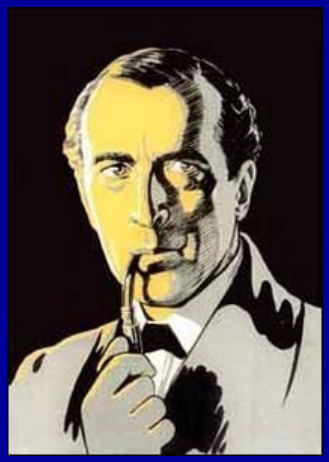
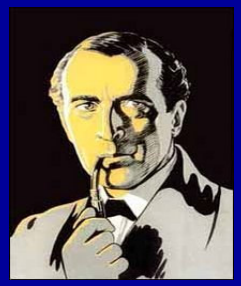
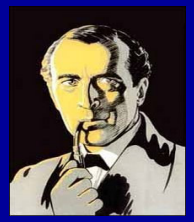


FINGERPRINTS



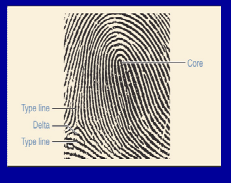
History

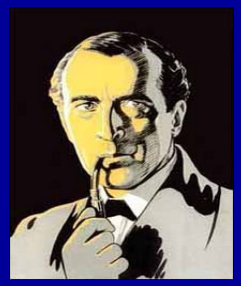
- The first systematic attempt at personal identification was devised by a French police expert, Alphonse Bertillion.
- The Bertillion system relied on a detailed description of the subject, combined with full length and profile photographs and a system of precise body measurements called anthropometry.
- In 1892 Francis Galton published his classic textbook *Finger Prints*.



History - Continued

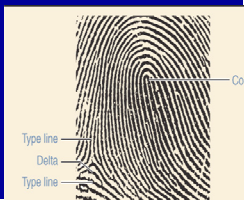
- Dr Juan Vucetich devised a classification system still used in most Spanish-speaking countries, while Sir Edward Henry devised another classification system used in most English-speaking countries.
- In 1903, when the Bertillion system could not distinguish between two men (one Will West and the other William West), it was fingerprinting that clearly distinguished them.
- After the Will West incident, the use of fingerprinting by the New York City Civil Service Commission in 1901, and the training of American police by Scotland Yard representatives at the 1904 World's Fair, fingerprinting began to be used in earnest in all major U.S. cities.

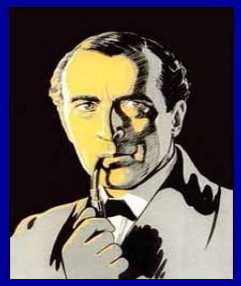




Principle One

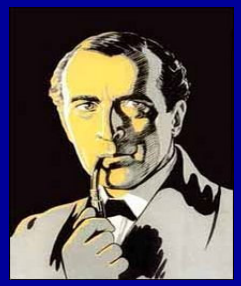
- Mathematically, the probability for the existence of two identical fingerprint patterns in the world's population is extremely small.
- Besides theoretical calculations, of the millions upon millions of individuals who have had their prints classified, no two fingerprints have been found to be identical.
- The individuality of a fingerprint is not determined by its general shape or pattern, but by the careful study of its ***ridge characteristics***, known as minutiae.
- It is the identity, number, and relative location of these minutiae that imparts individuality to a fingerprint.
- There are as many as 150 minutiae on the average





Principle One

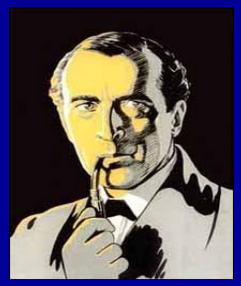
- After a three year study, it was determined that "no valid basis exists for requiring a predetermined minimum number of friction ridge characters which must be present in two impressions in order to establish positive identification."
- In a judicial proceeding, an expert must ***demonstrate a point-by-point comparison in order to prove the identity of an individual.***



Principal Two

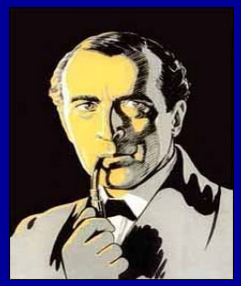
- The epidermis is the outer layer of the skin, while the dermis is the inner layer of the skin.
- The dermal papillae is the layer of cells between the epidermis and dermis, that is responsible for determining the form and pattern of the ridges on the surface of the skin.

