body to eliminate waste products. It is also used as a method of cooling the body through the evaporation of sweat. These two functions are combined as the sweat carries the waste materials to the surface through the eccrine glands where they are washed away as we bathe.

Since there are limited amounts of waste materials to be discarded the quantity exuded at any one time depends upon the opportunity the body has had to remove them. For instance, in cool weather the body does not become overheated as frequently as in warm weather so does not need to sweat much to provide cooling. Waste products are therefore not eliminated very frequently but when sweating does eventually occur the body uses the opportunity to excrete relatively large amounts of waste. Thus the concentrations in the secretions temporarily become very high.

Conversely, in the summer when the body needs to be cooled, sweating is frequent and often profuse but there is still only the same amount of waste material to eliminate. Because the opportunity to remove the material is almost constant, the concentration of waste materials at any particular moment is therefore much less. This then leads to the conclusion that cooler weather, when sweating would be likely to occur only occasionally, would lead to higher concentrations of the materials for which we search with our chemical fingerprint development techniques.

The Organic Substances

Of the many organic substances present in eccrine secretions, those of significance in identification work include amino acids and fatty

acids. Also present are ammonia and urea. These materials are generally water soluble.

Amino Acids

Many amino acids have been successfully identified in normal eccrine secretions. Under conditions of normal daily activity the concentration of amino acids decreases with high rates of sweating in proportion with the other materials.

One very big exception is that the autonomic nervous system causes the body to secrete very large amounts of amino acids when it is placed under stress. The autonomic system is the one that controls heart rate and other bodily functions over which we normally have no direct control.

As a practical example let us look at a fraudulent cheque offence scenario at a bank. The offender must control all outward signs of nervousness to avoid arousing the suspicions of the bank employees. Internally the subject is tense and the autonomic nervous system reacts to this by increasing heart rate and respiration and by secreting more amino acids among other things.

As the cheque is passed the offender must handle it with bare hands in a normal fashion and thus transfers amino acids to the paper. When the document is examined, the amino acids react with the ninhydrin reagent and become visible.

This has been confirmed repeatedly at the Ontario Police College by processing student examination papers (or specimen impressions taken during exams) for fingerprints, and comparing the results with non-stress samples.

In the large majority of cases, identifiable fingerprints develop on the exam or specimen papers. Often nothing at all or only poor quality impressions develop on the non-stress comparison samples.

Fatty Acids

These naturally occurring fats and oils are found within the group of substances known as lipids. The lipid group also contains such substances as the waxes and squalenes that are found in sebum (discussed below). It is important to understand that the oils and fatty acids do not remain in a viscous state (as does motor oil, for example).

The lipids are changed over a period of time through oxidization and hydrolysis. This is sometimes referred to as 'drying out'. It would be perhaps better to use the term 'cured' to differentiate the process from simple evaporation of substances such as water.

A latent impression composed primarily of lipid materials will remain amenable to certain development techniques much longer if it is protected from the air.

Ammonia and Urea

While little specific use is made of them in commonly used development processes, ammonia and urea are also present on the skin in quantities that vary with the rate of sweating.

It has been suggested that, in fact, ammonia is also of great importance in the ninhydrin process but this has not been positively established.

SEBACEOUS GLANDS

Sebum is the secretion of the sebaceous glands and consists mainly of saturated fats, waxes and squalene. These materials do not oxidize or hydrolyse as rapidly as the unsaturated fatty acids.

There are no sebaceous glands on the friction ridge surfaces of the hands and feet. Sebum is, however, usually found on the hands as a result of touching other parts of the body, such as the face, head or arms, where the material is plentiful.

The concentration of sebum will vary from person to person and from time to time in the same person. It is one of the materials to which fingerprint powders adhere, and is also one of the materials with which the iodine fuming and physical developer processes react.

The speed at which sebum oxidizes will vary in relation to temperature, air movement and other environmental conditions. The length of time during which sebum will be useful for latent fingerprint development will also depend on the development technique chosen. It will be relatively short in the case of powders and iodine, much longer in the case of physical developer.

FOREIGN MATERIALS

The variety of foreign materials that might be found in a latent fingerprint deposit is virtually unlimited. The actual composition obviously depends on what the person has handled prior to the deposit of the impression. While it would be impossible to list them all, a few of the more likely materials can be mentioned.

- oily or greasy hair dressing.
- motor oil or grease.
- grease or dirt picked up from a window during a restaurant or service station break and enter.
- bodily secretions picked up during a sexual assault.
- grease from pizza, hamburger, french fries or other foods.

The list is endless, but a careful analysis of the details of the offence may suggest that a particular material may have been picked up on the fingers of the culprit. This in turn may suggest which specific development technique might be most successful.

Summary

- the various glands are controlled by the autonomic nervous system
- the individual cannot consciously affect the composition of the secretions
- the organic and inorganic substances in sweat will vary considerably in their concentration
- greatest concentrations will be found in the sweat of a person who is under stress and who is in a phase of temporary sweating as a result of that stress
- lowest concentrations will be found in the sweat of a person who is sweating continuously and profusely as a result of physical activity and/or climatic conditions
- quantity and type of secretion is affected by diet.

