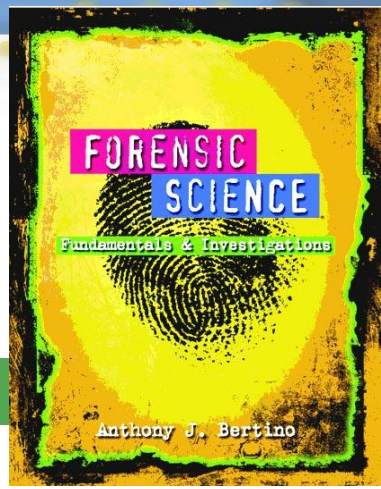
Chapter 6 ***Fingerprints***



By the end of this chapter you will be able to:

- Discuss the history of fingerprinting
- Describe the characteristics of fingerprints and fingerprinting minutiae
- Explain when and how fingerprints form
- Describe how fingerprints can be left on objects
- Identify the basic types of fingerprints
- Describe how criminals attempt to alter their fingerprints

Chapter 6 ***Fingerprints***

By the end of this chapter you will be able to:

- Determine the reliability of fingerprints as a means of identification
- Describe the Integrated Automated Fingerprint Identification System (IFAIS)
- Explain how fingerprint evidence is collected
- Describe the latest identification technologies
- Determine if a fingerprint matches a fingerprint on record
- Use the process of lifting a latent print

Historical Development

1. **3rd century B.C. in China**—oldest known documents
2. **Ancient Babylon** (1792-1750 B.C.)—fingerprints pressed into clay tablets marked contracts
3. **1684**—Dr. Nehemiah's paper describes the patterns on human hands, including the presence of ridges
4. **1788**—Johann Mayer noted that the arrangement of skin ridges is never duplicated in two persons

Historical Development

5. **1823**—Jan Evangelist Purkyn describes nine fingerprint patterns
6. **1856**—Sir William Herschel (right) began the collection of fingerprints and noted they were not altered by age
7. **1883**—Alphonse Bertillon created a way to identify criminals that were repeat offenders

Historical Development

8. **1888**—Sir Francis Galton (r) and Sir Edmund Richard Henry developed the fingerprint classification system still used in the US
9. **1891**—Iván (Juan) Vucetich collected all ten fingerprint impressions and noted measurements
10. **1896**—Sir Henry, with two colleagues, created a system that divided fingerprints into groups. All ten fingerprints are imprinted on a card (called a *ten card*) along with other notations

