Fingerprinting 1B

PART 1, JANUARY 20, 2020

CHAPTER 8

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Reading Quiz the Week of Jan 27

The material that will be covered on each reading quiz will be revealed in the lecture the week prior to the quiz

Quiz will be open for students ONLY Thursday Jan 31 at 4 pm and close on Saturday Feb 1 at 11:59 PM.

Overview

History of fingerprint use

Principles of using fingerprints in criminal investigations
◦ Individual
◦ Unchanged
◦ Can be classified – characteristic components of a fingerprint

Classification system

AFIS

Latent, and visible prints

History

The first systematic attempt at personal identification was devised by a French police expert, Alphonse Bertillon.

The Bertillon system relied on a detailed description of the subject, combined with full length and profile photographs and a system of precise body measurements called <u>anthropometry</u>.

In 1892 Francis Galton published his classic textbook *Finger Prints*.

At Galton's insistence, the British government adopted fingerprinting as a supplement to the Bertillon system.

The next step was the creation of classification systems capable of filing many thousands of prints in a logical and searchable sequence.

History

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 Bertillon 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.

Fingerprint Principles

Fingerprints are a reproduction of <u>friction skin ridges</u> found on the palm side of the fingers and thumbs.

The <u>basic principles</u> underlying the use of fingerprints in criminal investigations are that:

1. a fingerprint is an <u>individual characteristic</u>, because no two fingers have yet been found to possess identical ridge characteristics;

2. a fingerprint will <u>remain unchanged</u> during an individual's lifetime; and

3. fingerprints have general ridge patterns that permit them to be <u>systematically classified</u>.

Principle One – individual characteristic

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 <u>minutiae</u>.

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 finger.

A Fingerprint is an Individual Characteristic

Verified, 1 in over 50 million comparisons

Theoretically 1 in 64 billion probabilities

However, studies on the statistics of <u>partial</u> matches have <u>not been conducted</u>

Principle One – individual characteristic

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 conclude that the crime scene fingerprint cannot be ruled out as originating from the suspect

Minimum Number of points for a positive identification*

Britain – 16 points

Paris – 17 points

France, Australia, New Zealand – 12 points

Turkey – 8 points

India – 6-12 points (depends on the area)

United States – No fixed number

Canada – No fixed number

Principle Two – fingerprints remain unchanged

Friction ridges are formed on the surface of your fingers, thumbs, palms and feet soles to improve grip and reduce slippage