Conclusion

- except in unusual circumstances a Scenes of Crime or Forensic Identification Officer will rarely, if ever, know the exact composition of the latent impression which is being developed
- neither is there any way of accounting for many of the other variables, such as amount of secretion; pressure and length of contact; temperature; humidity; air flow, reaction with the specific substrate etc.
- it can be stated as a general rule that the chance of successfully developing a fingerprint varies inversely with the time that has elapsed since it was deposited.
- in the case of anticipated powder development this rule holds because of deterioration of the secretions
- with other types of development methods the rule still holds because of the increased possibility of damage through handling of the exhibit, accidental or otherwise, with the passage of time
- it is, therefore, essential to attend scenes of crime as soon as possible after the event. Leaving it until the next day may make the difference between success and failure.

LIFE SPAN OF A FINGERPRINT

How long a fingerprint impression will last in a particular set of circumstances depends on a number of variable factors. These factors will determine whether the impression will endure for only a few minutes or virtually indefinitely.

The factors to be considered include:

- the composition of the impression
- the effect of environmental conditions
- the substrate on which the impression has been deposited.

Composition of the Impression

As noted earlier, sweat is composed of 98.5 - 99.5% water. It follows then that impressions consisting mainly of sweat will be fairly short-lived since the water content will rapidly evaporate. After only a short time, in conditions of low humidity or high temperature, powder development will likely be unsuccessful.

Those impressions consisting of a large proportion of sebum, the secretion from the sebaceous glands, will usually last longer under similar circumstances. Although the sebum is an oily substance it does cure, or dry out but it does so at a much slower rate than sweat. Careful powder techniques will often develop such impressions for several days or even weeks after they were deposited.

Chemical development methods will be effective on impressions many years old. The maximum length of time is unknown, but researchers have developed forty-year-old fingerprints with ninhydrin and nine-year-old fingerprints with physical developer.

Foreign materials transferred to a surface by dirty fingers also vary widely in their receptivity to development.
Motor oils do not dry out as do natural secretions and should, therefore, be amenable to various development methods almost indefinitely.

Grease from foods may be animal or vegetable in origin and will be affected differently by time and environmental conditions. Each case would have to be investigated individually to see which method might be most effective.

Environmental Conditions

Severe weather conditions may restrict your ability to examine the scene.

In addition, these conditions can make it unlikely that impressions will successfully develop. If the items to be examined are portable you should take them under cover, out of the extreme weather.

Freezing

Freezing temperatures solidify the secretions that then become no more ‘tacky’ than the substrate. The powder clings equally well to both, resulting in a smear of powder with no visible ridge detail. The logical assumption would be that there were no fingerprints on that surface.

If, however, the object is taken to a place where it can be warmed up, the results may be considerably different.

As it warms, condensation will form on the surface and on the fingerprint secretions. Continued warming will evaporate the moisture from the substrate but the secretions of the impressions will hold the absorbed moisture much longer.

Monitor the object as it warms and, immediately after the surface condensation has evaporated, attempt powder development. The powder should then stick to the impressions and development may be excellent.

NOTE: It is important to wait until the condensation has completely evaporated from the substrate otherwise the powder will stick to everything equally and obscure any impression that may exist.

High temperature - summer sun

Hot sunny weather will cause the secretions to "bake" onto the surface

The moisture is quickly driven off and, once again, the tackiness of the secretions and the substrate is equal. In this situation the powder

does not adhere well to either area, again suggesting, perhaps incorrectly, that no impressions exist.

To overcome the problem, take the object into a cooler environment, preferably with air conditioning. Allow it to cool to room temperature. As it does, the secretion will absorb moisture from the atmosphere thus restoring much of the tackiness.

Wait until the substrate is cool before making any attempt to use powder. This will ensure that the initial condensation will have evaporated from the substrate. Otherwise the moisture will wet the brush and cause smearing of the powder.

The 'Huffing' method

It may be possible to add moisture to an impression by "huffing." This is simply breathing on the impression with several deep-lung, moisture-laden breaths. If conditions are right the impression may develop if powdered immediately.

On hot, sunny days this method often is unsuccessful on a hot surface, such as an automobile outdoors, because the moisture evaporates as soon as it touches the surface. If the object can be taken out of the sun and allowed to cool before attempting it, the 'huffing' method may be quite successful.

Freeze-thaw method

Another technique, which works quite well with small objects, is the 'freeze-thaw' method. It is, in fact, simply a matter of artificially creating the conditions described earlier.

Place the object to be examined in a freezer long enough to lower the temperature to freezing or below. Then remove it from the freezer and allow it to warm up. As it does, condensation will form on the surface and the secretions will absorb some of the moisture. As soon as the condensation evaporates from the substrate, you can examine the object using fingerprint powder. The impression will still be moist and will retain the powder.

The 'freeze-thaw' method also works well on old fingerprint impressions that appear dried out and that will not readily accept powder. Using this method could mean the difference between seeing just a few ridges and developing an identifiable impression.

