Historical overview

One of the countless blessings of God is the presence of skin lines, especially those that form fingerprints. Their presence has many benefits, including firm grip and preventing things from slipping after holding them in the hand, in addition to the miracle of the uniqueness of the shapes of fingerprints in individuals in a distinctive way, which is a sign of the sophistication and perfection of creation. The first thing that was relied upon to classify criminals was to put a tattoo on the human body or cut off a part of his body because he was unable to repair himself. After that, the method of measuring the human body was adopted by the scientist (Bert Lyon). This method was excluded because it was inaccurate due to the similarity and presence of similar measurements. **The first to discover criminal fingerprints is the Argentine scientist (Juan Foch) in 1898, and the first to discover the classification of fingerprints** is the British (Edward Richard Henry).

التركيب التشريحي لطبقة الجلد (منطقة الخطوط الحلمية)

Anatomical Structure of the Skin (Friction Ridge Area)

Skin Layers

The skin consists of two main layers:

1. Epidermis – Outer layer
2. Dermis – Inner layer

They are separated by a cellular membrane. خمس انواع من طبقات البشرة

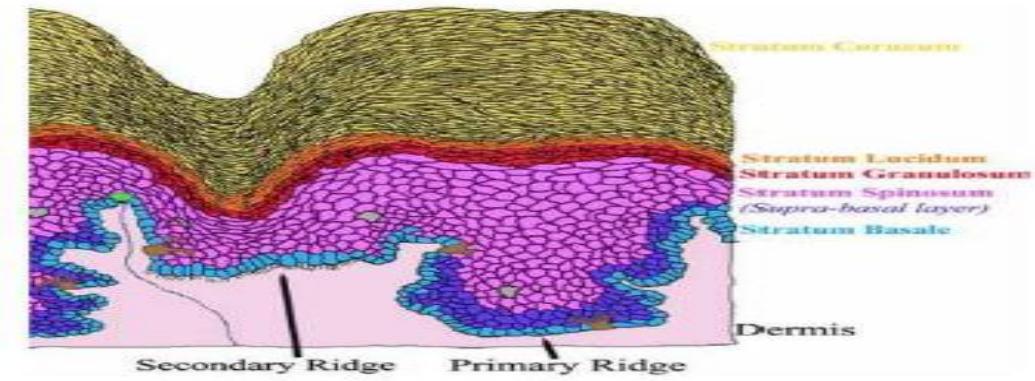
Five Layers of the Epidermis

- (Stratum Germinativum)الطبقة المولدة الرئيسية
- (Stratum Spinosum)الطبقة الشوكية
- (Stratum Granulosum)الطبقة الحبيبية
- (Stratum Lucidum)(الصافية) الطبقة الزجاجية الانتقالية
- (Stratum Corneum)الطبقة المتقرنة

Friction Ridgesالخطوط الحلمية

Ridges in the epidermis correspond to valleys in the dermis القمم في البشرة تقابلها وديان في الأدمة

Main ridges are called Primary Ridges Additional ridges are called Secondary Ridges



Finger prints

are the science of personality investigation and are considered one of the most important means used in personality investigation, In criminal terminology, a fingerprint is defined as those prominent lines that are adjacent to other low lines that take different forms on the skin of the fingers and palms from the inside and on the toes and soles of the feet that develop in the fetus and carry distinctive characteristics that are not repeated in other people.

The characteristics of the fingerprint are embodied in the following:

1- Characterized by stability throughout life

Scientists' experiments have proven the stability of fingerprints and their unchanged ability over time. A child's fingerprint can be used to confirm his personality at any age, as the image of the raised and lowered lines in the fingerprint maintains its shape, precise features and directions during childhood, youth, manhood, old age and even after death until the body decomposes and wears out.