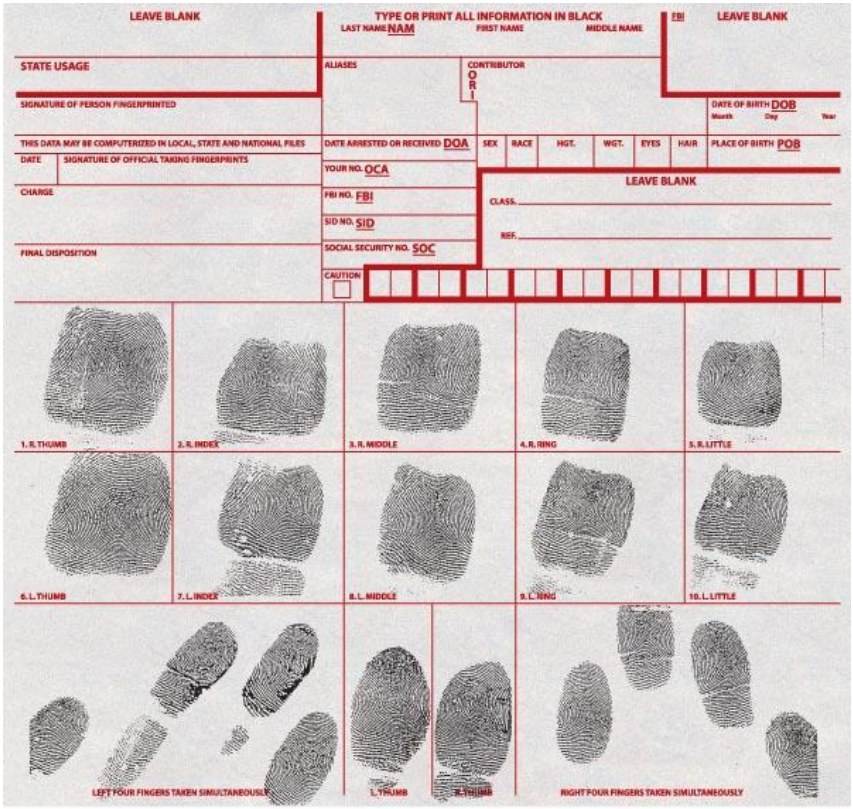
The West Story

	William West	Will West
		
Bertillon Measurements (in centimeters)		
Height	177.5	178.5
Outstretched arms	188.0	187.0
Trunk	91.3	91.2
Head length	19.8	19.7
Head width	15.9	15.8
Cheek width	14.8	14.8
Right ear	6.5	6.6
Left foot	27.5	28.2
Left middle finger	12.2	12.3
Left little finger	9.6	9.7
Left forearm	50.3	50.2

The Two Wests

- **Will West arrived to serve prison sentence at Levenworth in 1903. ID personnel insisted that he had been there before. After Bertillon measurements taken, officials found file of William West, whose measurements were virtually identically to Will West. William West was still in prison serving time for murder. Even their photos were identical**

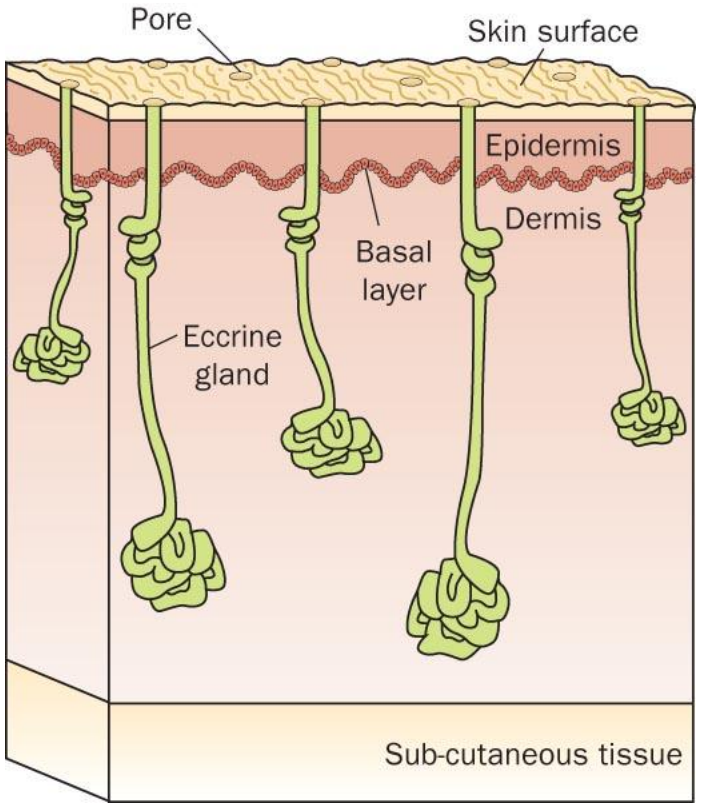
Example of a Ten Card



What Are Fingerprints?

- All fingers, toes, feet, and palms are covered in small ridges
- Ridges help us grip objects
- Ridges are arranged in connected units called *dermal,* or *friction, ridges*
- Fingers accumulate natural secretions and dirt
- Fingers leave create prints on objects we touch

Structure of Skin



Formation of Fingerprints

- Skin consists of:
  - Inner layer—dermis
  - Outer layer—epidermis
  - Basal layer in between
- Basal layer grows faster than the layers above and below it
- Basal layer collapses and folds to form intricate shapes
- Fingerprints begin forming near the 10th week of pregnancy

- Around week 10 of development – volar pads of a fetus stop growing but the hand continues to grow.
- Over the next few weeks, the volar pad is absorbed back into the hand.
- During this critical stage, the first signs of ridges begin to appear on the skin of the volar pads.