High humidity

The other major environmental condition that affects development of fingerprint impressions is the opposite of the two above, namely very high humidity. In this case the powder adheres to everything equally well and, in addition, often tends to smear as the brush gets wet.

Again the solution to the problem, where possible, is to remove the exhibit from the existing conditions, in this case, the humidity. An air-conditioned area will be lower in humidity and if the exhibit is left an hour or two to acclimatize, it may be possible to use normal powder development techniques.

First test an area of the exhibit that you feel is least likely to bear impressions and observe the reaction of the powder on the substrate. If there is little or no adherence, it should be safe to examine the more likely areas.

AGE OF FINGERPRINT IMPRESSIONS

Occasionally a question is asked, by investigators or in court, about the age of a fingerprint. Typically it arises when a fingerprint from a crime scene has been individualized and that person claims to have had legitimate access some time prior to the offence.

Not surprisingly, in this situation, the investigators and perhaps the prosecutor would like identification personnel to determine the age of the impression. The hope being, of course, that this will establish that the impression was deposited at the time of the offence.

Conversely, of course, the defence wants you to be able to show that the age of the impressions supports the claim of the defendant.

Frequently, as an impression is being developed by the powder method, it will appear very quickly and strongly. This may lead to the comment that it appears 'fresh'.

When all of the factors are taken into account, however, it will be seen that such a conclusion does not have a sound scientific basis.

Some of the factors that would need to be taken into account in determining the age of an impression are listed below:

The Person

- the type of natural secretion present on the fingers
- the type of foreign materials present
- the overall amount of materials present
- the amount of pressure applied to the substrate
- the length of contact with the substrate.

The Substrate

- cleanliness
- porosity
- temperature
- vulnerability to damage

The Environment

- air temperature
- substrate temperature
- air movement
- humidity

Each of the listed factors is extremely variable and while a few may be known at the time of the examination, it is unlikely that any will be known as they existed at the time of the offence.

One other factor that may affect an assessment of the age of the impression is the development method chosen.

For instance, in the initial examination, a dried out fingerprint might appear to be 'old' because the powder does not readily stick. As described earlier, adding humidity to an impression by 'huffing' or by the 'freeze-thaw' method may make it more responsive to powdering techniques after which the same impression may well appear 'fresh'.

Examples

At times, circumstances may appear to clearly indicate a time frame within which the impression must have been deposited. The following examples will serve to show that such evidence must be very carefully considered.

During an entry into a school cafeteria, the intruder drank from a milk bottle. The identification officer set the bottle aside to take with him after he had completed his examination. Upon preparing to leave he discovered that the bottle had been washed by a 'helpful' cafeteria worker.

Despite this, the bottle was examined and fingerprints were developed which later convicted the culprit. Common sense might have suggested that there would be no fingerprints remaining after the bottle was washed.

Another example:

At a break and enter scene the identification officer examined a broken double-glazed window and found an impression on a surface that would have been between the two panes of

the window. The impression responded readily to powdering and appeared 'fresh'.

Common sense in this case suggested that the fingerprint could not have been placed there until the window was broken.

It was eventually learned that the impression belonged to an employee of the company that made the windows and that it must been left on the glass several years earlier. The employee was completely eliminated as a suspect and later another person was charged with the offence.

One final example:

An elderly lady was murdered in a farmhouse. There was no electrical service to the house, but a neighbour reported that a kerosene lamp had been burning during the evening and that she later noticed that it had been extinguished.

A fingerprint, developed on the chimney, was identified as that of a nephew of the dead woman.

The common sense assumption was made that a fingerprint would not survive the heat of a burning lamp. It was suggested that therefore the impression must have been deposited when the lamp was being extinguished.

The nephew was totally exonerated by other factors and it was later shown that an impression could indeed survive the heat. (It was also pointed out that a hot, burning kerosene lamp is not extinguished while holding the chimney!)

Summary

There are many stories of fingerprints that have survived unusual conditions. They all illustrate the necessity of remaining objective and investigating every possibility before coming to a firm conclusion.

There may be exceptional circumstances, (e.g., a freshly painted surface) in which there can be no doubt as to the maximum possible age of the impression. Such occasions will be few and will usually be obvious.

In the great majority of cases, however, it will not be possible to offer an opinion as to the age nor the potential life span of a fingerprint impression.

Many articles have been written discussing the question and pondering ways in which the question might be capable of being answered.

Do not let yourself be coerced into offering an opinion on the age of a fingerprint - in the vast majority of situations it simply cannot be done!

CRIME SCENE FINGERPRINTS

Chance Impressions

For the purpose of this discussion fingerprints found at the scene or on objects of evidence will be referred to as 'chance impressions'.

The term 'latent impression' is often used in this context, but while it has become accepted in everyday conversation, it is not technically correct and its use could be confusing in this part of the text.

Chance impressions can be categorized in several ways:

- latent
- visible
- deposit
- take-away

or a combination of these types.

Latent

The term 'latent', in the context of fingerprint work, simply means 'invisible'.