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.
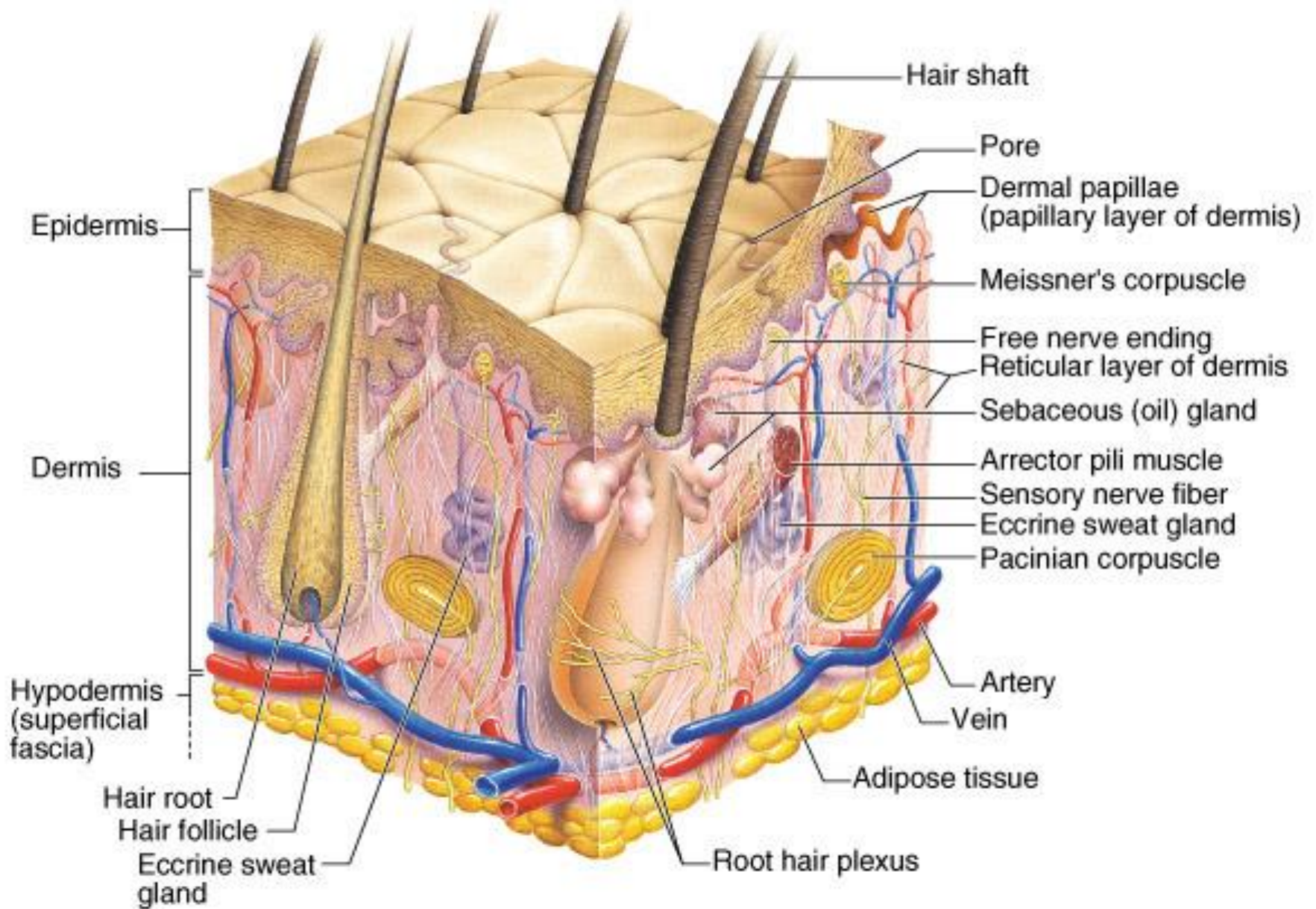
Once the dermal papillae develop in the human fetus, the ridge patterns will remain unchanged throughout life except to enlarge during growth.

Principle Two – fingerprints remain unchanged

Minutiae – ridge endings, bifurcations, enclosures and other ridge details which must match in two fingerprints to establish their possible common origin

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, are transferred onto that surface, leaving the finger's ridge pattern (a fingerprint).

Epidermis

Dermis

Hypodermis
(superficial
fascia)

Hair root
Hair follicle
Eccrine sweat
gland

Root hair plexus

Hair shaft
Pore
Dermal papillae
(papillary layer of dermis)
Meissner's corpuscle
Free nerve ending
Reticular layer of dermis
Sebaceous (oil) gland
Arrector pili muscle
Sensory nerve fiber
Eccrine sweat gland
Pacinian corpuscle
Artery
Vein
Adipose tissue

Principle Three -Fingerprints can be systematically classified

3 classes of fingerprint characteristics
- Loops
  - 60-65% of the population
- Whorls
  - 30-35% of the population
- Arches
 - 5% of the population

Principle Three: Loops

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.

