

Fingerprints

1. History

A. Early Use

- 1) ~3000 years ago - Chinese used fingerprints to sign legal documents
- 2) 1850s - William Herschel - English civil servant in India, started requiring natives to sign contracts w/an imprint of the right hand
- 3) 1880 - Henry Fauld - Scottish physician, suggested that skin ridge patterns could be important for the identification of criminals. Offered to set up a fingerprint bureau @ Scotland Yard to test the methods practicality. He was turned down. It was reversed 20 years later.

B. Early Classification of Fingerprints

- 1) 1892 - Francis Galton proposed classifying prints to 3 pattern types - loops, arches, & whorls. Said no 2 prints are identical & unchanging over time.
- 2) 1891 - Dr. Juan Vucetich - Argentinian police officer devised a workable classification system. It's been revised over time & is still widely used today in most Spanish-speaking countries
- 3) 1897 - Sir Edward Richard Henry - an Englishman, proposed a different classification system. It was adopted by Scotland Yard & some version is still used today in English-speaking countries, including the U.S.

C. Adoption of Fingerprinting

- 1) 1901 - 1st systematic and official use of fingerprints for personal identification was used by the NYC Civil Service Commission, used to certify all civil service applications.
- 2) 1904 - U.S. Police officials received instruction in fingerprinting at the St. Louis World Fair from Scotland Yard
- 3) 1924 - Fingerprint records of the Bureau of Investigation & Leavenworth were merged to form the new records of the FBI
 - a) FBI has the largest collection of fingerprints in the world
- 4) 1999 - U.S. v. Byron C. Mitchell - defendants argued that prints could not be proven unique under the Daubert ruling. After arguing for 4½ days, the judge upheld Daubert & the admissibility of fingerprints as scientific evidence
 - a) human friction ridges are unique and permanent
 - b) human friction ridge skin arrangements are unique and permanent

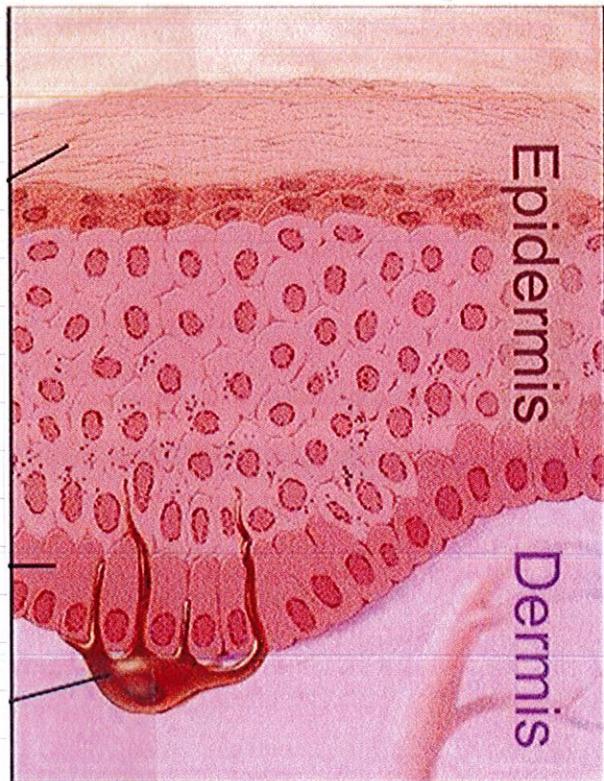
2. Fundamental Principles of Fingerprints

A. Fingerprints - raised ridges of skin on your fingers & toes, called friction ridges. water, oil, salts, & dirt can leave an impression behind when you touch something

- 1) Formation - pattern starts to develop at 10 weeks gestation
• complete when the fetus is 6 mos. along.
 - a) occurs in the basal layer
 - b) the basal layer grows faster than the rest of your skin
• it "folds" in on itself, creating ridges.

C. purpose -

to provide our fingers, hands, & feet with a firmer grasp
resistance to slippage.