Many impressions are composed of a thin film of natural secretion and/or foreign material in such a small quantity that they are invisible without some form of enhancement.

In actual fact, some of these latent impressions can be seen if viewed from oblique angles, or by illumination from various angles with a flashlight.

They will, however, still require development if they are to be photographed and collected.

Visible

Most of these visible impressions are two-dimensional and consist of a deposit of some foreign material such as dirt, grease, blood or paint.

It is then simply a matter of marking, photographing and collecting them. To collect them it may be necessary to add fingerprint powder so that there will be some material that will lift off the substrate.

Some impressions will be partially visible and partially invisible. For example, a blood print may be partly whole blood and partly clear serum, necessitating the use of a reagent to darken it

Occasionally visible fingerprints are three-dimensional. Such impressions may be found in the soft putty of a window, in fresh paint, thick blood or some types of food such as chocolate or cheese.

These are sometimes referred to as moulded impressions. You should first photograph these impressions and then attempt to cast them, using one of the elastomer impression materials.

Deposit impressions

Most chance fingerprint impressions are deposits. They consist of material transferred from the friction ridges to the substrate.

This may be a deposit of normal bodily secretions, such as sweat or sebum or it may be material such as blood, oil, paint or dirt transferred from another surface by the hands of the subject.

Deposits consisting solely of bodily fluids are very often latent, needing to be enhanced by development of some type.

Transferred deposits of other materials are more frequently visible and can be photographed as is. Enhancement for lifting purposes can sometimes be difficult.

Take-away impressions

Occasionally the friction ridges remove material from the substrate.

For example, you might examine a surface with fingerprint powder and discover that it is generally covered with a slightly tacky deposit to which the powder adheres. However, where a finger has touched it, the friction ridges have removed, or taken away the tacky material. Where this has occurred the powder does not adhere and the friction ridges show as unpowdered areas.

Impressions of this type can be quite confusing, particularly in those instances when an impression is part 'deposit' and part 'take-away'. This is a fairly common occurrence on soft drink cans where the contents have run down the side leaving a sticky residue. The finger lifts off the residue in one place and, at the same time, leaves a deposit from the finger in an adjacent area.

Another type of take-away impression is an impression left in a fine layer of dust. The dust adheres to the friction ridges and is lifted away, leaving a clear background.

An impression of this kind is easy to miss because it may not be visible unless the surface is carefully examined by shining the flashlight obliquely across the surface in otherwise dim light. If an impression is located, it will have to be photographed using the same type of lighting. This is not an easy task since there will be very little contrast.

In addition to being difficult to photograph, faint dust impressions are equally difficult to preserve. Using lifting tape is generally unsuccessful because the faint dust impression disappears into the glue of the tape.

It may be possible to collect these impressions using an electrostatic lifting procedure normally used in collecting footwear and tire impressions.

SUITABLE SURFACES

Many myths have arisen suggesting that fingerprints can never be found on surfaces such as door knobs, cash register keys, and steering wheels among many others.

Some of these myths have persisted despite advances in techniques that now permit examination of such substrates. Fingerprints have been found on such things as patterned vinyl inside vehicles and rocks from a smash and grab. Items which only a few years ago would have been considered impossible.

While it is undoubtedly true that the success rate will be lower than normal, identifiable fingerprints have been found on all of the substrates mentioned above. You must, therefore, make an effort to examine even unlikely items. It takes very little extra time and just might reveal the fingerprint that solves the case.

The general principle to remember is:

> **Fingerprints may be found on any surface with sufficient size and surface continuity to disclose the necessary ridge characteristics in sequence.**

Examining that principle in more detail, we find that there are three main factors that will determine the suitability of a surface to yield fingerprints:

- size
- surface continuity
- material.

Size

Sometimes small objects are ignored because it appears that there is insufficient room for a fingerprint. In fact, a circle with a diameter of five or six millimeters could contain an identifiable partial impression.

Fingerprints suitable for individualization have been found on small objects such as paper matches; the side of a revolver trigger; a .25 calibre cartridge case; keys; a headlight switch knob; a hypodermic syringe; telephone wires and other small surfaces.

Do not expect to find whole fingerprint impressions, they will be rare, even on large flat surfaces. Most frequently you will develop and collect fragments. These can be examined more closely, at the identification laboratory, to decide which ones are useful.

Substrate Continuity

Substrate or surface, continuity or smoothness, is another limiting factor in the successful development of impressions. It is not necessary to have a mirror-like finish to support good detail but the question becomes, how smooth is 'smooth'?

On a very rough surface the ridge detail may be so fragmented that it becomes impossible to follow. The checkered grips on a gun would be one example.

On the other hand, many surfaces that are considered to be rough in texture may satisfactorily hold a finger impression.

The imitation leather-grained vinyl surfaces on purses and automobile interiors are certainly not smooth. Old 33 or 45 rpm phonograph records, the crinkle finish on business machines, finely woven cloth and painted concrete have all yielded impressions.

