

SIMPLIFIED FINGERPRINT ANALYSIS

Adapted from: <http://sites.bergen.org/forensic/fingerprint.htm>
Originally from: Ward's Fingerprinting Analysis Kit (36W5889)

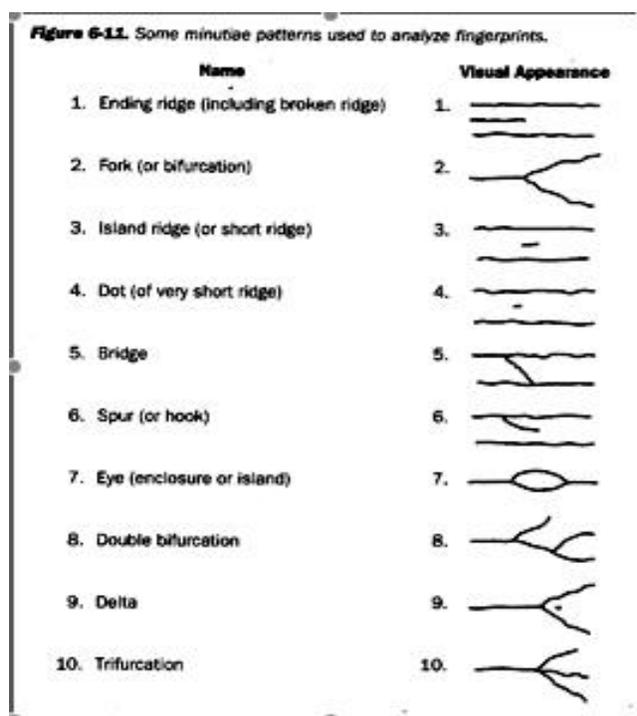
WHY USE FINGERPRINTS IN A CRIMINAL INVESTIGATION?

According to most professional criminal investigators, fingerprints obey three fundamental principles. These principles are:

1. A fingerprint is an individual characteristic. It is yet to be found that prints taken from different individuals possess identical ridge characteristics.
2. A fingerprint will remain unchanged during an individual's lifetime.
3. Fingerprints have general characteristic ridge patterns that permit them to be systematically classified.

The individuality of any fingerprint is based not upon the general shape or pattern that it forms, but instead upon its ridge structure and specific characteristics (also known as **minutiae**). The recognition of these ridges, their relative number, and the approximate location of them, on the observed print, are the special characteristics that make the fingerprint a specific identifying characteristic of each individual. There are at least 150 individual ridge characteristics on the average fingerprint. If between 10 and 16 specific points of reference for any two corresponding fingerprints identically compare, a match is assumed.

Some examples of typical ridge characteristics (minutiae) are shown in the drawings below:



Minutiae descriptions:

- *Ridge ending* – the abrupt end of a ridge
- *Ridge bifurcation* – a single ridge that divides into two ridges
- *Short ridge, or independent ridge* – a ridge that commences, travels a short distance and then ends
- *Island* – a single small ridge inside a short ridge or ridge ending that is not connected to all other ridges
- *Ridge enclosure* – a single ridge that bifurcates and reunites shortly afterward to continue as a single ridge
- *Spur* – a bifurcation with a short ridge branching off a longer ridge
- *Crossover or bridge* – a short ridge that runs between two parallel ridges
- *Delta* – a Y-shaped ridge meeting
- *Core* – a U-turn in the ridge pattern