Stratum:

corneum
lucidum
granulosum
spinosum

basale

contain
dermal papillae
which
determine
the form and
pattern of
the ridges.

B. 1ST Principle - Fingerprint is an individual characteristic, no 2 fingers have been found to possess identical ridge characteristics

1) General ridge characteristics

a) Loops
(65% of pop.)



have one delta

Whorls
(30 % of pop.)



have 2 deltas

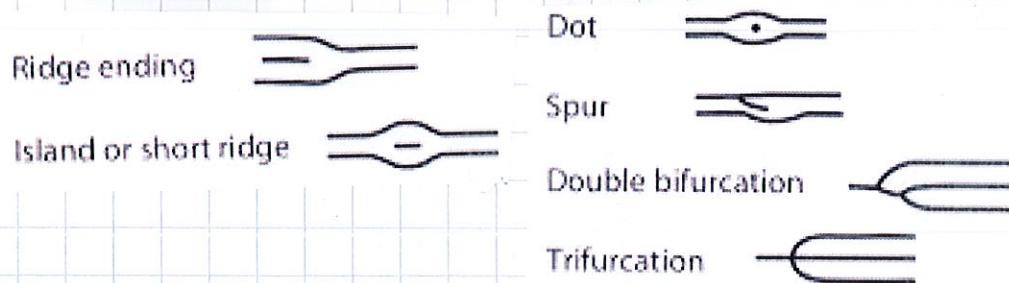
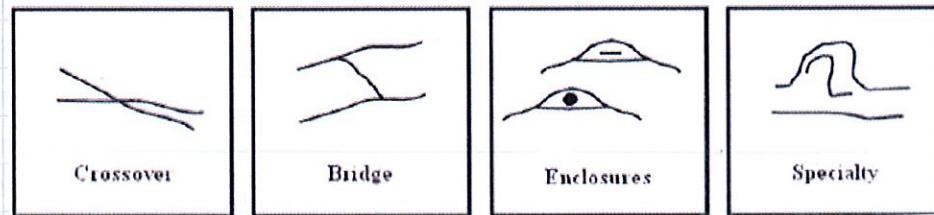
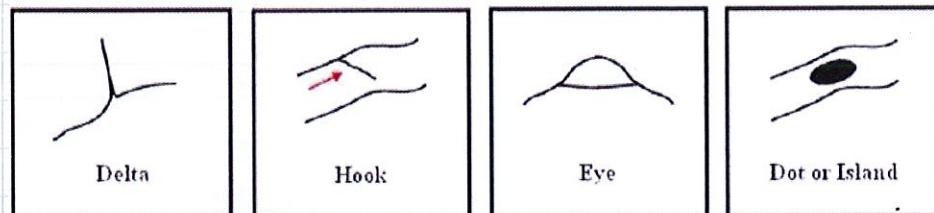
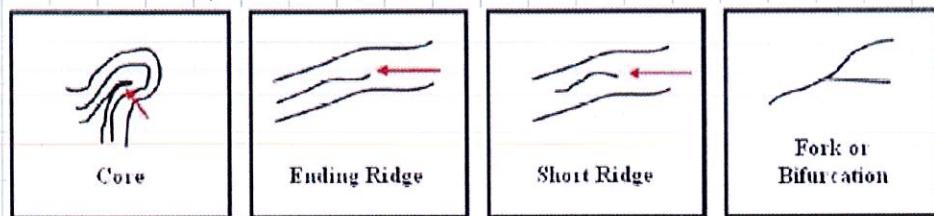
Arches
(5 % of pop.)