Material

The best materials from the standpoint of powder development are those that have a very slightly textured surface. These have sufficient 'tooth' to grip the latent deposit and prevent it from sliding off the substrate or being otherwise damaged during the development process.
At first glance these surfaces may not be thought of as textured. A glossy painted or varnished surface is one example, ordinary window glass is another. Even when new these surfaces have sufficient tooth for our purposes and after exposure to atmospheric pollutants they may even have too much.

Paper surfaces, on the other hand, are usually too 'toothy' to facilitate good powder development. The powder adheres to the whole surface and may obscure the impression. In addition the deposited secretions are absorbed into the paper, leaving nothing for the powder to stick to. Papers are better examined with one or more of the chemical reagents.

The type of material of which the article is made will be the main influence on the choice of development technique. You must therefore know all of the available techniques so that you can make an informed choice in any specific situation.

Cleanliness of the Substrate

Substrate cleanliness also has an effect on the quality of impressions that may later be deposited and consequently on the method of development and collection that you will choose.

Touching a dirty or greasy surface may result in the transfer of materials onto the hands of the subject rather than the deposit of any secretions from the hands onto the substrate. Where this transfer has taken place the culprit may, however, have left sharply defined visible take-away impressions in the dirt.

As an example, entry is often gained into a service station or factory through a window. The windowsill is frequently dirty and the glass in the window covered with a layer of grease and dust. The intruder will lift a layer of the dirt and grease off the substrate onto his hands and leave 'holes' in the dust. When you examine these closely you will often find clearly defined impressions.

What dirt remains on the surface is in the pattern of furrows, not the ridges. The ridges of the fingers picked up, and removed, the grease and dirt but the furrows did not touch the surface and thus did not pick up any of the material. It is important that you note and report this fact so that there is no confusion later when the impression is being searched.

The lesson is, of course, that you must not overlook surfaces merely because they are dirty.

Impressions suitable for Individualization

You will find many partial impressions but not all of them will be suitable for comparison and individualization. Each one will need to be closely examined to determine whether it has sufficient detail and clarity to enable a comparison to be made. This examination is best done in the office under good lighting conditions.

Experience has shown that many neophyte identification personnel expect too much clarity and detail in impressions developed at the crime scene. Occasionally you will find impressions that are better quality than many inked impressions, but this is the exception. Chance impressions very seldom have that degree of completeness or clarity.

Until you gain experience it is best not to be too hasty to discard impressions while at the scene. The evaluation and 'weeding out' can be more easily and comfortably accomplished at the office. You will quickly learn what to look for if you follow the advice of more experienced officers as they assist you to evaluate your collected crime scene impressions.

SUBSTRATES AND SUGGESTED TECHNIQUES

NOTE: The following list represents the techniques most likely to give satisfactory results. The number of variables involved in any examination makes it impossible to be specific. Each substrate or exhibit must be assessed on its own merits and the final selection of technique made by the technician at the scene.

The methods listed here are only to give you suggestions and as a place to start your consideration of which techniques to apply.

Check with your own unit for advice as to which techniques are in local use.

GLASS

Clean
- metallic powder such as aluminum or copper

Greasy (restaurant, service station windows)
- granular powder - white is first choice but black and red can be used.

Dirty (e.g. mud splashed basement windows or dirty factory windows)
- look for take-away prints, photo before development if possible. Granular powders will be more effective than metallic.

METAL

Highly polished; plated; brushed finish, galvanized.
- camphor smoke or cyanoacrylate fuming,

PAINTED SURFACES

Hard enamel (e.g. automobiles and household appliances)
- aluminum or copper metallic powder.
- granular powders.

Gloss and semi-gloss household paint.
- granular powders, especially black.

Flat paint.
- iodine fuming, ninhydrin spray.

NOTE: Use ninhydrin at a crime scene only when you have fully considered the health hazards and potential for damage caused by staining. Not for use at minor scenes.

PLASTICS

The large number of 'plastic' materials makes a definitive list of appropriate development techniques impossible. Materials having a very similar outward appearance often have completely different powdering characteristics. The following list is a general guideline only.

Hard plastics (e.g. cash trays, video and audio tapes)
- cyanoacrylate fuming.
- magnetic or granular powder (use hair brush)

Soft plastics (e.g. "baggies," garbage bags)
- cyanoacrylate fuming,
- magnetic or granular powder

- **Vinyl (e.g. purses, automobile interiors)**
- cyanoacrylate fuming
- magnetic powder.

Cellophane (e.g. cigarette packages)
- cyanoacrylate fuming,
- white granular powder, magnetic powder.

- **Foamed plastics (e.g. coffee cups)**
- cyanoacrylate fuming,
- powder suspension, magnetic powders, (iodine fuming if fresh).

Melamine and Arborite (e.g. counter tops)
- magnetic powder, granular powders,
- cyanoacrylate fuming

PAPER AND CARDBOARD

Bond paper and cheques
- DFO, ninhydrin, physical developer

Paper that has been or is still wet
- physical developer

Paper Money
- ninhydrin followed by physical developer

Kraft paper and boxes

- ninhydrin followed by physical developer (ninhydrin may react adversely with the substrate, test a small section first).