- ***Once the dermal papillae develop in the human fetus, the ridge patterns will remain unchanged throughout life except to enlarge during growth. Thus, a fingerprint will remain unchanged during an individual's lifetime.***



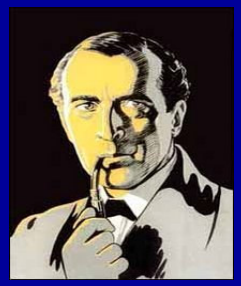
Principle Two

- Each skin ridge is populated with pores leading to sweat glands from which perspiration is deposited on the skin.
- Once the finger touches a surface, perspiration, along with oils that may have been picked up by touching the hairy portions of the body, is transferred onto that surface, leaving the finger's ridge pattern (a fingerprint).



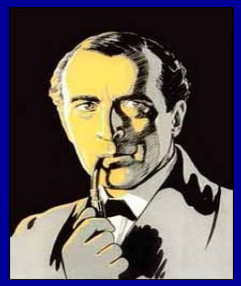
Principle Three

- **All fingerprints are divided into three classes on the basis of their general pattern: loops, arches, and whorls (L.A.W.).**
- **A loop must have one or more ridges entering from one side of the print, recurving, and exiting from the same side.**
  - **If the loop opens toward the little finger, it is called an ulnar loop.**
  - **If the loop opens toward the thumb, it is called a radial loop.**
- **All loops must have one delta, which is the ridge point at or directly in front of the point where two ridge lines (type lines) diverge.**



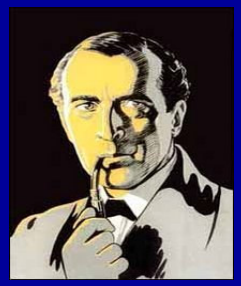
Principle Three

- Whorls are divided into four groups: plain, central pocket loop, double loop, and accidental.
- All whorl patterns have type lines and a minimum of two deltas.
- A plain whorl and a central pocket loop have at least one ridge that makes a complete circuit.
- The double loop is made up of two loops combined into one fingerprint.
- An accidental either contains two or more patterns, or is a pattern not covered by the other categories.



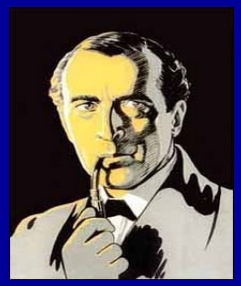
Principle Three

- Arches, the least common of the three general patterns, are divided into two distinct groups: plain arches and tented arches.
- The plain arch is formed by ridges entering from one side of the print, rising and falling, and exiting on the opposite side (like a wave).
- The tented arch is similar to the plain arch except that instead of rising smoothly at the center, there is a sharp upthrust or spike, or the ridges meet at an angle that is less than 90 degrees.
- Arches do not have type lines, deltas, or cor



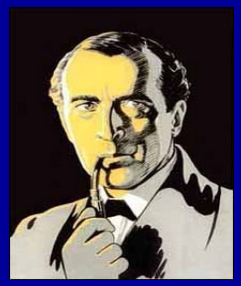
Primary Classification

- Fingerprint classification systems are based on knowledge of fingerprint pattern classes.
- First, fingers are paired up, placing one finger in the numerator of a fraction and the other in the denominator.
- The presence or absence of the whorl pattern is the basis for the determination of the primary classification.
- If a whorl pattern is found on any finger of the first pair, it is assigned a value of 16; on the second pair, an 8; on the third pair, a 4; on the second pair, a 2; and on the last pair, a 1.
- Any finger having a loop or arch is assigned a 0.



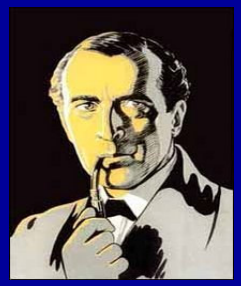
Primary Classification

- After values for all 10 fingers are obtained, they are totaled, and a 1 is added to both the numerator and denominator.
- The fraction thus obtained is the primary classification.
- Approximately 25 percent of the population falls into the 1/1 category; that is, all their fingers have either loops or arches.
- A fingerprint classification system cannot in itself unequivocally identify an individual; it will merely provide the fingerprint examiner with a number of candidates, all of whom have an indistinguishable set of prints in the system's file.