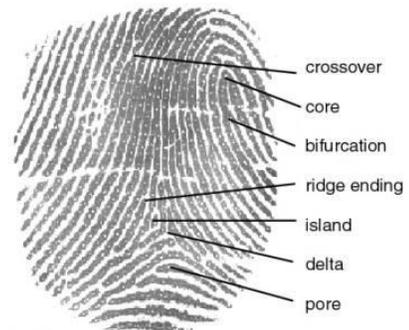
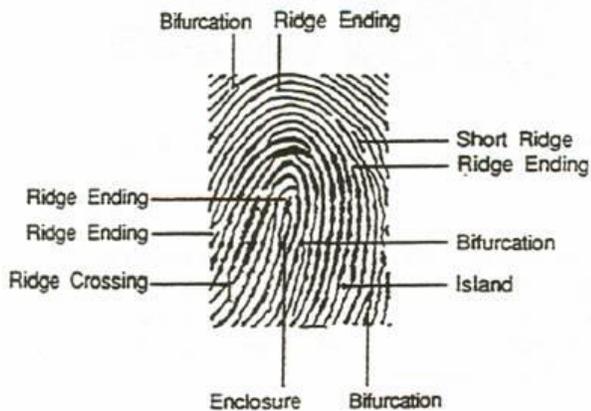
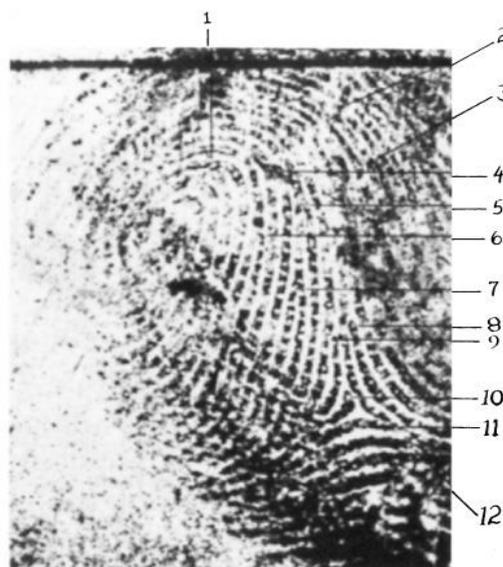
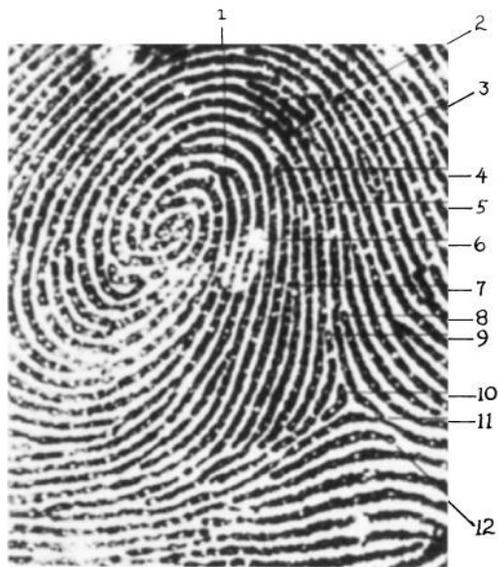


Figure 1

Point by Point Comparison

In a judicial proceeding however, a point-by-point comparison must be graphically demonstrated for at least 12 different, but corresponding, points in order to prove the identity of a specific person. (The number of identified minutiae required for a match differed between states and countries, but 12 is becoming the standard especially as fingerprinting becomes digital). Note the use of a legend and how each minutia has its own number (i.e. every Bifurcation is not #1, each Bifurcation needs its own number).



- 1. Bifurcation
- 2. Ridge ending
- 3. Enclosure
- 4. Ridge ending

- 5. Bifurcation
- 6. Bifurcation
- 7. Bifurcation
- 8. Ridge ending

- 9. Ridge ending
- 10. Short ridge
- 11. Bifurcation
- 12. Ridge ending

IDENTIFICATION OF PRINT CHARACTERISTICS

There are three specific classes for all Fingerprints based upon their general visual Pattern. These are: loops, whorls, and arches. Approximately 60% of the total population have loops, 35% have whorls, and 5% have arches. The three major groups are also subcategorized based upon smaller differences existing between the patterns within the specific group. These subcategories are as follows:

I. ARCH

- a) Plain arch
- b) Tented arch

II. LOOP

- a) Radial loop (opens toward thumb)
- b) Ulnar loop (opens toward little finger)

III. WHORL

- a) Plain whorl
- b) Central pocket whorl
- c) Double loop
- d) Accidental whorl

Examples of each of these subcategories are illustrated as follows:



I.A. Plain Arch

I.B. Tented Arch

II.A. Radial Loop

II.B. Ulnar Loop



III.A. Plain Whorl

III. B. Central Pocket Whorl

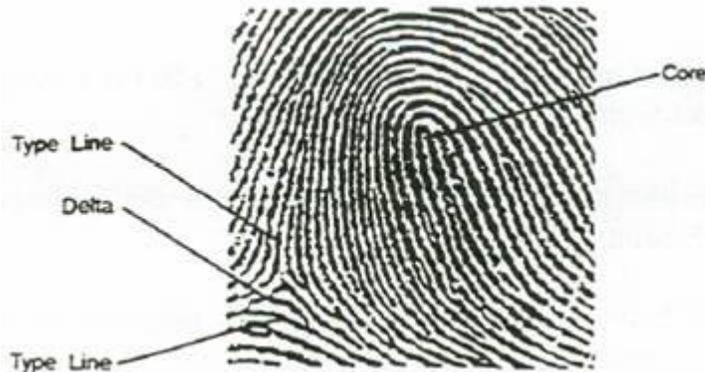
III.C. Double Loop

III.D. Accidental Whorl

Of the two types of arches, the PLAIN ARCH is the simplest of all fingerprint patterns. It is formed by ridges entering from one side of the print and existing on the opposite side. These ridges tend to rise at the center of the pattern, forming a wavelike structure. The TENTED