Waxed cardboard (e.g. milk cartons, soft drink cups)

- cyanoacrylate fuming,
- magnetic powders, granular powders, powder suspension, iodine fuming.

FURNITURE

Waxed or polished

- granular powder, cyanoacrylate fuming.

Oiled

- generally unproductive, if necessary try granular powder, cyanoacrylate fuming.

Varnished or painted

- granular powders, cyanoacrylate fuming

Unfinished wood

- granular or magnetic powders on very smooth surfaces, iodine, ninhydrin spray.

LEATHER

(e.g. purses, briefcases)

- magnetic powder, powder suspension if wet, cyanoacrylate fuming.

HUMAN SKIN

- iodine fuming with silver plate transfer
- transfer to 'Kromekote' which is then dusted with conventional or magnetic powders
- magnetic powder direct
- laser fluorescence direct

WET SURFACES

- while wet, treat with powder suspension or physical developer,

or

- allow to dry and then treat with conventional methods i.e., powders and/or physical developer.

COLD SURFACES

(i.e. below freezing)

- remove to warm area and allow to warm to room temperature
- use conventional methods, (powders, cyanoacrylate) as soon as condensation evaporates. Powder suspension may be effective.
- examination while frozen is unlikely to develop impressions.

HOT SURFACES

(e.g. automobile in summer sun)

- remove to shaded area, allow to cool. Usual powders, cyanoacrylate, powder suspension may be effective.

MULTI-COLOURED SURFACES

- fluorescent powder applied under U.V. energy source, photograph by U.V. fluorescence.
- cyanoacrylate and dye with Ardrox dye. Illuminate with U.V. and photograph the luminescence.

DRIED-OUT IMPRESSIONS

- "huffing" and powdering technique
- powder suspension may be effective.
- freeze-thaw technique if object can be placed in a freezer.

EXAMINING THE CRIME SCENE

Introduction

One of the greatest pioneers in the use of scientific evidence was Edmund Locard (1877 - 1966). Many current methods can be traced back to his Institute of Criminalistics in Lyons, France around the turn of the century.

Locard laid down as a guiding principle that 'Every contact leaves a trace'. These traces may include fingerprints, footwear impressions, hairs, blood or body fluids, paint chips, glass fragments, fibres, and soil, to mention only a few of the more obvious types.

His principle also implies that at the same time the subject will take away on his/her person, clothing, car, tools, weapons etc., traces of the scene or the victim. In other words the contact results in a two-way transfer of trace evidence.

Finding and identifying those traces is, however, sometimes beyond the current capabilities of forensic science.

Improved methods and techniques are continually being developed at both the field identification and the forensic laboratory levels to expand these capabilities.

By analyzing each case in detail you will be able to develop a clear idea of the types of traces that might be present and where they are most likely to be found.

Contamination of the Scene

One of the difficulties that you will often face is contamination of the scene by persons who have entered the area subsequent to the offence. This poses the problem of determining which traces were left by the criminal and which were left by the complainant; the uniformed officers; investigators; ambulance attendants; fire fighters; the coroner and others.

Question the complainant, the uniformed officers and the investigators to obtain names, addresses and telephone numbers of everyone present, including ALL police officers, even senior officers who 'just dropped in for a quick look'!

It is amazing just how many fingerprints and footwear impressions are developed at crime scenes of officers who 'didn't touch anything', not to mention hairs, fibres, dirt from footwear, even cigarette butts and coffee cups that are inadvertently left behind.

The biggest danger from the point of view of the identification specialist is that the real evidence will have been damaged or destroyed by the sightseers.

Even if you can get a fairly complete list, there will be a great deal of work involved in obtaining the necessary samples from these individuals for elimination purposes.

Providing a continuing education program for patrol officers and investigators can minimize crime scene contamination. This should stress the nature of physical evidence and its susceptibility to damage.

Planning the Search

In addition to determining who has been present at the scene you will want to obtain as much information as possible about the offence and the scene itself before you commence a search for physical evidence.

The investigating officers should be able to provide some information about the type of offence and how they think it was committed.

The complainant will be able to point out things in the scene that may be important but of which a visitor would not be aware.

As examples:

A home appeared very neat with nothing out of place but the homeowner was able to point out a trophy, of which he was particularly proud, that had been moved. An impression was developed that may not have been found without the information from the complainant.

In another case, the recreation room bar was open and all of the bottles had been taken out of the cabinets. The officer was preparing to examine them all when the homeowner stated that he had taken them out to take stock before a party. In this case a great deal of unnecessary

work, both at the scene and later in searching any found impressions at the office, was avoided.

Synthesizing the information received from all of these sources will assist you to make informed decisions on what to look for, where to look and which methods to use in the collection and preservation of the evidence. It will also lessen the chances of inadvertently overlooking or destroying evidence.

Be cautious about accepting the information received at face value. Mentally store the information away for future reference and, as you perform your identification duties, try to form your own opinion of what actually took place. You may be surprised at how often you are able to point out actions by the culprit that have become obvious to you during your examination that were not evident to the other persons.