2- its impossibility to change:

The lines in the fingerprint cannot be changed. If the outer layer of the skin is injured and the fingerprint lines are damaged, these lines will reappear in their original form when the wound heals without change and in the same place and without leaving a trace. Lab2 Fingerprints

3- It does not match in two different people:

Perhaps the practical application of the fingerprint theory for nearly a century is the best evidence of the individuality of fingerprints. Two identical fingerprints may be discovered among millions of fingerprints, whether for two people or for one person. Therefore, fingerprints do not match between two different people at all. Twins may resemble each other in many features, but their fingerprints differ in the fine details. There is absolutely no match between the fingerprints of two people in the family.

The importance of fingerprints in criminal evidence

A- Identifying the perpetrator:

Scientific experiments have proven that it is rare for a perpetrator not to leave his “visiting card” at the crime scene, as everything he touches can be used as evidence against him, because it will leave its mark on him unless he takes precautions by wearing gloves or is careful to remove the traces he left after committing the crime.

B- Using fingerprints to find out the accused’s criminal record:

Fingerprints are considered infallible based on two scientific facts:

1- A person carries distinctive lines on his palm, fingers, and foot that do not change from birth until death.

2- These lines are specific to each individual and do not match the lines of any other person at all .

C- Reaching the knowledge of the deceased victim

If he does not have anything to prove his identity, people are often found in murder, drowning or fire incidents who do not have anything to prove their identity, so the investigator takes the fingerprints of the corpse and then compares them to the models available to the relevant authorities to verify the identity of the deceased.

D- Fingerprints help in identifying the name of the accused in forgery and impersonation crimes:

The accused may use another person’s name in an attempt to escape the grip of justice as a result of committing a crime. By conducting an identity investigation with the relevant authorities, the truth about his identity and the number of crimes he has committed can be known. Lab2 Fingerprints.

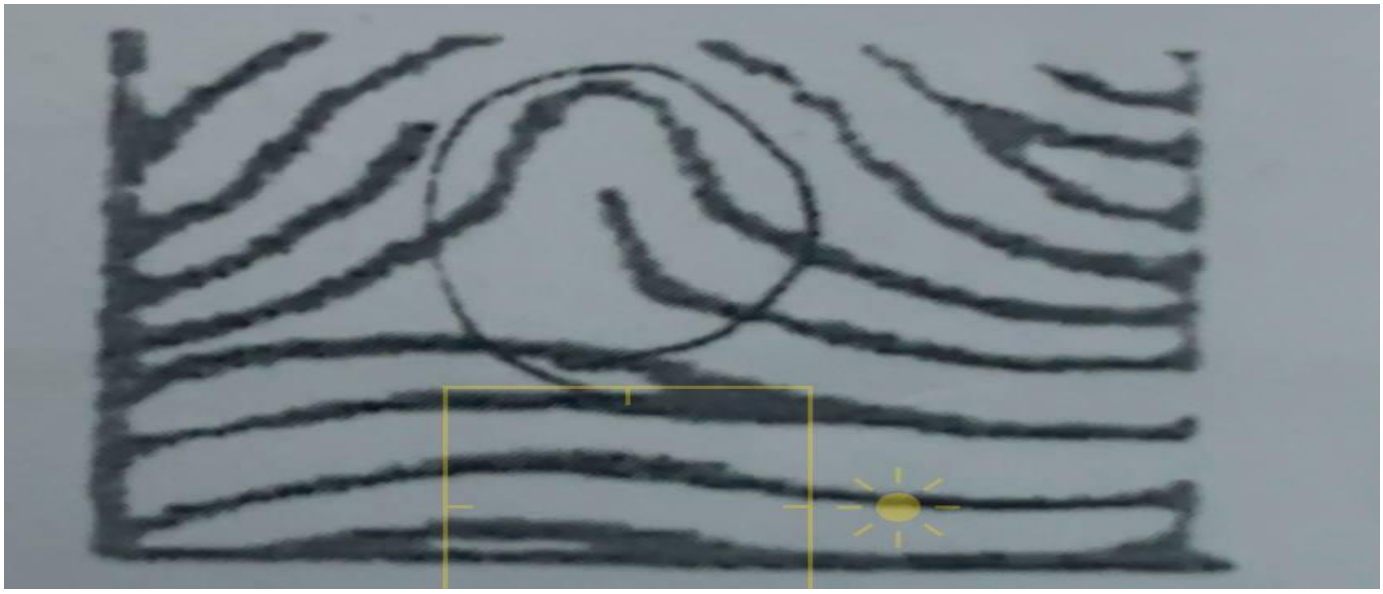
General forms of fingerprints:

