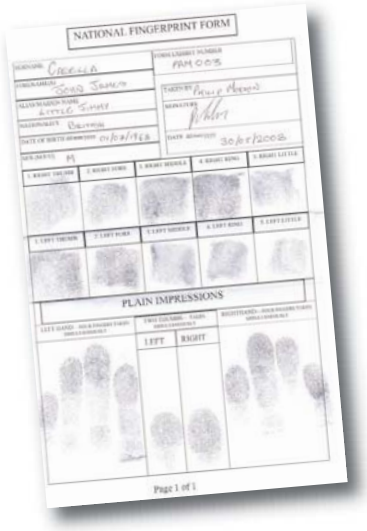
What are Fingerprints?

Friction ridge skin is found on the palms of the hands and the soles of the feet, these highly varied skin patterns are formed when the person is still in the womb and are influenced by a wide variety of random events such that as of yet no two prints or areas of friction ridge skin have ever been found to be identical in over 100 years of collecting and recording prints. This friction ridge skin originated as a means of increasing the grip of these areas of the skin enabling humans (and some other primates) to grip objects strongly and specifically. You can test the effectiveness of this by comparing the friction you experience when you drag your fingertips over an object such as a desk with the friction when you drag the back of your hand over the same object.

Fingerprints are individual and do not change over a persons life, although they do get larger when you grow the pattern will be the same. These characteristics of fingerprints have been known for thousands of years and they were used as a method of signing contracts in ancient China and business transactions in ancient Babylon. The potential to use fingerprints as a method of indentifying criminals was not realised until the late nineteenth century and the first identification of a print found at a crime scene was attributed in 1880, they were not used in court however until the start of the twentieth century.



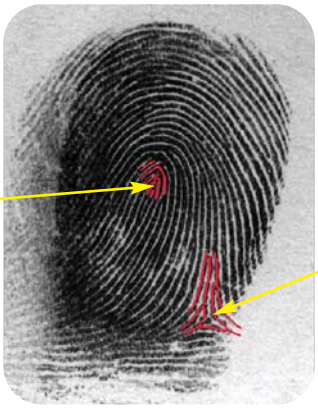
There are two main types of fingerprints encountered regularly, inked prints such as those taken from a suspect or someone whose prints could be expected to be at the scene, and latent prints. Latent prints are those prints which are invisible or nearly invisible to the naked eye and need some kind of enhancement or development to make them visible, such as oblique lighting or using fingerprint powders.
The chances of two fingerprints being identical was calculated in 1892 to be 1 in 64 billion, of the hundreds of millions of prints so far classified and recorded no two fingers have ever been found to have the same pattern, not even with identical twins which do share identical DNA.

Important uses of Fingerprints include

- Establishing the identity of a person (or corpse)
- Establishing the identity of someone who was present at a crime scene
- To link recovered stolen property to a victim
- To link several crime scenes individually investigated with one suspect
- To connect an individual with an object known to have committed an offence, such as a firearm
- Personal use, with security on palm pilot and some cars now being built with systems which recognise your fingerprint and use that to adjust to your preferred settings and to override security features
- The importance of fingerprint evidence can never be underestimated as people can be freed, cleared or convicted on this evidence alone, and at times it's the only evidence to go on.

Pattern Type

The classification system used for fingerprints has remained relatively unchanged since it was introduced to the UK in 1901.
There are three levels of detail looked at when classifying prints.
First level detail involves looking at the macroscopic elements of the print, the features which are initially identified are the Cores and deltas of the print.



Core
This is the centre of the pattern

Delta
These are where fingerprint ridges are coming in from three sides of the pattern.

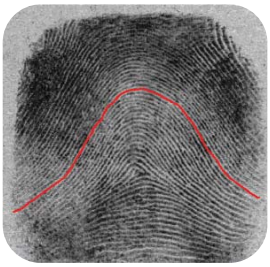
Fingerprints are also classified into three types of specific pattern;

Loops

In loops the ridges of the print enter from one side of the print crossing going between the core and the delta and then curve back round and exiting on the same side of the print.

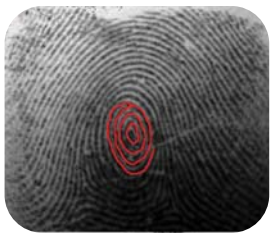
Arches

In arches the ridges of the print enter from one side of the print sloping upwards, then slope down before exiting the print on the other side.