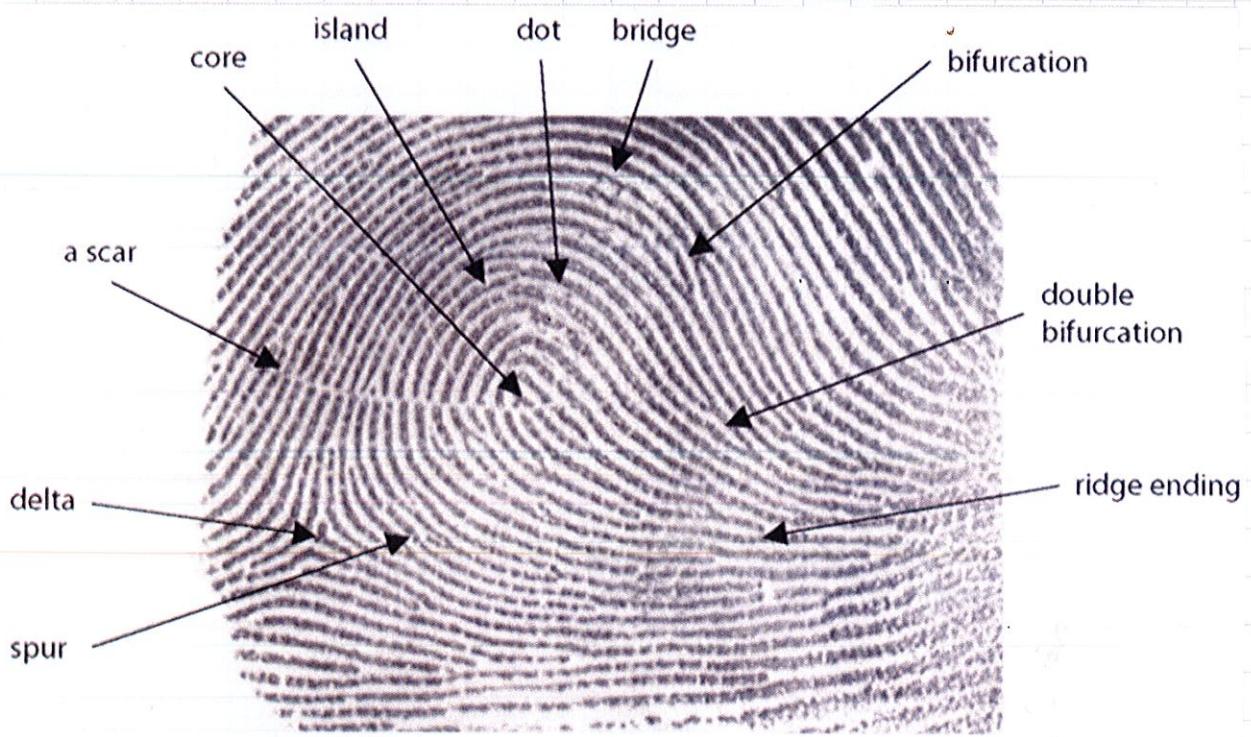


do not have deltas

b) Minutiae (specific ridge characteristics) - impart originality to fingerprints. If 2 prints are to match, they must have the same minutiae in the same relative location to one another