Identifiable Characteristics
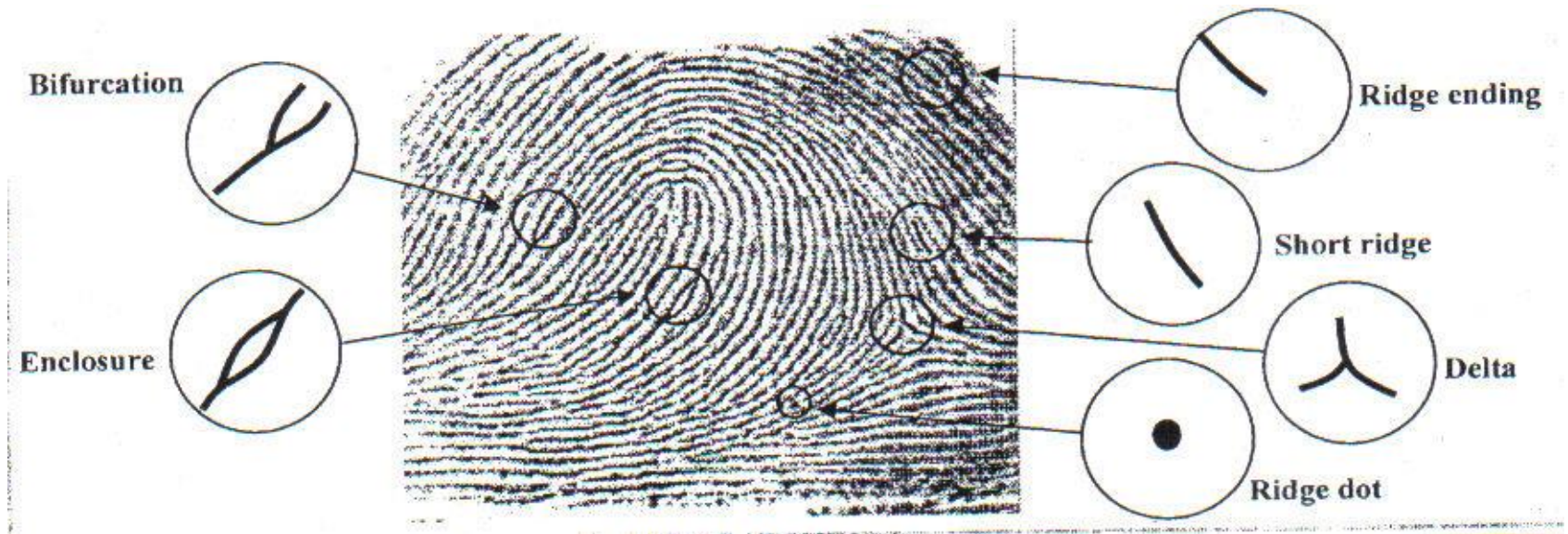
Loops

One or more ridges entering from one side of the the print, recurving, and exiting from the same side. + one delta

Loops

Ulnar Loop

◦ Loop starts on the pinky-side of the finger (ulna)

Radial Loop

◦ Loop starts on the thumb-side of the finger (radius)

Principle Three: Whorls

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.

Whorls

Plain Whorl

Central-Pocket Whorl

Double-Loop Whorl

Accidental Whorl

Principle Three: Arches

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.