Development of Fingerprints

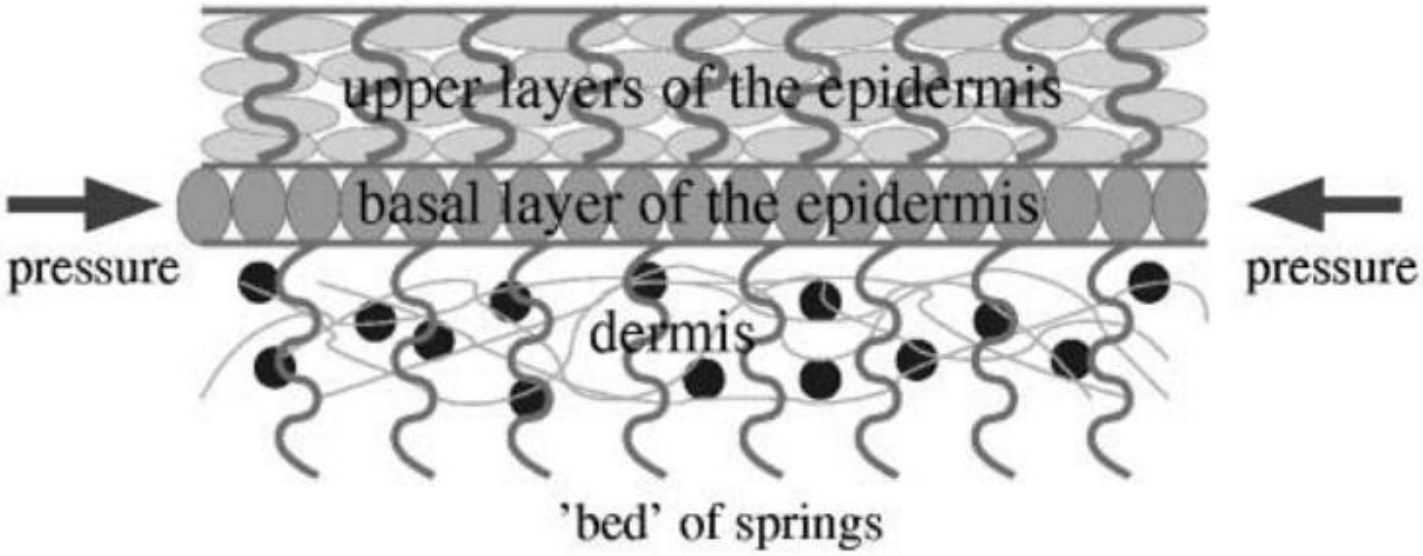


Fig. 3 – We consider the basal layer of the epidermis trapped between the intermediate layer and the dermis. Due to differential growth a compressive stress acts on the basal layer.

Summary

- Volar pads enlarging at different times with embryonic hand growth provides stress to the layers of skin.
- Possibly a genetic factor that determines primary template.

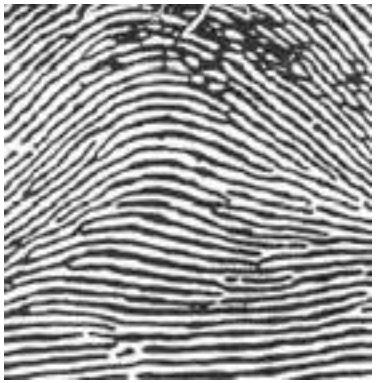
Stress + Genetics = Fingerprints

Fundamental Principles of Fingerprints

- A fingerprint is an individual characteristic.
- A fingerprint will remain unchanged during an individual's lifetime.
- Fingerprints have general characteristic ridge patterns that permit them to be systematically classified.

Characteristics of Fingerprints

- There are 3 general fingerprint distinctions:



ARCH

About 5%

WHORL

About 30%

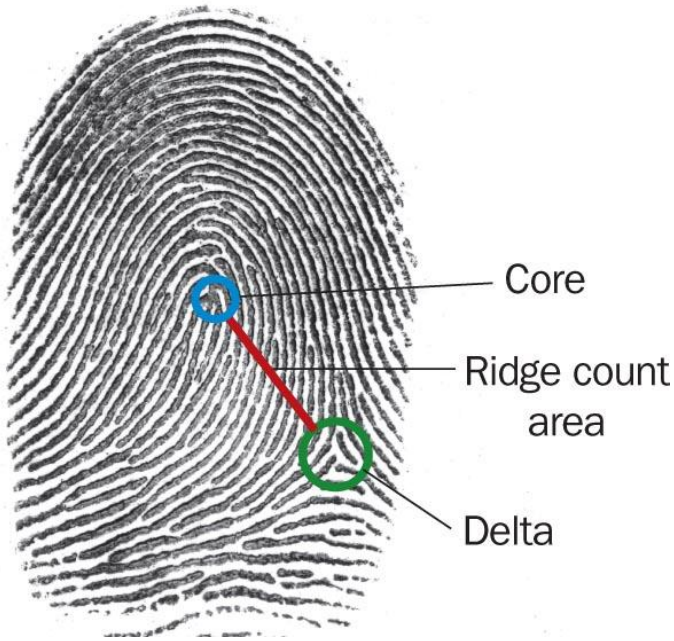
of the population

LOOP

About 65%

Characteristics of Fingerprints

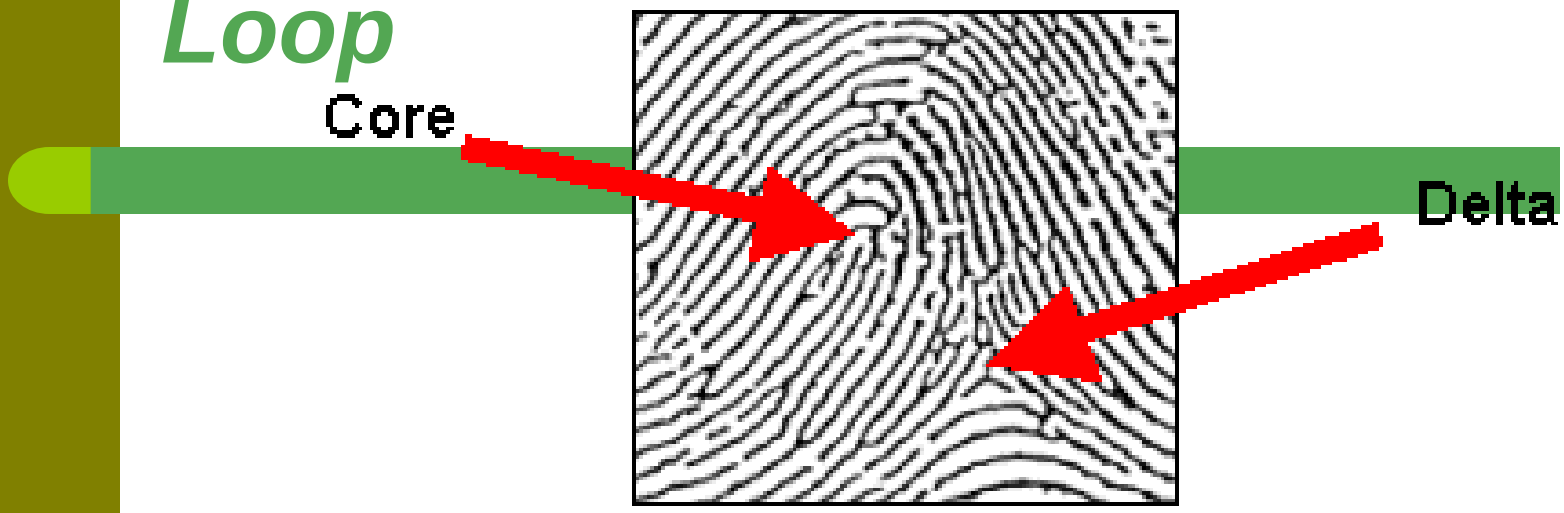
- Forensic examiners look for
  - **Core**
    (the center of a whorl or loop)
  - **Deltas**
    (triangular regions near a loop)
- **Ridge count**
  - Counting from the core to the edge of the delta
  - Distinguishes one fingerprint from another



Characteristics of Fingerprints

- Basic patterns can be further divided:
  - Arch patterns:
    - 4% plain
    - 1% tented
  - Whorl patterns:
    - 2% central pocket
    - 4% double loop
    - 0.01% accidental
- Even twins have unique fingerprints

Loop



In the **Loop** pattern there are two focal points: the **Core**, or the center of the loop, and the delta.