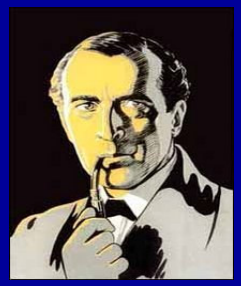
AFIS

- The heart of AFIS technology is the ability of a computer to scan and digitally encode fingerprints so that they can be subject to high-speed computer processing.
- AFIS aids in classifying and retrieving fingerprints by converting the image of a fingerprint into digital minutiae that contain data showing ridges at their points of termination (ridge endings) and their branching into two ridges (bifurcations).
- When the search is complete (a computer can make thousands of comparisons per second), the computer produces a list of file prints that must be examined by a trained fingerprint expert.



Latent Prints

- Once the finger touches a surface, body perspiration and/or oils present on the finger ridges are transferred to that surface, leaving an impression.
- Prints deposited in this manner are invisible to the eye and are commonly referred to as latent or invisible fingerprints.



Visible Prints

- Visible prints are made when fingers touch a surface after the ridges have been in contact with a colored material such as blood, paint, grease, or ink.
- Plastic prints are ridge impressions left on a soft material, such as putty, wax, soap, or dust.
- Locating visible or plastic prints at the crime scene normally presents little problem to the investigator, because these prints are usually distinct and visible to the eye.

Detecting Prints

- Latent prints deposited on hard and nonabsorbent surfaces (e.g., glass, mirror, tile, and painted wood) are preferably developed by the application of a powder; whereas prints on porous surfaces (e.g., papers, cardboard, and cloth) generally require treatment with a chemical.
- Examiners use various chemical methods to visualize latent prints on porous surfaces, such as iodine fuming, ninhydrin, and Physical Developer.
- Super Glue® fuming develops latent prints on nonporous surfaces, such as metals, electrical tape, leather, and plastic bags.
  - Development occurs when fumes from the glue adhere to the print, usually producing a white latent print.

Detecting Prints

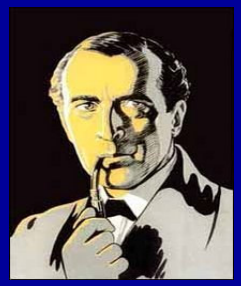
- A devise called the Reflected Ultraviolet Imaging System (RUVIS) can aid in the detecting of latent fingerprints, without chemicals or powder.
- Once located, the crime scene investigator can develop the print in the most appropriate fashion.
- Powders, available in a variety of colors, can be applied with a brush or magnetic wand, and adhere to perspiration and/or body oils of the print.
- Iodine fuming involves heating iodine crystals that cause vapors which combine with latent prints to make them visible.
  - Iodine prints are not permanent and will fade, making it necessary to photograph the prints immediately.

Detecting Prints

- Ninhydrin reacts chemically with trace amounts of amino acids present in latent prints to produce a purple-blue color.
- Physical Developer is a silver nitrate-based reagent used to develop prints when other chemical methods are ineffective.
- Super Glue® is approximately 98 to 99 percent cyanoacrylate ester, a chemical that actually interacts with and visualizes a latent fingerprint.
- Super Glue fuming can be accomplished by using either a fuming chamber (for up to six hours) or a handheld wand that heats a small cartridge containing cyanoacrylate.

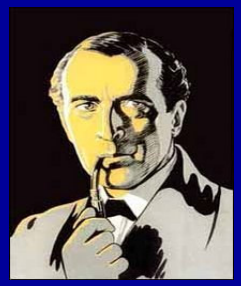
Detecting Prints

- The high sensitivity of fluorescence serves as the underlying principle of many of the new chemical techniques used to visualize latent fingerprints.
- Fingerprints are treated with chemicals that would induce fluorescence when exposed to lasers, or high-intensity light sources (“alternate light sources”) such as quartz halogen, xenon arc, or indium arc light sources.
- Once the latent print has been visualized, it must be permanently preserved for future comparison and for possible use as court evidence.
- A photograph must be taken before any further attempts at preservation are made.