- Arches

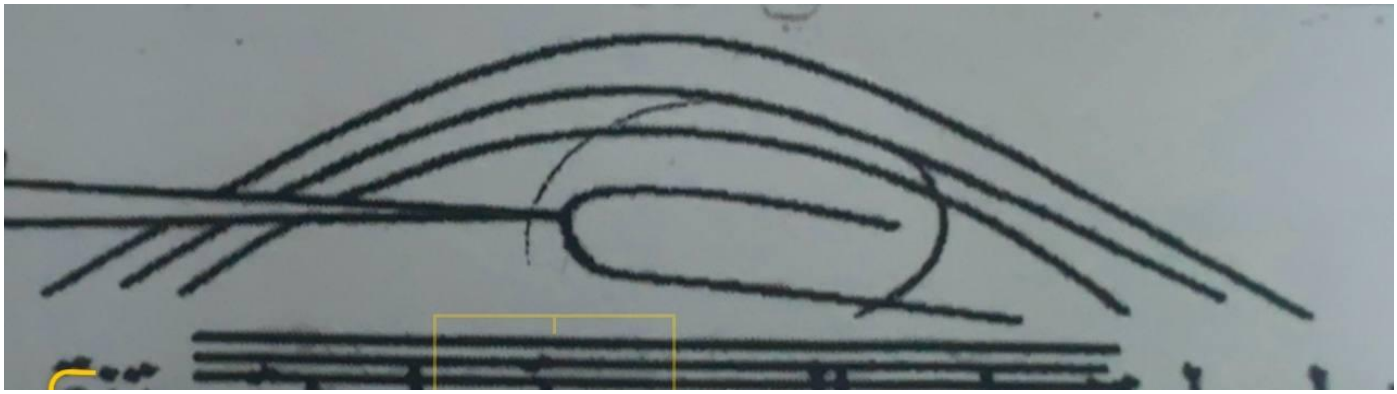
The arched footprint is the one whose lines - which may be horizontal, curved or arched upwards - move from one end to the other without changing their direction and are divided into two types:

* **Simple arches**: These are the ones that arch slightly as they move and then end on the other opposite side, so the lines look like arches

* **Tent or raised arches**: These are the ones in which the lines enter from one side of the footprint but rise in the middle to the top and arch sharply and then descend to the opposite side, so the shape drawn by these lines looks like a tent and the middle column looks like a tent column.



* **Exceptional arches** : Lines enter from the right side and exit from the left side or vice versa, with a line entering and exiting in the same direction and a curve in the middle.



- Slopes

A sloping fingerprint is any fingerprint in which one or more lines rotate around itself in the middle, forming a "loop". There are two types of slopes:

* Ulnar slopes: These are the ones whose formal lines and central lines point towards the little finger when they emerge. Lab2 Fingerprints

* Radial slopes: These are the ones whose central and formal lines point towards the thumb when they emerge.

Slope Conditions:

1- The presence of one angle

2- The presence of a center

3- There is at least one line separating the angle and the center

Rounds include:

1- Circular rounds: Its center is circular.

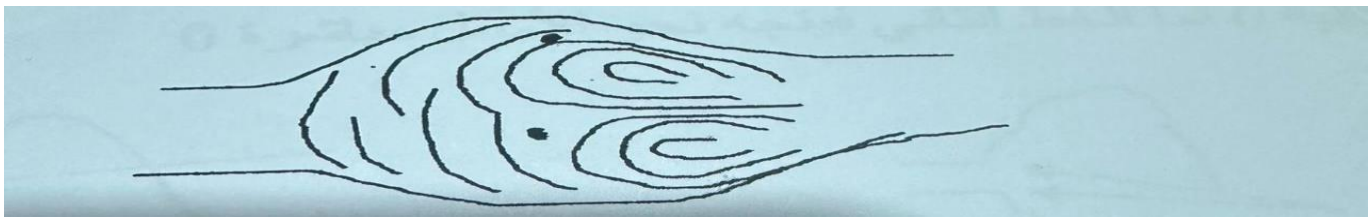
2- Spiral rounds: Its center is spiral shaped.