Photographing the Scene

(Covered in more detail in the photographic section of the course)

You will usually take photographs to record the conditions at the scene and the appearance and location of individual objects of evidence. Each case will have to be taken on its own merits as to the type and number of photographs required. When evidence is located you will usually take overall locating views, medium range views and a very close-up (1:2) or life-size (1:1) view.

You will often find that it is preferable to work your way into the scene, taking photographs, collecting physical evidence, then taking more photos as the search progresses.

The Search for Physical Evidence

Having taken the overall, or general, scene photographs you can now begin the actual search for evidence. As already mentioned, the knowledge of the crime, gleaned from discussions with complainants, witnesses and investigators will enable you to form a fairly good idea of the activities of the criminal. This knowledge will assist you to plan and conduct the search in a methodical fashion.

You should generally follow the sequence outlined below when conducting a search, although modifications will undoubtedly be required to fit individual circumstances.

The Route to the Scene

This might also be referred to as 'the path of entry'. The culprit will approach the specific point of entry along a path that you may be able to determine.

For example, in the forcible entry of a private dwelling house, a rear ground floor bedroom window may have been forced. Look for signs of the approach to the window from the back fence across the lawn. There may be a cultivated flowerbed below the window. Such a 'path of entry' provides several possibilities for physical evidence, beginning at the back fence.

Look for things such as footwear impressions, fibres, and items that have been dropped when the culprit was either entering or leaving the scene. You should examine this route as quickly as possible, before it is accidentally disturbed or destroyed or before atmospheric conditions alter the evidence.

The Point of Entry

If the scene is a secured area, such as an automobile, an office or a residence, there will likely be an obvious point of entry. This location may be very productive of trace evidence since it is the first place handled by the culprit.

Imagine that you are the culprit and ask yourself where you would place your hands, knees, elbows and feet. It is then very simple to decide where to begin looking for trace evidence.

Do not limit your examination to those areas alone but examine them first as the most promising. Then expand your search to adjacent areas.

One of the prime considerations whenever the P.O.E. is a broken window is the broken glass itself. When the culprit breaks the window he/she will often pull, rather than break, extra pieces that are held by the putty. This does two things from the point of view of the culprit.

First, it makes the hole larger and so makes it easier to reach or climb through. Second, it accomplishes the first goal without making much additional noise.

The broken glass lying inside the POE (assuming the window was broken from the outside) often will not have been handled by the culprit. They will have fallen inside simply as the result of breaking the glass. They should be examined for footwear impressions in the event that the culprit stepped on them as he/she climbed in.

Those pieces outside however, especially those with straight edges showing traces of paint or putty, will almost certainly have been handled by the culprit.

Ask yourself whether there is sufficient broken glass in the immediate area to fill the hole left in the window. If not, make a thorough search for it because you can be certain that it has been handled. After being pulled out it may have been thrown, Frisbee style, onto the lawn or, in winter, into a snowbank (look for the slits in the snow).

If you do find glass bearing putty or paint traces make note of the paint colours inside and outside the POE. You will then later be able to state whether the impressions you developed were on the interior or exterior surface of the glass. The putty side is usually the exterior.

The Object of Attack

From the inside of the point of entry the culprit will have gone to one or more locations, depending on the object of attack.

It could be general ransacking with no particular objective, in which case the whole premise may require examination. If it appears to have been a specific target such as a safe, cash box, stereo components, computer etc. you may be able to limit the area of search.
In any case, first pay special attention to the possibility of finding footwear impressions immediately outside and inside the point of entry.

If you, or others, first walk around looking for other evidence the footwear impressions will probably be damaged or destroyed.

Too often they are overlooked entirely and yet some identification units are making from 30-50 percent of their total individualizations on footwear evidence.

The rule, for anyone other than yourself, should be

DO NOT STEP

Having located these impressions and protected or collected them, you can carry on to examine the remainder of the scene, including the specific object(s) of attack.

Other Logical Objects or Areas

Certain things will have been noticeably disturbed. Common sense will suggest other items that the intruder may have touched. As noted above, discussion with the complainant and witnesses will suggest other things to examine that are not obviously out of place.
As an example, an intruder had assaulted one young woman in her own apartment. On being asked by the identification officer if the culprit had touched anything, she remembered that he had briefly handled an apple in a fruit bowl. Examination of the apple resulted in the development of a useful fingerprint impression and the eventual identification and conviction of the culprit.

Do not overlook washrooms during the course of your search. Human physiology is such that a culprit who becomes nervous during the commission of a crime (and most do) sometimes has a great necessity to relieve himself. This is sometimes evident adjacent to windows when a lookout has been unable to leave his position. More commonly, they will simply use a convenient washroom. Even though gloves may be worn during the course of the crime, they will probably be removed for this activity. Excellent fingerprints have been found on the underside of toilet seats!
The importance of eliciting information from victims and witnesses cannot be over emphasized. Since you will probably never have previously been to the scene you cannot be expected to know the normal condition of the premise without their help.

The Path of Exit

If the physical circumstances, or witnesses, indicate that the culprit left by a different route than that used for entry, you must, of course, also check that area.