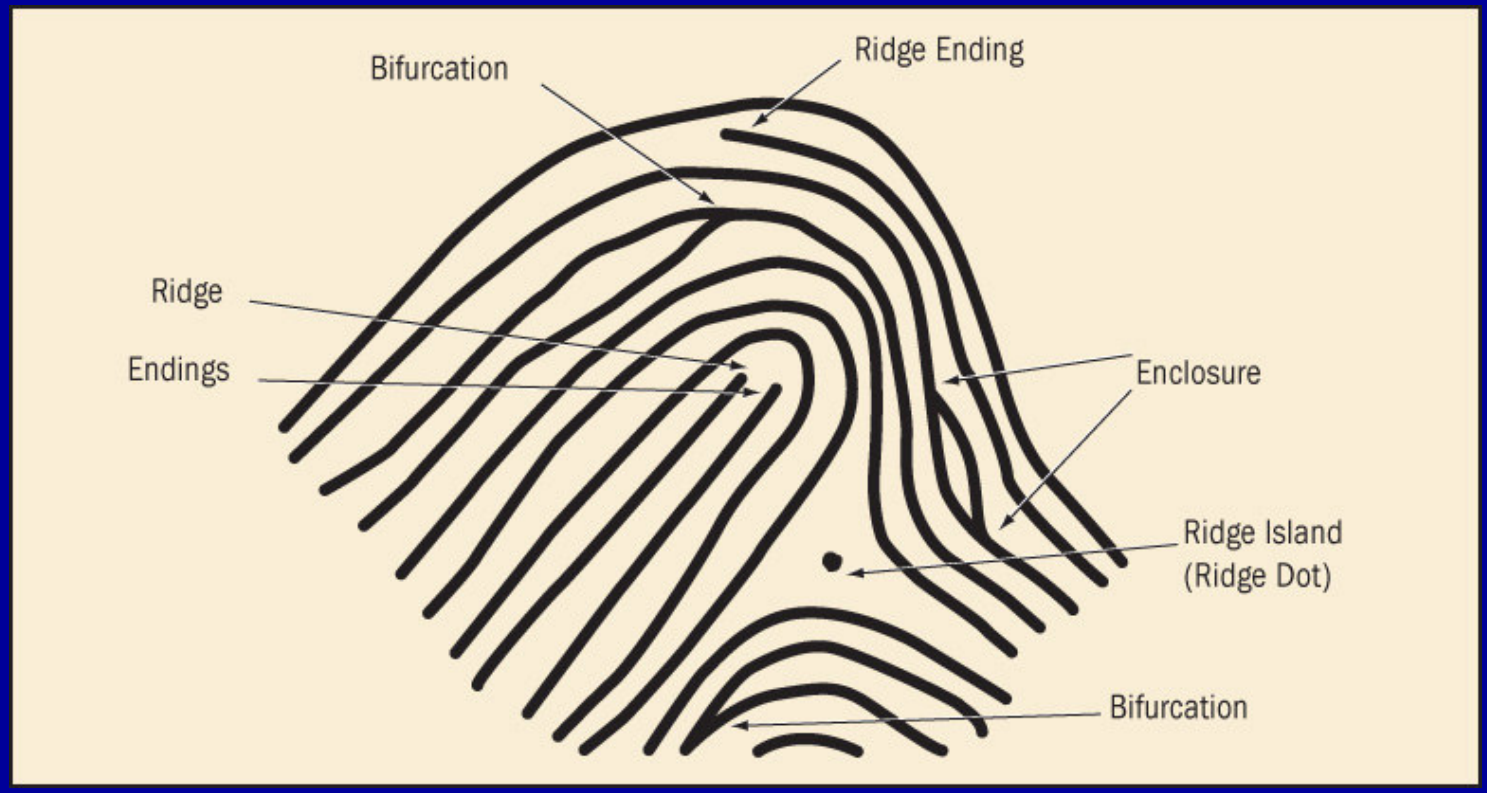
Transporting Prints

- If the object is small enough to be transported without destroying the print, it should be preserved in its entirety.
- Prints on large immovable objects that have been developed with a powder can best be preserved by “lifting” with a broad adhesive tape.
- Then, the tape is placed on a properly labeled card that provides a good background contrast with the powder.