Whorls

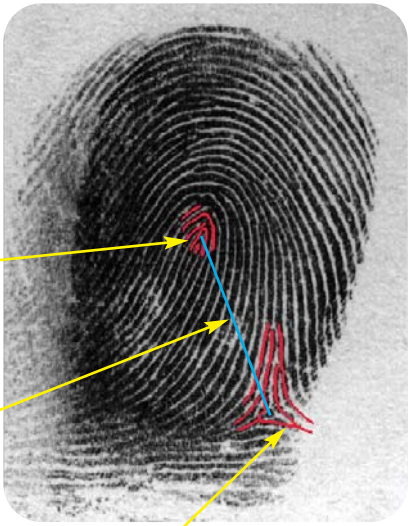
In whorls some of the ridges turn through a full circle. Any fingerprint which contains two or more deltas is classified as a whorl.



First Level Detail and Pattern Type – Higher Level

The classification system used for fingerprints has remained relatively unchanged since the Henry system was first introduced to the UK in 1901.
There are three levels of detail looked at when classifying prints.

First level detail involves looking at the macroscopic elements of the print, the features which are initially identified are the Cores and deltas of the print.



Core
This is the centre of the pattern which is usually near the centre of the print though can be offset

Ridge Count
This is the number of ridges between the core and the delta, this print has a ridge count of 11.

Delta
These are where fingerprint ridges are coming in from three sides of the pattern, usually found near the bottom of the print off set on one or both sides.

Fingerprints are also classified into specific patterns. These are:

Loops

In loops the ridges of the print enter from one side of the print crossing going between the core and the delta and then curve back round and exiting on the same side of the print. Loops can be either right sided or left sided depending upon which side the ridges of the loop enter the print, and more than 60% of all prints are loops. These can be classified as left or right sided loops in the case of latent prints, however when they are prints taken from a known source these are termed radial and ulnar loops (named after the radius and ulnar bones in the arm). On Radial loops the ridges enter and leave the print on the thumb side of the print, Ulnar loops enter and leave the print on the little finger side of the hand.

Plain loop

In the UK these loops are divided further into;

Plain loops
As above with the loop pointing upwards away from the delta

Nutant loops
Same as a loop but with the loop pointing towards the delta

Converging loops
Same as a plain loop but with the ridges at the core converging.

Converging loop

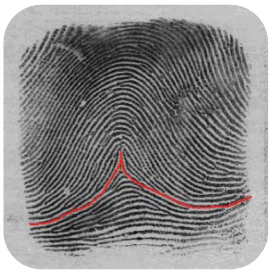
Arches

In arches the ridges of the print enter from one side of the print sloping upwards, then slope down before exiting the print on the other side.
These are further categorised into either plain arches or tented arches:

Plain Arches
The ridges in plain arches flow evenly from one side to the other with no significant up-thrusts.


Plain Arch

Tented Arches
The ridges in the tented arch have significant up thrusts with the curve in a ridge being less than 90°.

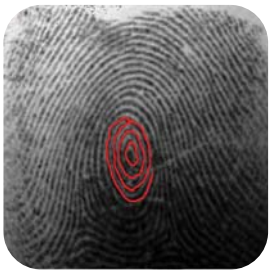

Tented Arch

Whorls

In whorls some of the ridges turn through a full 360°.
Any fingerprint which contains two or more deltas is classified as a whorl.

Whorls themselves can be split into four different types:

Plain whorls
Have at least one ridge which completes a full circle between the two deltas.


Plain whorl

Central pocket whorls
Have at least one ridge which turns through 360°, this can be a circle, oval or spiral. Usually a loop which enters one side curves round the centre and exits on the same side is also seen.


Central pocket whorl

Double loop whorls
Consist of two separate loop formations and hence two cores and two deltas.

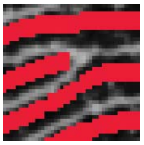
Accidental Whorls
Consist of two separate pattern types not including a plain arch and conforms to non of the previous definitions.