The **Delta** is the area of the pattern where there is a triangulation or a dividing of the ridges. When recording fingerprints, the delta and the area between the delta and the core must be completely recorded.

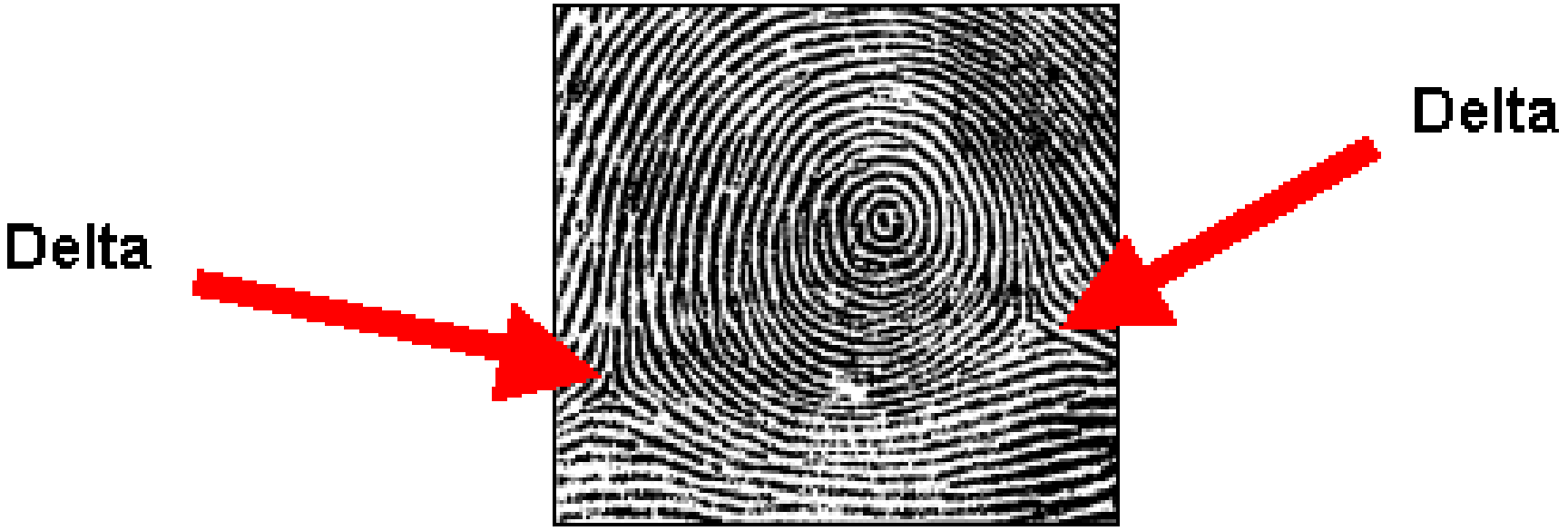
A Loop must have 2 characteristics or it is not a Loop!

Loop

In a loop pattern, the ridges enter from either side, re-curve and pass out or tend to pass out the same side they entered.

Loop

Whorl



- A **Whorl** pattern will have two or more deltas. For a whorl pattern, all deltas and the areas between them must be recorded.

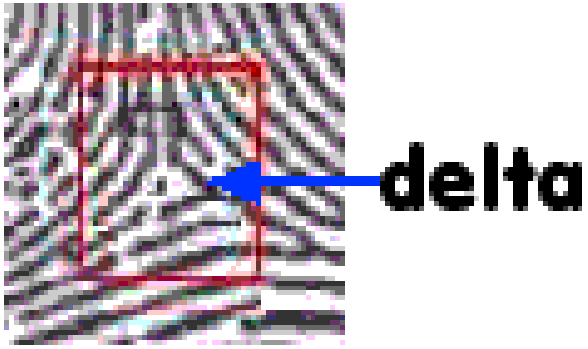
Whorl

Ridges form a circular pattern completely around a central point or short line. Typically two **deltas** will be noticed below and to the outside of the whorl.