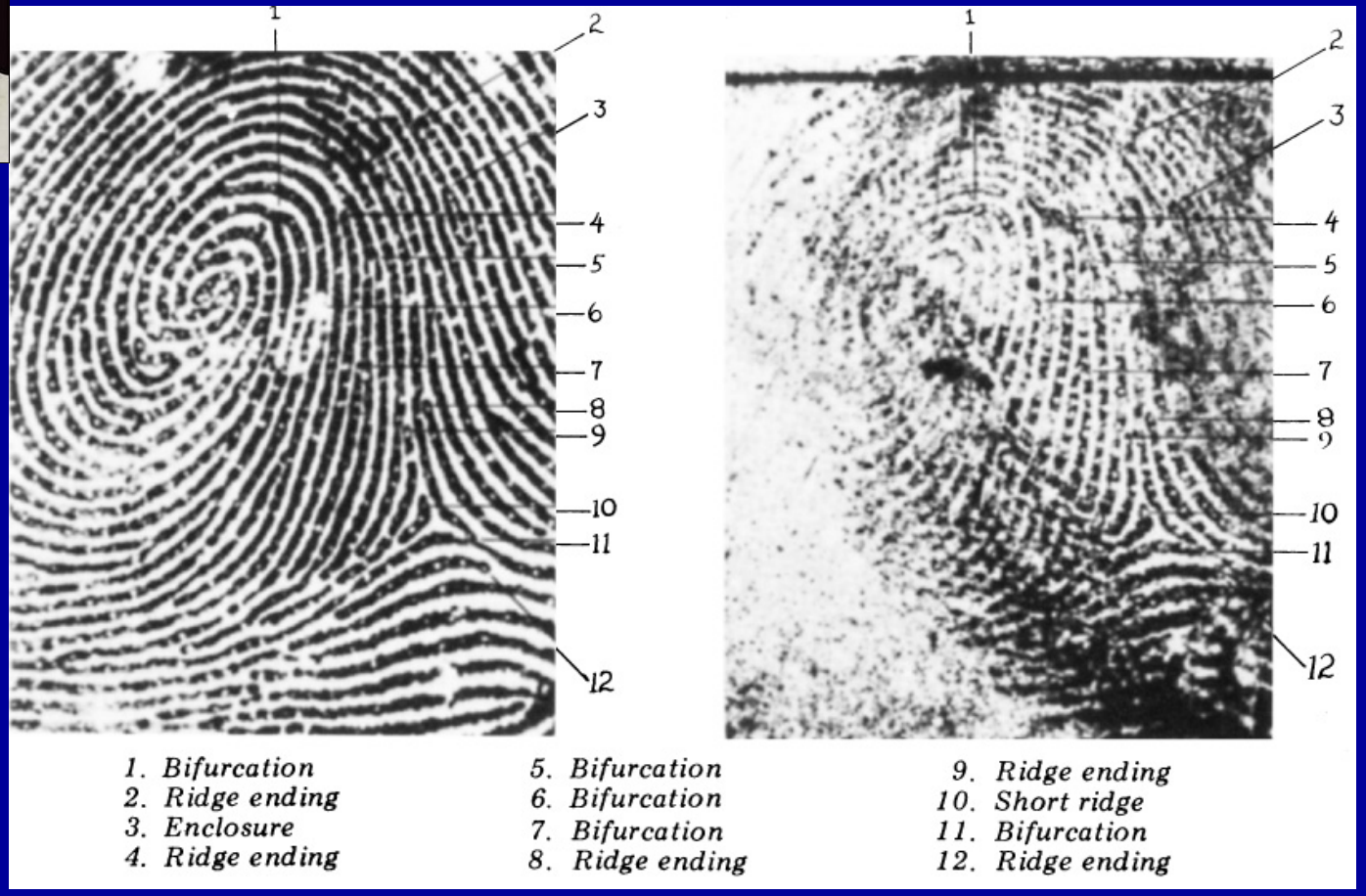


Digital Imaging

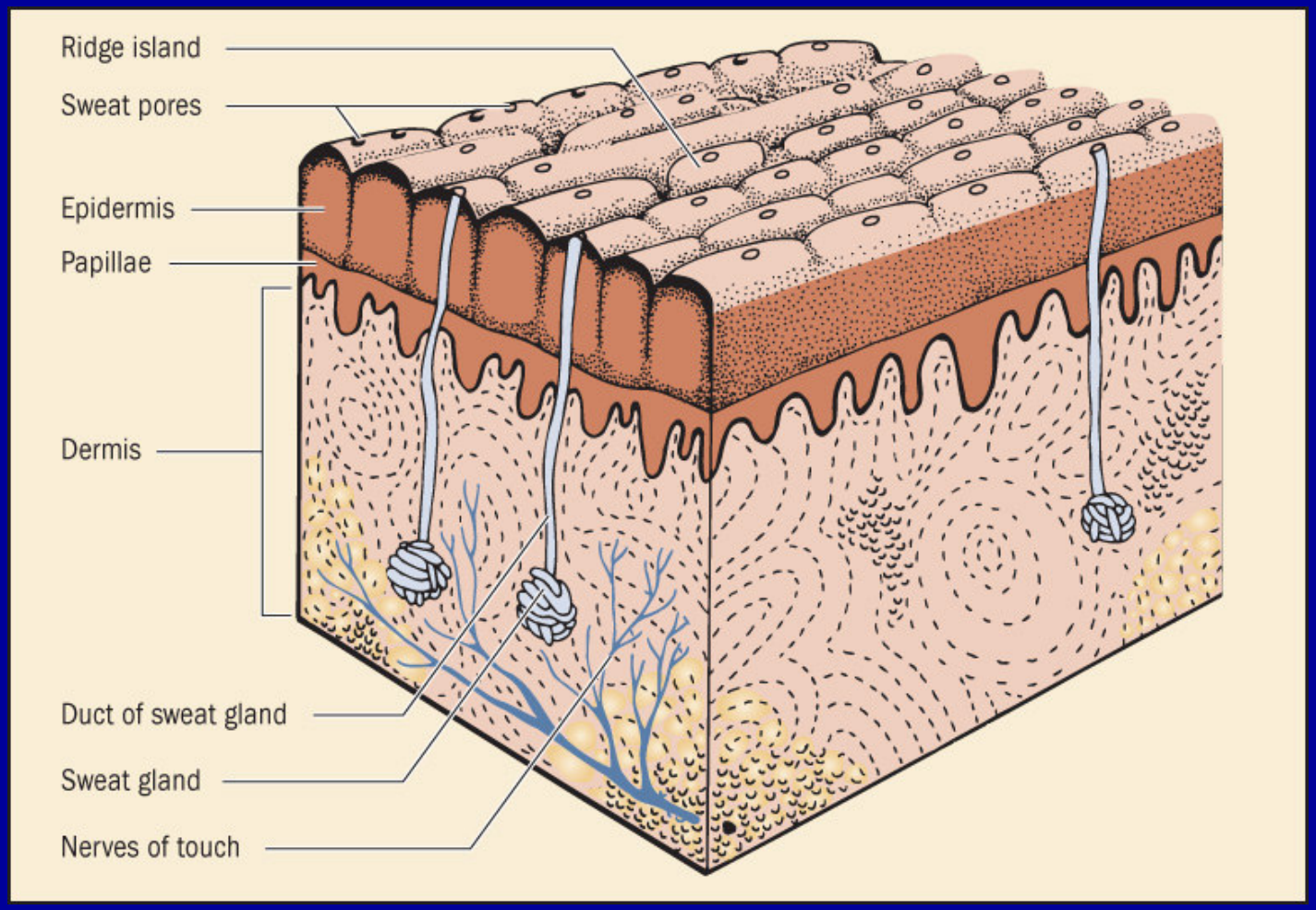
- Digital imaging is the process by which a picture is converted into a digital computer file.
- With the help of digital imaging software, fingerprints, which are often not in perfect condition, can now be enhanced for the most accurate and comprehensive analysis.
- An important and useful tool, especially for fingerprint identification, is the compare function that places two images side by side and allows the examiner to chart the common features on both images simultaneously.



Fingerprint ridge characteristics. Courtesy Sirchie Finger Print Laboratories, Inc.,



A fingerprint exhibit illustrating the matching ridge characteristics between the crime-scene print and an inked impression of one of the suspect's fingers. Courtesy New Jersey State Police.