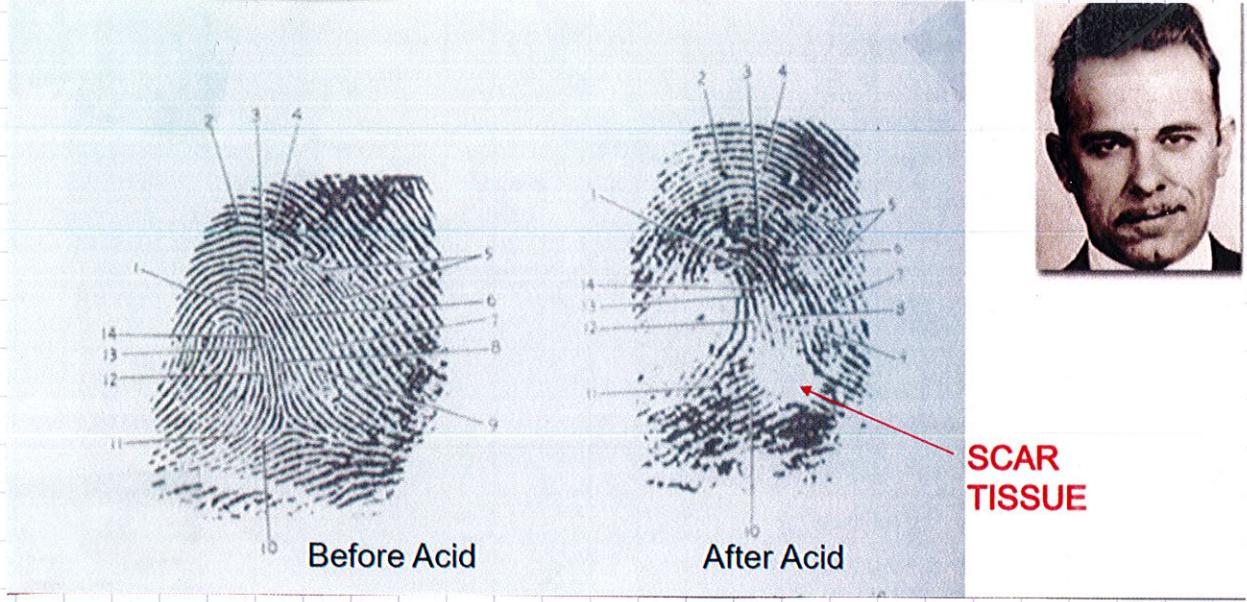
- i) average print has 150 individual minutiae
- ii) most crime scene prints are only partial prints
- iii) experts agree that 8-10 minutiae must match to prove a print matches another.





C. 2nd Principle: A fingerprint remains unchanged during an individual's lifetime

- 1) Each ridge has a single row of pores-opening for sweat glands. It's where the sweat comes from & is deposited on skin. Once a person touches a surface, their perspiration & oils picked up by touching their hair leave "hidden" prints on the surface, called a latent print.
 - a) Some criminals have tried to destroy their fingerprints so they could not be linked to crimes
 - i) If an injury damages the dermal papillae, a scar will form (permanent) - must reach 1-2 mm into the skin. (creates new unique features)
 - ii) It is impossible to completely obliterate all the minutiae
 - Ex) John Dillinger - tried to destroy his fingerprints by putting acid on them. Didn't work



D. 3rd Principle: Fingerprints have general ridge patterns that permit them to be systematically classified

- 1) All prints are divided into 3 classes on the basis of their general pattern: loops, whorls, and arches. (See p 2)
- C The ACE-V Process - to identify & individualize a print - stands for Analysis, Comparison, Evaluation, and Verification
 - 1) Analysis - identify any distortions associated w/the ridges as well as surface or deposition factors or processing techniques that may impinge on the print's appearance.

2) Comparison - 3 levels

- Level 1 - looks at general ridge flow and pattern configuration
- Level 2 - locate and compare minutiae (can individualize a print)
- Level 3 - exam and locate ridge pores, breaks, crases, scars, and other permanent minutiae. Examiner compares the latent print side by side with an exemplar print in the totality

3) Evaluation - requires 1 of 3 decisions

- Identification - latent print & exemplar came from the same source - positive match
 - Exclusion - latent print & exemplar did not come from the same source - no match
 - Inconclusive - cannot determine that the latent print and exemplar came from the same source, or not, with a relatively strong level of certainty
- 4) Verification - a 2nd examiner independently verifies the 1st examiner's results. There must be consensus between the 2 examiners before a final conclusion is drawn.

3. Automated Fingerprint Identification Systems (AFIS) - have been around since the 1970s)

A. 1999 - FBI initiated full operation of the Integrated Automated Fingerprint Identification System (IAFIS) - largest AFIS in the U.S. - links state AFIS systems with the FBI database

1) contains nearly 50 million fingerprint records

B. How AFIS works

1) The computer's search algorithm determine the degree of correlation b/w the location & relationship of minutiae for both the search & file prints.

a) a set of 10 fingerprints can be searched against a file of 500,000 in about .8 seconds.

b) computers selects a list of possible print matches scored according to best matches