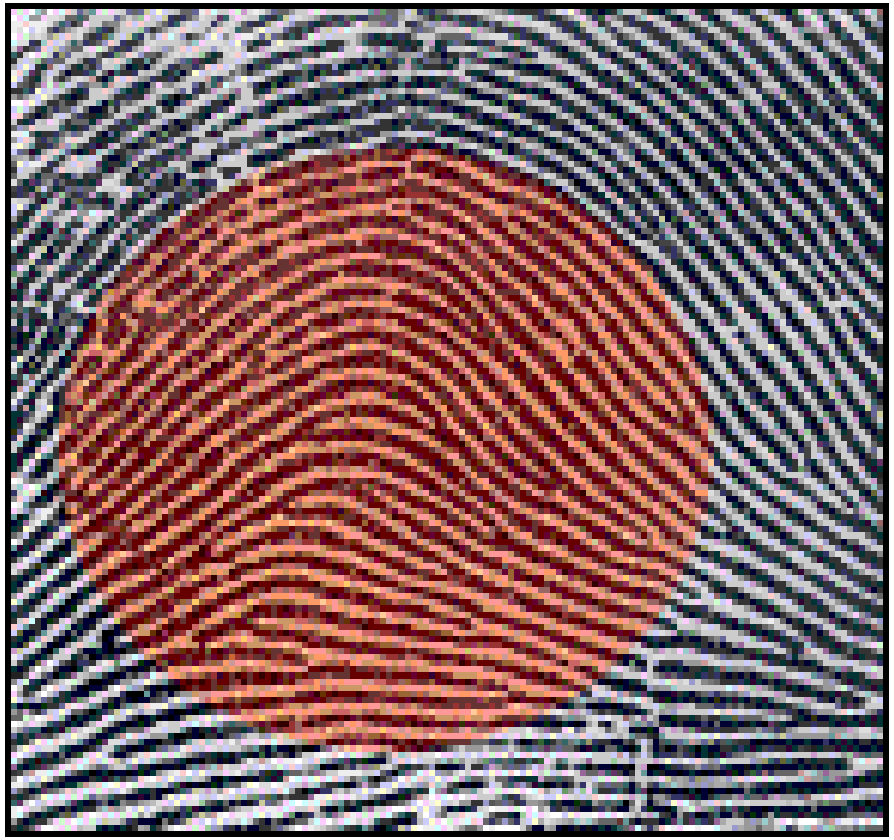
Whorl

Arch

- The arch pattern is the only pattern without a "delta" or triangular pattern made of ridges forming a triangle around a point.