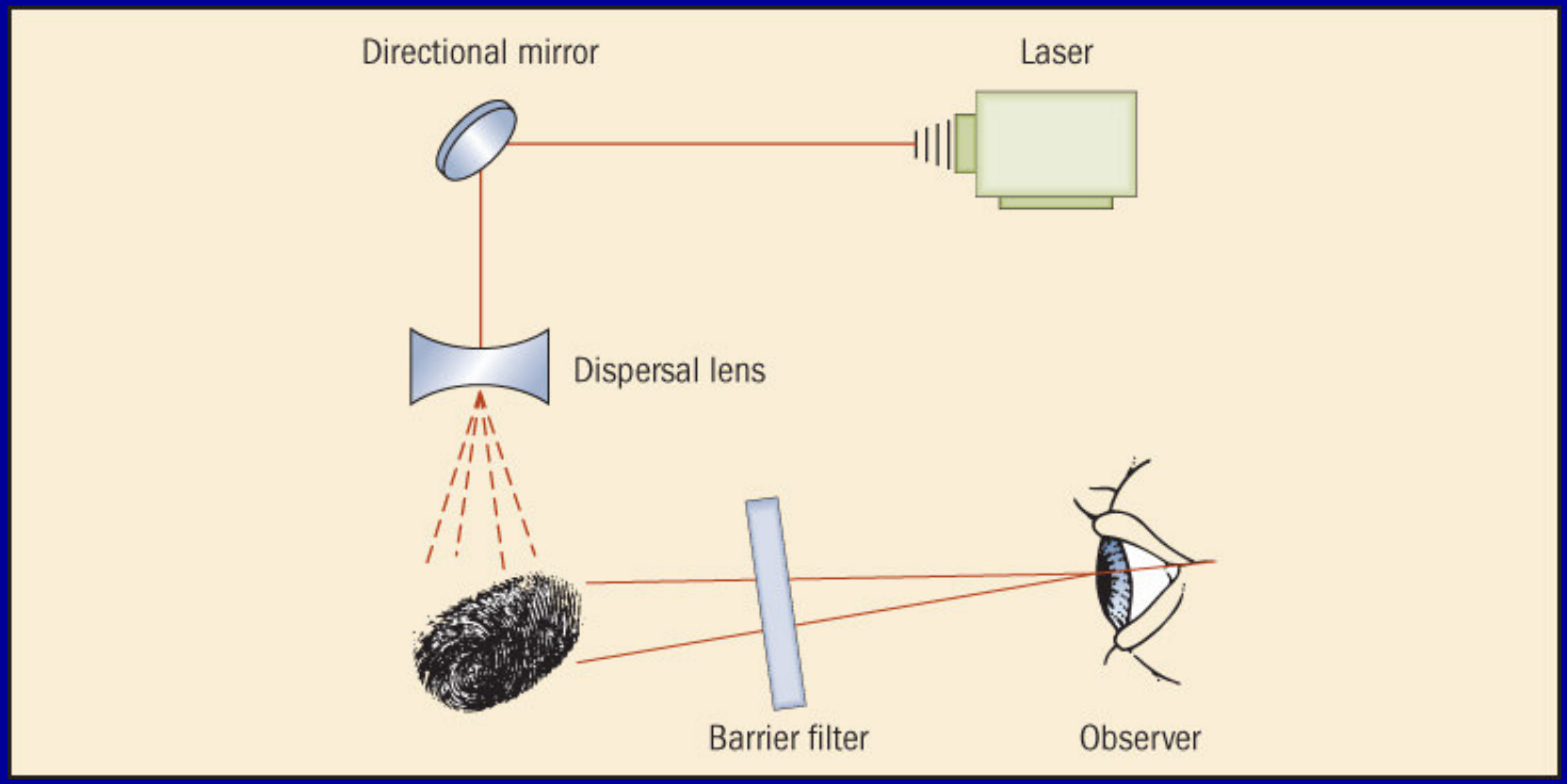


Cross-section of human skin.

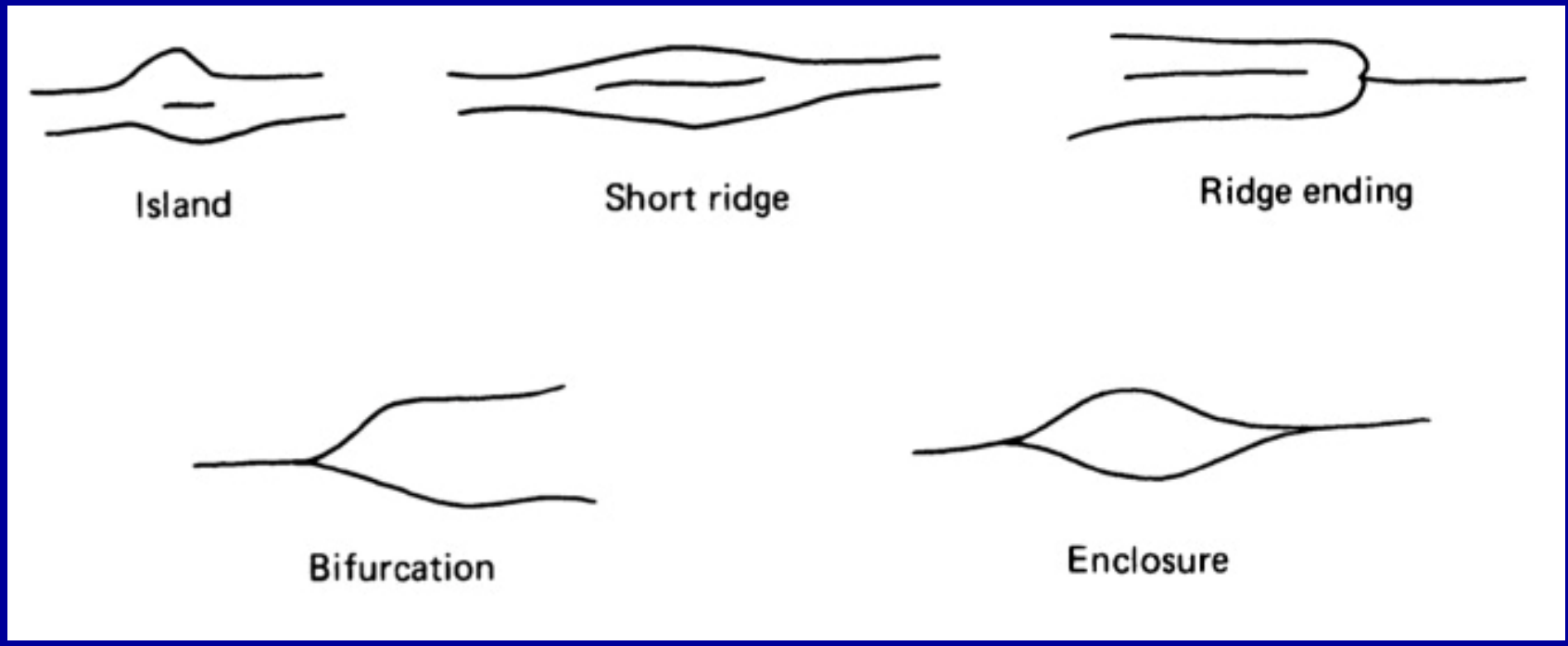
Loop pattern.