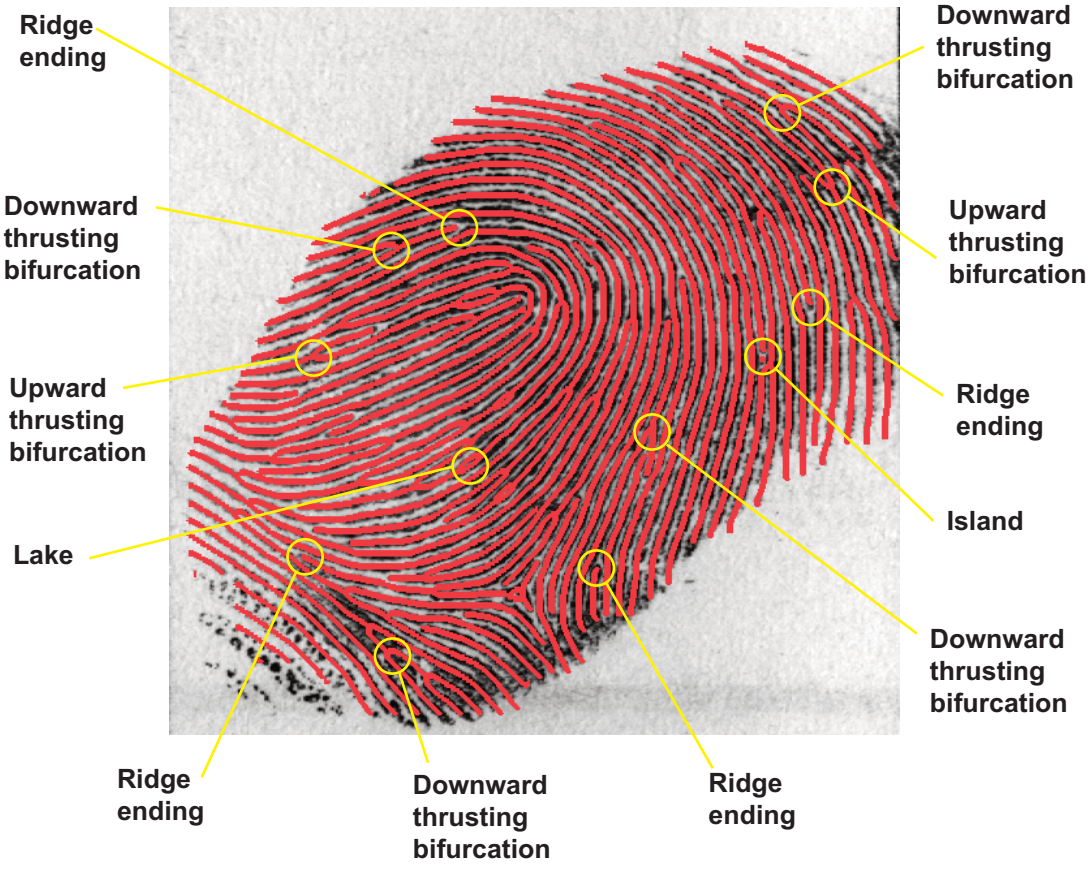

Double loop whorl

Second Level Detail: Minutia/Ridge Characteristics

The classification of a fingerprint is not enough to determine whether two prints are a match, specific ridge characteristics are looked at. These ridge characteristics are called minutia. The most common ridge characteristics are ridge endings and bifurcations. There may be dozens of ridge characteristic on any given print, with partial prints this can be lower but in some cases a match can still be determined.

Usually at least 12 points are looked at but in UK in 2001 it was ruled that no specific number of minutia are needed for a positive match but there need to be a match in the opinion of three fingerprint examiners. Another form of second level detail which is thought to be individualising is the location of any scars and their intersection with pre-existing ridge formations.

Ridge Ending	Upward Thrusting Bifurcation	Downward Thrusting Bifurcation	Lake	Island/Dot	Spur	Bridge
						