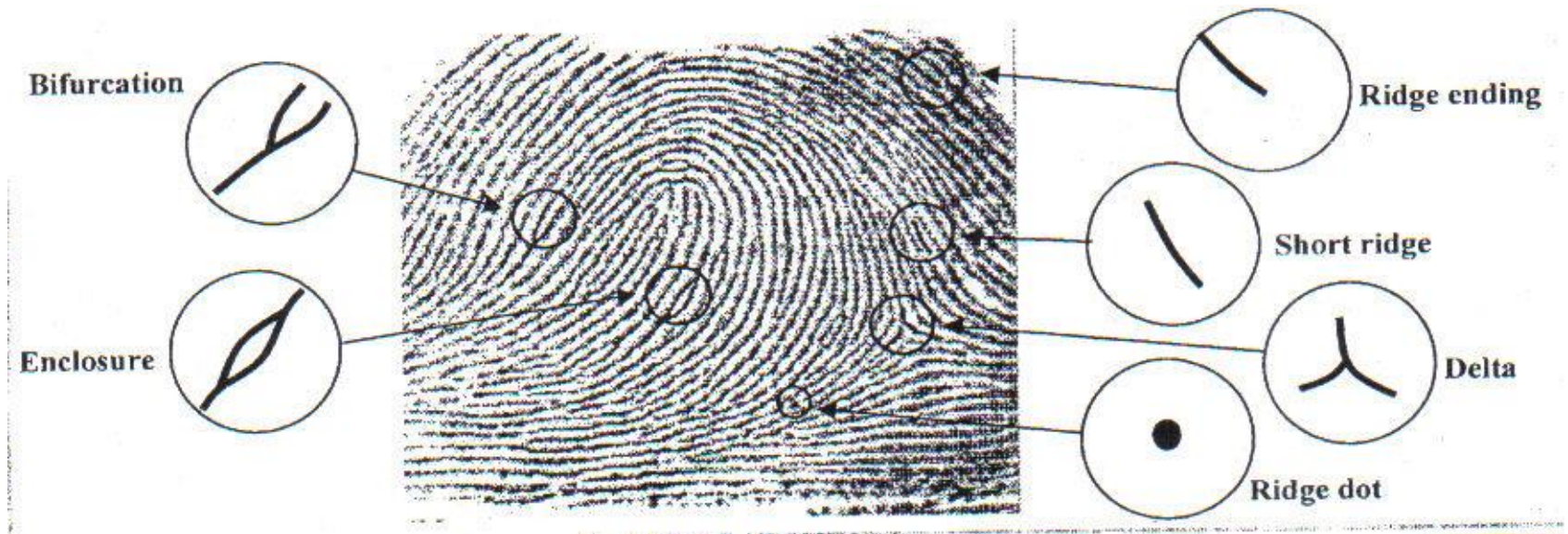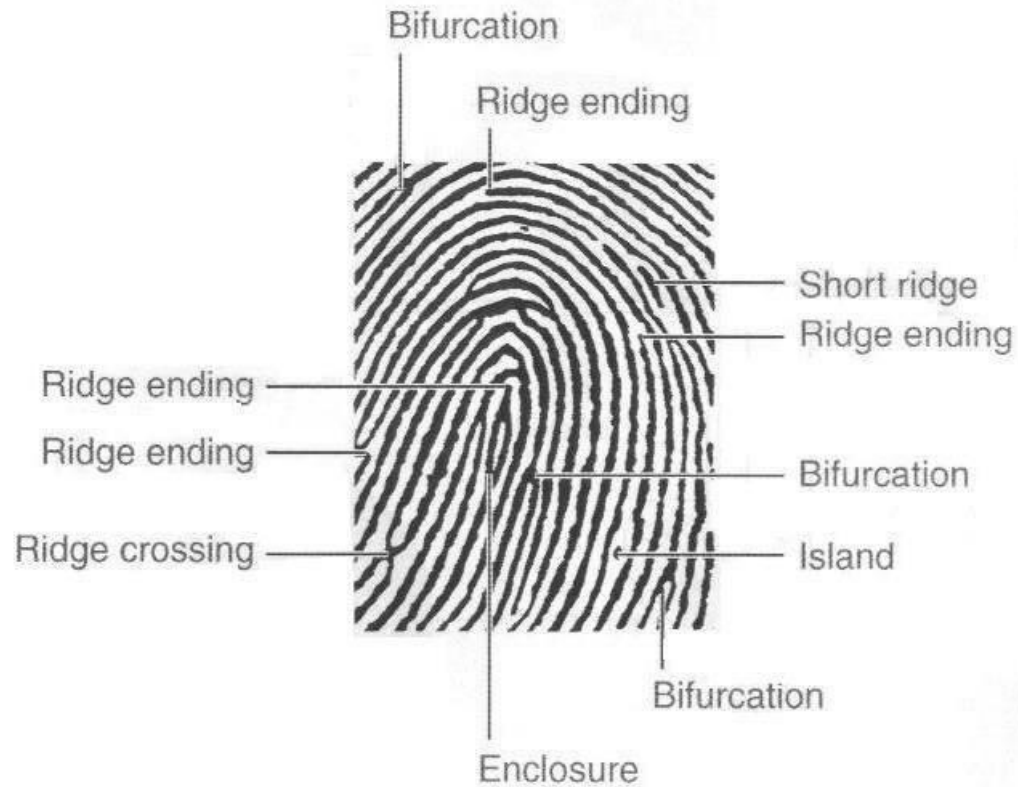Arches do not have type lines, deltas, or cores.