3- Oval rounds: Its center is oval in shape.

Circular conditions: 1- There are two angles 2- There is a center 3- There is at least one line separating the two angles.

- The complex : It is divided into the following types:

- Consistent slopes are two slopes within a single shape and the lines flow in one direction.



- Different slopes are two slopes within a single shape and the lines flow in opposite directions

- A slope with a central loop is a circular shape within the slope.

- Varieties: There is more than one form within the edition.

Nanotechnology: has emerged as a phoenix in the field of forensic science and proved to be of great im-portance in solving criminal cases where other tech-niques failed to provide conclusive results. This field of science possess humongous potential in the field of forensic science and assist in crime detection. It holds huge amount of value in making a positive contribu-tion in assisting forensic experts and scientists in nab-bing the criminals and most importantly prevent any wrongful conviction. In the past decade, many researchers have re-ported the satisfactory application of Nano technique in Forensic Science for the analysis of latent finger-prints.

If a fingerprint on a knife or any weapon falls into the water, can it be erased? To answer scientifically, scientific and practical reality confirms that each fingerprint has preservation conditions and a degree of exposure to dust or weather changes and the extent of exposure to any factor affecting it such as dust, water, friction and temperature. Accordingly, the fingerprint can be erased after minutes and can last for years. In other words, water may erase the fingerprint depending on the nature of the component and surface of the body on which the fingerprint is imprinted and the component of the physical medium of fresh, salty,

polluted, muddy or sandy water and its duration. Remains of the fingerprint may remain on the physical body such as a knife or weapon that can be detected using unconventional methods and modern technologies. There is recent research that has dealt with dealing with, detecting and displaying fingerprints that may be difficult to detect using traditional methods. Scientists at the University of Technology in Sydney have developed a new technology called nanotechnology (ultra-fine particles) that helps solve many cases of identifying dry, wet and unclear fingerprints that are not recognized by the currently used methods. In detection and reproduction, and it is difficult to detect them with those traditional methods, as nanotechnology reveals clearer details than the traces left by amino acids. On different types of surfaces, scientists aim to obtain fingerprint traces from any surface, whatever its nature, wherever it is found, no matter how long it is. And in any material medium in which it is found, as researchers relied in their work on new chemical treatments that target amino acids, which are those molecules that are usually found in sweat and remain in fingerprint traces. Although targeting amino acids to obtain these fingerprints has been a method used for decades, researchers at the University of Technology have Lab2 Fingerprints

employed nanotechnology to obtain clearer details for unclear fingerprints. This leads to obtaining more clear fingerprints, which helps increase the number of cases that are solved. And lifting the traces of objects, tools and machines that were in physical bodies in any medium, including water, using the developments of chemistry, and through the analysis of these traces, and finding the results of an abundance of completely new information about the user of these tools or their owner, such as his appearance (man or woman...), his activities, and his lifestyle, with the aim of directing the search, when there is no verified suspect. There is a study in the Chemistry Department at the University of Sharjah, on developing a new method to detect latent fingerprints using nanotechnology, which is one of the latest sciences in this field, based on developing compounds containing small particles of pure gold in nano size. What makes these compounds unique is the presence of the element of gold, which helps to highlight the fine lines of fingerprints easily, which helps forensic science to preserve evidence for the longest possible period. As nanotechnology has a great impact on modern technology, the application of natural science techniques helps forensic sciences, in a distinctive way, in its goal of revealing evidence in crimes in which no error is accepted in the investigation, and in which the result of the examination using nanoparticles is considered more reliable than photographing the latent and hidden fingerprint residues on different objects and materials. The (micro-X-ray fluorescence) technology was used to reveal images of latent fingerprints, unlike the methods and demonstrations of fingerprints with ordinary chemicals, where the latent fingerprint is shown through interactions between chemicals and amino acids, or fatty acids from fingerprints, and the MXRF technology generates latent fingerprint images based on the detection of inorganic elements in the fingerprint in addition