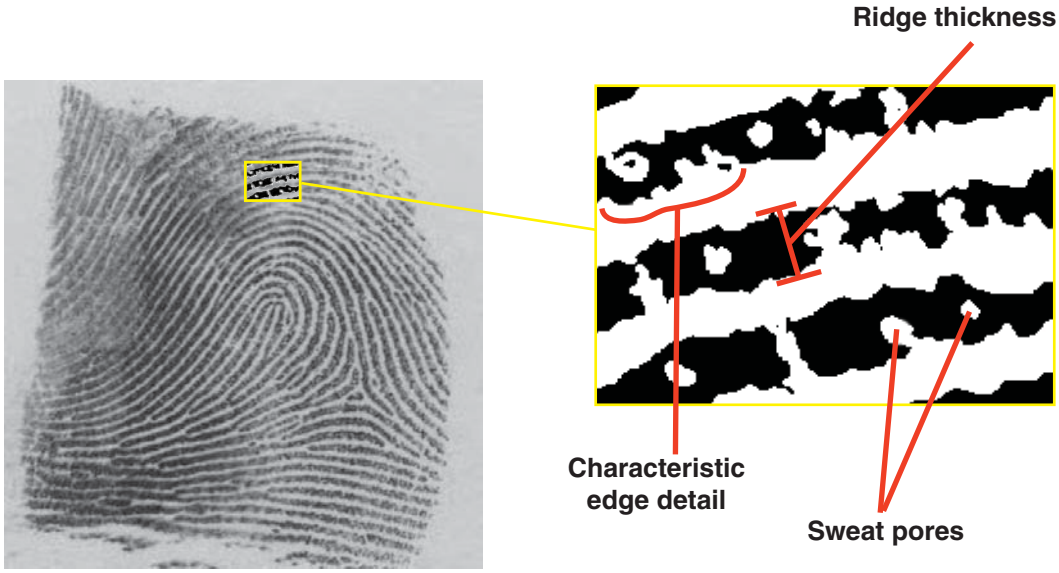
Third Level Detail: Edgeoscopy and Poroscopy

This is the additional aspect of detail that experts would be expected to look at, comment upon and use to ad further weight to their comparison of prints from two different sources, either confirming a conclusive match or a non-match between the two prints.

Details looked for include;

Edgeoscopy
Small shapes on an individual ridge.

Poroscopy
The thickness or thinness of a particular ridge and the location of sweat pores if they can be seen in the print.



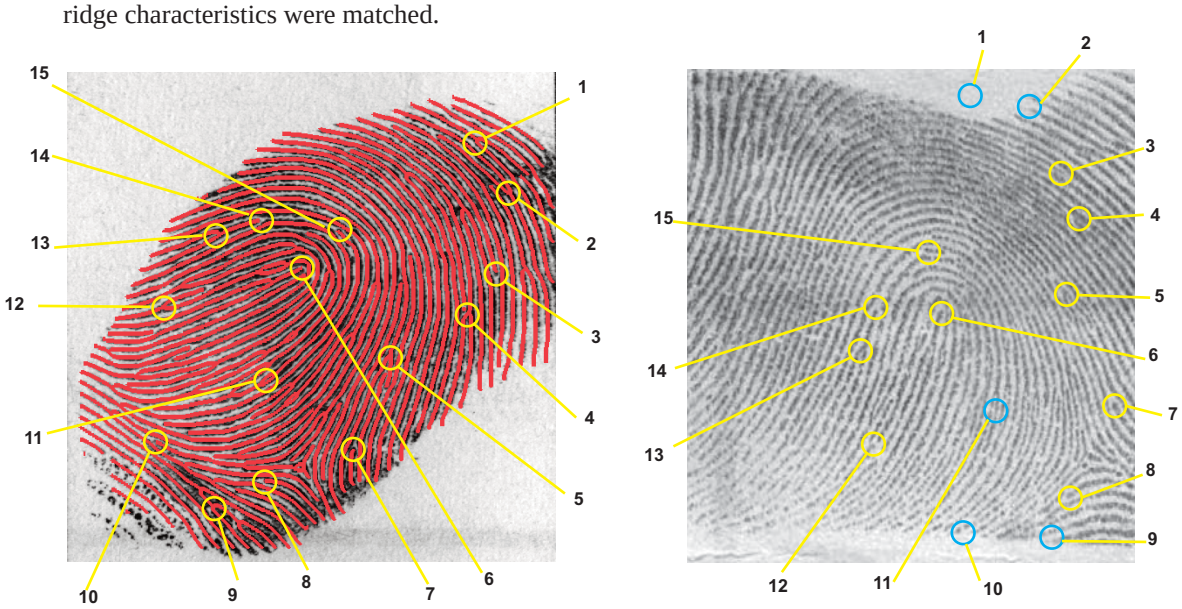
Third level detail examination nearly always confirms the conclusions made by looking at the second level detail but the specific measurements and location of sweat pores is thought to be even more random than the minutia locations and pattern type and therefore more individualising.