Whorl patterns

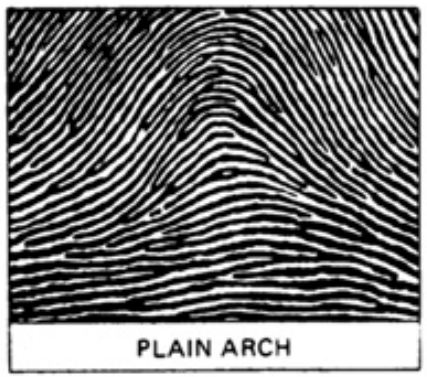
Arch patterns.



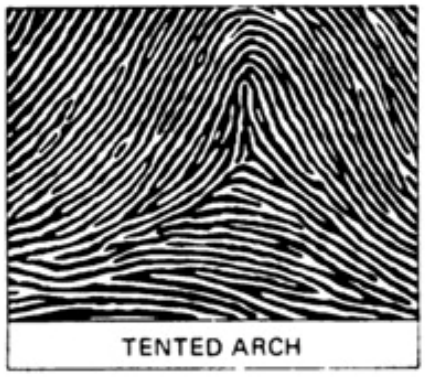
Schematic depicting latent-print detection with the aid of a laser. A fingerprint examiner, wearing safety goggles containing optical filters, examines the specimen being exposed to the laser light. The filter absorbs the laser light and permits the wavelengths at which latent-print residues fluoresce to pass through to the eyes of the wearer. Courtesy Federal Bureau of Investigation, Washington, D.C.



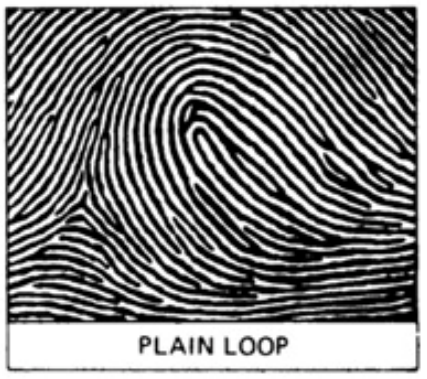
Fingerprint Ridge Characteristics



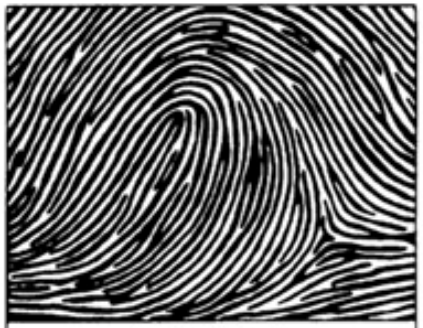
PLAIN ARCH



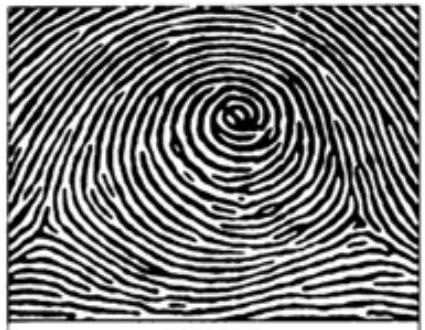
TENTED ARCH



PLAIN LOOP



PLAIN LOOP



WHORL

CENTRAL POCKET LOOP

DOUBLE LOOP WHORL

ACCIDENTAL