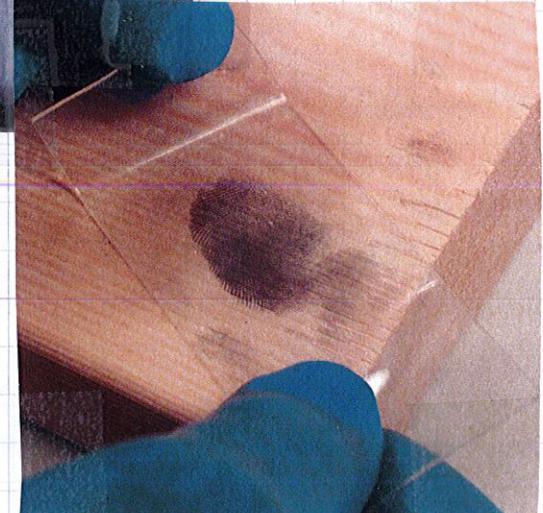
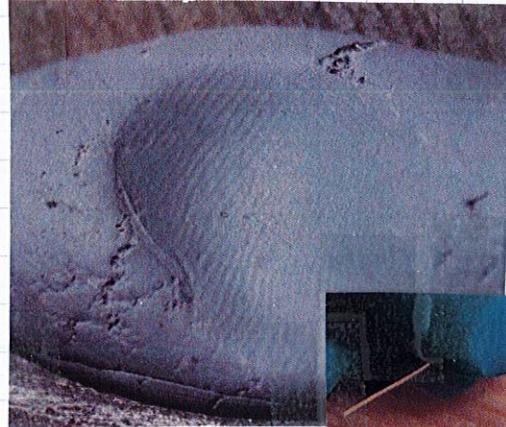
2) Then those are sent to the examiner.

4. Types of Fingerprints

A. Patent - visible prints left on a smooth surface when blood, ink, or some other liquid comes into contact w/ hands and is transferred to that surface.

B. Plastic - actual indentions in a soft material such as clay, putty, or wax.

C. Latent - hidden prints, caused by the transfer of oils or other body secretions onto a surface. invisible.



5. methods of Detecting Latent Fingerprints

A. method used depends on the type of surface being examined

1) Hard, nonabsorbant surfaces - glass, mirror, tile, etc.

Painted wood - prints are usually developed by application of powder or treatment w/ superglue.

2) Soft, porous surfaces - paper, cardboard, cloth - prints are usually developed using one or more chemical processes.

B. Developing latent Prints

1) Fingerprint powders - available in a variety of colors & compositions

a) Powder is applied lightly to a nonabsorbant surface w/ a brush, it adheres to the sweat/oils in the print, making it visible

i) gray powder - made of aluminum dust, is used on dark colored surfaces. It is also used on mirrors or other highly polished metals b/c those surfaces photograph black

ii) black powder - made of carbon, is used on white or other light-colored surfaces

iii) magnetic powder - applied w/ a magnet instead of a brush. Less messy. Comes in gray or black - useful on finished leather or rough plastics

iv) fluorescent powder - fluoresce under UV light - avoids having the color of the surface interfere w/photographing the print.

2) Iodine Fuming - material w/ suspected print is placed in a container w/ iodine crystals. The iodine sublimes (turns to a gas) and interacts w/ the print, turning it brown. This is NOT permanent. Can be made permanent by spraying w/ a 1% starch solution - turns print blue

3) Ninhydrin - forms a purple-blue print when it reacts w/ amino acids in the fingerprint. Forms w/i 1-2 hours after spraying. Can be sped up by applying heat. Has been used on prints that are 15 years old!

4) Silver nitrate - good on prints that other methods don't work on. Also works on porous materials that may have been wet once.

5) Cyanoacrylate (superglue) fuming - used for paper, cardboard, metals, electrical tape, leather, plastic bags. Print placed in a container w/ a small amount of glue which is heated & turned to vapor. Glue sticks to print, turning it white.

- U. Preservation of Developed Prints - prints must be preserved for comparison & use in court
 - A. photographs
 - B. smaller objects - cover print w/ cellophane to protect it
 - C. larger objects - develop & "lift" them using one of the methods already discussed.