ARCH is similar, but instead of rising smoothly at the center, there is either a sharp up thrust or spike, or the ridges meet at an angle that is less than 90 degrees. Arches do not have type lines, deltas, or cores.

TYPE LINES are two diverging ridges usually coming into and splitting around an obstruction, such as a loop. A DELTA is the ridge point nearest the type line divergence. The CORE is the approximate center of the pattern. Examples of these characteristics are shown below:



A loop must have one or more ridges entering from one side of the print, recurving, and exiting from the same side. If a loop opens toward the little finger, it is called an ULNAR LOOP; if it opens toward the thumb, it is a RADIAL LOOP. The patterned area of any loop is surrounded by two TYPE LINES. All loops must have one delta.

All whorl patterns must have type lines and a minimum of two deltas. A PLAIN WHORL and CENTRAL POCKET LOOP have at least one ridge that makes a complete circuit. This ridge may be in the form of a spiral, an oval, or any variant of a circular form. The main difference between these two patterns can be shown if an imaginary line is drawn between the two deltas contained within the two patterns. If the line touches any one of the spiral ridges, the pattern is determined to be a plain whorl, if no ridge is touched, the pattern is a central pocket loop. An example of this procedure is shown below:



Plain Whorl



Central Pocket Loop

The DOUBLE LOOP is made up of any two loops combined into one fingerprint. Any print classified as ACCIDENTAL either contains two or more patterns (not including the plain arch) or the pattern is not covered by other categories i.e., a combination loop and a plain whorl or a loop and tented arch.

Examples of these are more clearly shown below:



Double Loop



Accidental

HOW PRINTS ARE USED IN A CRIMINAL INVESTIGATION

When the police or FBI book a person suspected of having committed a crime, the suspect's fingerprints are taken and kept on file. These are **DIRECT** or **INKED FINGERPRINTS** which are the impressions of the ridge detail of the individual's fingertips. About 200 million prints are on in the FBI Identification Division. Using modern computer technology, a set of prints can be run through scanning devices and matched with a possible suspect within minutes.

The term **LATENT PRINT** (hidden print) is a misnomer but often used inclusively. There are actually three kinds of **CRIME-SCENE** prints. These are:

1. **VISIBLE PRINTS** which are prints made by fingers touching a surface after the ridges have been in contact with a colored material such as blood, paint, grease, or ink.
2. **PLASTIC PRINTS** which are ridge impressions left on a soft material such as putty, wax, soap, or dust.
3. **True LATENT PRINTS** which are invisible print impressions caused by the perspiration on the ridges of one's skin coming in contact with a surface and making an invisible impression on it. Perspiration contains water, salt, amino acids, or oils and easily allows impressions to be made.

The method used for obtaining latent prints depends on the type of surface to be examined, the manner in which the prints were left, and the quantity of material left behind. After the prints have been photographed, lifted and taken into the crime lab, they are then compared to the prints of all persons known to be at the scene of the crime or who had access to the crime scene. This procedure eliminates all but the criminal's prints.

The most common techniques used to find latent or hidden fingerprints include:

1. Dusting with [Carbon Powder](#) on white or light colored surfaces.
2. Dusting with [Lanconide Powder](#) for black surfaces.
3. Dusting with [Aluminum Powder](#) for hard or dark colored surfaces as well as mirrors and metal surfaces.
4. Use of [Cyanoacrylate \(Super-glue\) fuming](#) for use on nonporous surfaces
5. Use of [Iodine fuming techniques](#) the oldest method used for visualizing latent prints
6. Use of [ninhydrin](#) for use on porous surfaces
7. Use of [Silver Nitrate](#) for use on porous surfaces or if the surface had been wet at one time.
8. Use of [Gentian violet](#).
9. Use of [Laser technology](#).