Arches

Plain Arch
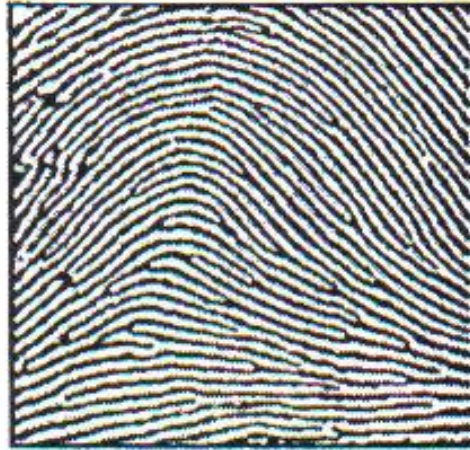
Tented Arch

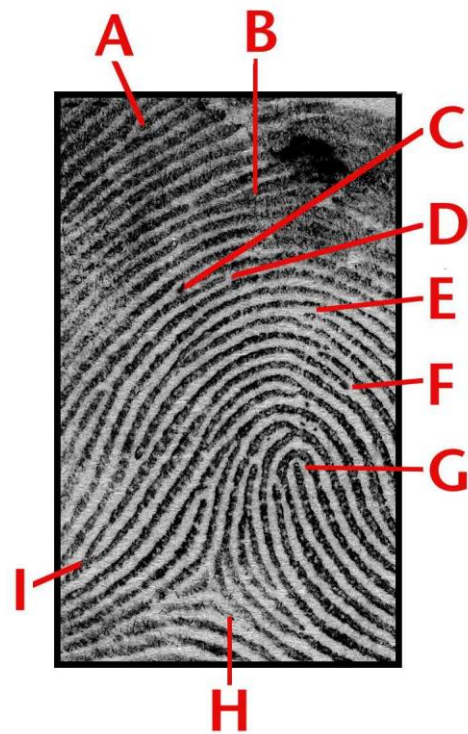# Identifiable Characteristics

Minutiae

1. Bifurcation
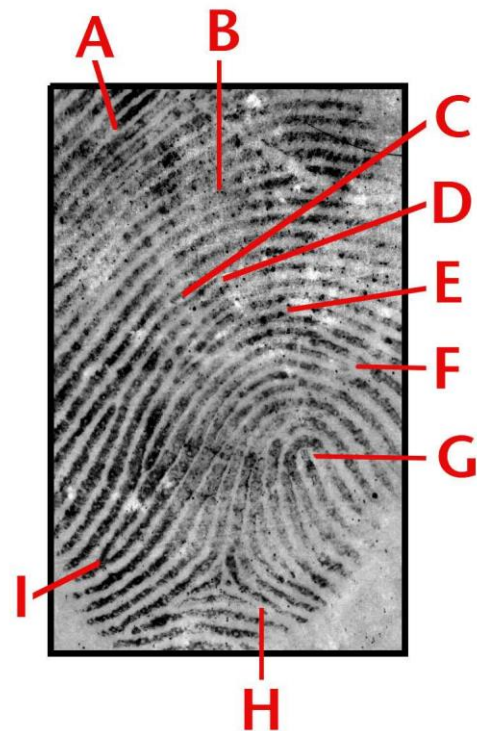2. Ridge ending
3. Enclosure
4. Ridge ending
5. Bifurcation
6. Bifurcation
7. Bifurcation
8. Ridge ending
9. Ridge ending
10. Short ridge
11. Bifurcation
12. Ridge ending

Rolled Ink
Finger #7

Latent Print
Rear View Mirror

The Henry System

Requires all 10 prints to be filed in the system

Until the development of computerized fingerprint search systems, it was necessary to have a suspect first to know which 10-print card to retrieve for comparison

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 fourth pair, a 2; and on the last pair, a 1.

Any finger having a loop or arch is assigned a 0.

Assigning a Primary Group

Finger	Left Pinky	Left Ring	Left Middle	Left Index	Left Thumb	Right Thumb	Right Index	Right Middle	Right Ring	Right Pinky
Finger #	10	9	8	7	6	1	2	3	4	5
Score if Whorl Present	1	1	2	2	4	16	16	8	8	4

Primary classification = $\dfrac{1 + (\text{sum of even fingers value})}{1 + (\text{sum of odd fingers value})}$

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 Henry 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.

Assigning a Primary Group

Finger	Left Pinky	Left Ring	Left Middle	Left Index	Left Thumb	Right Thumb	Right Index	Right Middle	Right Ring	Right Pinky
Pattern Type	Arch	Loop	Loop	Arch	Whorl	Whorl	Loop	Loop	Arch	Arch
Finger Value	0	0	0	0	4	16	0	0	0	0

Primary classification = 1 + (sum of even fingers value)

1 + (sum of odd fingers value)

= 1 + 4

1 + 16

= 5/17

Assigning a Primary Group

Therefore, this individual would belong to the 5:17 primary group

The Henry System allows for up to 1,024 primary groups

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.

Types of Fingerprints

Exemplar
- Deliberately taken (i.e. ink print records taken)

Patent
- Visible prints as a result of foreign transfer material

Plastic
- Found on soft surfaces that retains shape (impressions)

Latent
- Not visible

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.

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.

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. paper, 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.

Review and Next Lecture

History of fingerprint use

The 3 Principles of using fingerprints in criminal investigations

Classification system and AFIS

Latent, and visible prints

NEXT LECTURE - Fingerprint identification
◦ Detecting Fingerprints
◦ Developing & Enhancing Latent Prints
◦ Preservation Photography
◦ Recovery or Retention
◦ Matching
◦ Outcomes