to being more useful due to the non-destructive nature of the analysis and the stability of inorganic residues, as the fingerprints remain intact during the analysis and the fingerprint prints remain possible to photograph and can be used to conduct additional examinations, such as elemental analysis (almost elemental) within appropriate storage mechanisms for evidence. The most common inorganic residues observed in fingerprints Fingerprints are potassium and chloride ions, in addition to other elements that can be found in latent prints that MXRF detects, including silicon, calcium, and aluminum. However, this method has one drawback, which is that the elemental composition of the fingerprint depends on the person and/or their diet, and this method cannot be applied to all cases because MXRF actually provides an elemental analysis of the inorganic elements present in the fingerprint, and any materials other than the fingerprint components can also be detected or imaged including sweat, emollients, saliva, and sunscreen.

It is also considered a screening technique. Metal-organic framework (MOF) crystals, when applied to surfaces in a drop of liquid, quickly bind to fingerprint residues, including proteins, peptides, fatty acids, and salts. In about 30 seconds, this results in Lab2 Fingerprints

a very thin coating that forms an exact copy of the fingerprint and glows under UV light, allowing high-resolution images to be captured for easy analysis**.** Different colored fingerprints can also be used by changing the chemistry of the solution. **Imaging fingerprint residues using nanotechnology. Micro-X-ray fluorescence technology to reveal images of latent fingerprints. Unlike conventional chemical methods where the latent fingerprint is revealed through interactions between chemicals and amino acids, or fatty acids from fingerprints, MXRF technology gives images of latent fingerprints by detecting the inorganic elements in the fingerprint. Any non-fingerprint materials can also be detected or imaged including sweat, emollients, saliva, and sunscreen.**

It is also considered a screening technique. **Metal-organic framework (MOF) crystals**, when applied to surfaces in a drop of liquid, rapidly bind to fingerprint residues, including proteins, peptides, fatty acids, and salts. In about 30 seconds, this results in an ultra-thin coating that forms an exact copy of the fingerprint and glows under UV light, allowing high-resolution images to be captured for easy analysis. Different colored fingerprints can also be used by changing the chemistry of the solution. Fingerprint residues can be imaged using nanotechnology. Micro-X-ray fluorescence technology to detect latent fingerprint images, unlike conventional chemical methods where latent fingerprints are revealed through reactions between chemicals and amino acids, or fatty acids from fingerprints, MXRF technology produces latent fingerprint images by detecting inorganic elements in the fingerprint, in addition to being more useful due to the non-destructive nature of the analysis and the stability of inorganic residues, as fingerprints remain intact during analysis and can be used for

additional examinations, such as elemental analysis of gunshot residues, and fingerprint prints can remain imageable for up to eight months in suitable evidence storage mechanisms. The most common inorganic residues observed in fingerprints are potassium and chloride ions, in addition to other elements that can be found in latent prints detected by MXRF including silicon, calcium and aluminum. However, this method has one drawback, which is that the elemental composition of the fingerprint depends on the person and/or his diet, and this method cannot be applied to all cases because MXRF actually provides elemental analysis of the inorganic elements present in the fingerprint, and any non-fingerprint materials can also be detected or imaged including sweat, emollients, saliva, and sunscreen. For example, emollients and sunscreen can be detected due to TiO2 or ZnO nanoparticles, while sweat can be detected due to inorganic components. Furthermore, MXRF can be used to screen for dietary consumption by linking elements detected in saliva and food residues found in fingerprints to investigate cases of missing children...

Thus, nanotechnology in forensic science is the easiest way to criminal justice