Sometimes, in the euphoria of a successfully completed crime or in making a hurried exit after being disturbed, the culprit becomes careless and neglects to take the same care that he had done up to that point.

As an example, it is reported in the International Criminal Police Review that the criminals responsible for the Great Train Robbery in Great Britain in 1963 took the precaution of having a cleanup team responsible for ensuring that no fingerprints would be left behind at their farm hideout.

However, in the celebration after the robbery they became careless and Scotland Yard SCO's succeeded in developing 122 fingerprint impressions which led to the identification of sixteen individuals.

VEHICLES

Vehicles present a different type of scene but nevertheless one that often yields a wealth of physical evidence. While a step-by-step procedure cannot be given that would apply to all situations, the following points should be considered.

1. Follow a logical sequence in order to avoid missing any area. Develop a work habit and use it every time you examine similar scenes. In that way you will know that you have covered every scene thoroughly.

With a vehicle it makes most sense to start with the outside and work in. Nobody should enter the vehicle until the seats and floor have been carefully examined. You may need to restrain other officers who want to look in the glove compartment and under the seats!
The circumstances of the offence will dictate the actual procedure. Was the car hot wired or were the keys available? Was it used for a short joyride or has it been missing for an extended period of time?

2. Examine the following areas for fingerprints:

- roof above doors, the trunk lid, the hood, edges of doors and windows. (roll down the windows part way to examine the edges)
- rear view mirrors (interior and exterior). It may be necessary to remove the interior mirror in order to be able to properly examine it. You should have an assortment of tools in your kit for this purpose.
- steering wheel.
  Contrary to common belief, good fingerprints are sometimes found on steering wheels.
- armrests and door handles.
  Do not overlook the area of the armrest into which the fingers are inserted to pull the door closed. This will probably necessitate removal of the armrest. You may also need to remove door handles to examine their inside surfaces.
- dashboard and console.
  Even rough vinyl surfaces can yield fingerprints if the correct development and collection methods are used.
- ashtrays,
- knobs or handles on the seat controls,
- contents of glove compartment,
- debris found on floor such as cigarette packs, gum wrappers, etc.

HANDLING EXHIBITS

Crime scene impressions are very delicate, often only tenuously attached to the substrate on which they are found. They are extremely susceptible to damage from an external force, however slight it may be.

As an example, an impression in dust, whether it is a fingerprint, footwear or other type, can be completely destroyed simply by attempting to enhance it by applying powder with a fingerprint brush.

It is important, therefore, that no object bearing possible impressions should be touched by anyone before you have had an opportunity to examine it.
When handling is unavoidable it must be done in a manner that will not obliterate or damage existing impressions. Given a little thought it is usually possible to handle objects in areas where impressions are unlikely to be found.

The depiction in movies, of the investigator wearing gloves or using a handkerchief, when

picking up and transporting the gun or other articles for examination is absolutely incorrect and must be discouraged.

There is a great danger of obliterating impressions while wearing gloves or using a handkerchief because of the mistaken sense of security. The practice merely minimises the chance of leaving further impressions on the exhibit but does nothing to protect the existing impressions.

If a latent impression is touched with anything at all, be it bare hand, glove, handkerchief or anything else, it will be damaged.

The simple rule is:

DO NOT TOUCH!!

This is one time when police officers should be encouraged to keep their hands in their pockets!

One exception to the general precautions against damaging fingerprints is when dealing with a paper exhibit.

Impressions on paper exhibits are not damaged by pressure. The secretions 'soak in' to the paper and therefore cannot be wiped off as can those on a gun, for example, which are sitting proud of the substrate.

Of course, they should not be handled with bare fingers because of the potential for depositing new impressions on top of those that already exist.

Simply fold a clean piece of paper and slip it over a corner of the exhibit. This folded paper needs only to be large enough to prevent your fingers from contacting either side of the exhibit.

Then slide the exhibit into a large clean envelope for ease of handling. Contact with the inside of the envelope will not damage the impressions.

Careful handling with respect to excessive heat and humidity must still be observed. (e.g., do not leave such exhibits on the dash of your car in the summer).

CAUTION RE DAMAGE TO PROPERTY

Use common sense and exercise discretion when examining any type of crime scene to avoid causing unnecessary damage to the property of the complainant.

You must realize that powder and chemical methods of development can cause great inconvenience and sometimes expensive damage.
The nature of the crime and the potential for successful development of impressions may limit the types of examinations you carry out. What may be an acceptable level of damage caused by your examination in a very serious case may be totally unacceptable in a minor one.

You must take care to minimize the mess by developing neat, careful working habits. These same good habits will also help you to protect yourself against unnecessary exposure to the fingerprint powders.

HEALTH CONCERNS

It is suspected that there may be links between the long-term use of fingerprinting powders and chemicals and respiratory diseases among forensic identification personnel.

Despite the fact that these studies do not currently provide positive proof of the links it is only common sense that it is better to avoid inhaling such materials whenever possible. Read the MSDS on the products and govern yourself accordingly.