With poor quality latent prints this amount of detail is not always visible and matches can be made without this, however if this can be seen then it is useful for adding more weight to an expert's the conclusion.

Latent Print Analysis

To demonstrate how a fingerprint examiner would identify a latent print with a corresponding inked print. Using the version of the latent print from before with the ridges identified we have compared this to the inked fingerprint suspected to be the one which left the latent print behind. Each of the ridge characteristics identified previously were looked at, of these most were easily identified on the ink print, a few were not found on the inked print but this was due to them lying outside the region of the finger printed.

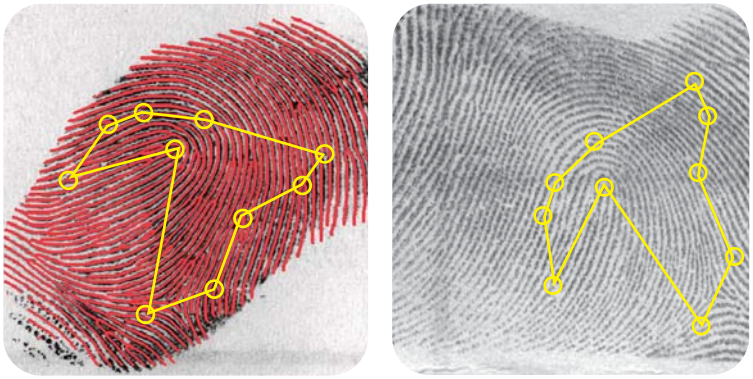
One of the methods used to locate a ridge characteristic on the inked print which has been identified on the latent print is to count the number of ridges between the ridge characteristic and the core or delta of the print (a previously confirmed ridge characteristic also can be used). In the above example thirteen ridge characteristics were matched.



Key

1. Downward thrusting bifurcation (outside area of inked print)
2. Upward thrusting bifurcation (outside area of inked print)
3. Downward thrusting ridge ending
4. Downward thrusting bifurcation
5. Downward thrusting bifurcation
6. Upward thrusting ridge ending
7. Upward thrusting ridge ending
8. Downward thrusting ridge ending
9. Bifurcation (outside area of inked print)
10. Ridge ending (outside area of inked print)
11. Lake (unclear in inked print)
12. Upward thrusting bifurcation
13. Downward thrusting bifurcation
14. Upward thrusting ridge ending
15. Ridge ending

A good method for visualising the match of all these points is to place a polygon over one print which covers all the minutia identified and then place the same polygon onto the other print, this can usually help confirm that the two prints are from the same source.



N.A.F.I.S

N.A.F.I.S is the National Automated Fingerprint Identification Service which is a database of nearly six million prints. Similar to AFIS in the USA and various other fingerprint databases around the world this is a collection of prints from all 43 police forces in the UK. An investigator can input a print either a latent or via live scan at any of over 200 live scan points around the country and conduct a search for those prints against the database, receiving verification of a match (if one is present) usually within 15 minutes.

The input of a latent print or ten print card into the database requires some human control, rather more than the simple scanning in which you will see on television. The key stages in this input method is as follows; (the order may change with differing systems but the principles are the same)

- Find the location and direction of Core and Delta

- Determining of Pattern type (if possible – may not be with some partial prints).
- Orientation of print. The core of the print is inside the blue circle, the more definite the location of the core the smaller the circle. The top of the print is between the blue lines, the more definite the orientation the closer the lines are to each other.

- Selection of the area where there are fiction ridges, this prevents the program wasting time trying to analyse the background.
- The program then tries to identify the location and flow of the ridges – ridge skeleton, these need to be manually checked by eye to ensure that the program has not missed out any ridge endings in the print or added any on that should not be there.

- Based on this ridge skeleton the program then the program tries to identify ridge endings and bifurcations – all other minutia types can be explained as a combination of one or more bifurcations or ridge endings.
- The data as a combination of these ridge characteristics is what is searched for in the database.

- Once these prints have been searched for in the database the result can return with dozens of potential matches which it has in the database. The automated system will give a score to these matches showing the examiner the prints it deems to be the closest to the original. Theses results would then need to be examined physically by an examiner. Any results which are deemed to be positive will also need to be examined by a further expert prior to confirmation.