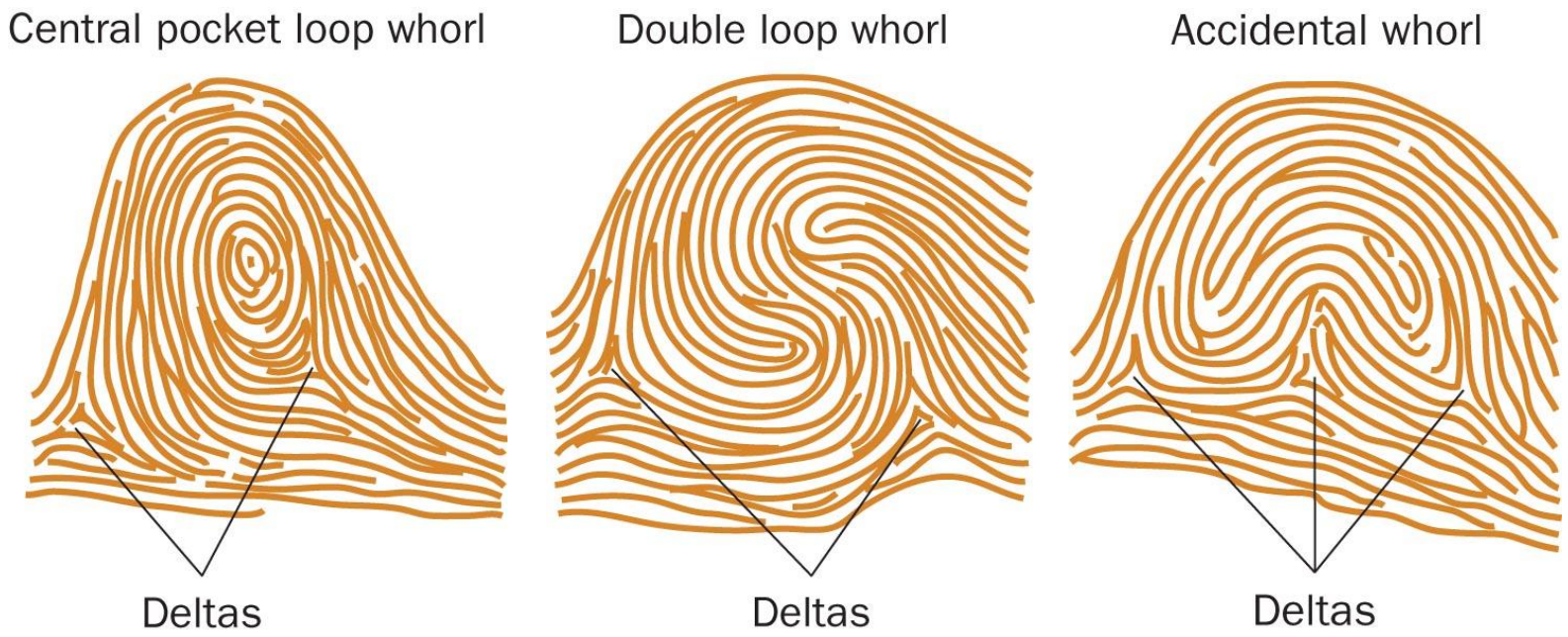


Arch

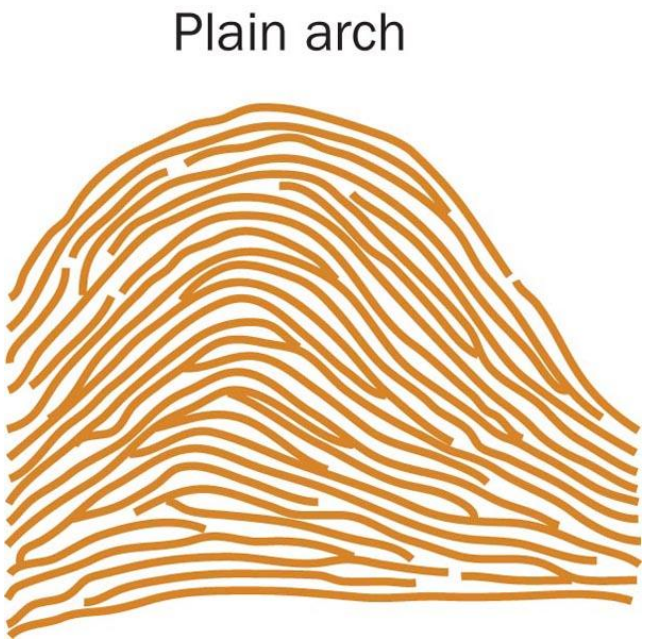


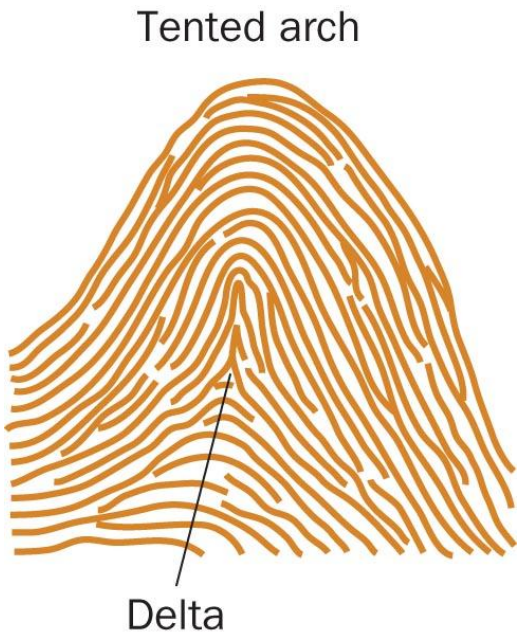
In an arch pattern the ridges enter from one side, make a rise in the center and exit generally on the opposite side.

Characteristics of Fingerprints



Characteristics of Fingerprints





Arch

Tentarch

Loop

Double Loop

Pocked loop

Whorl

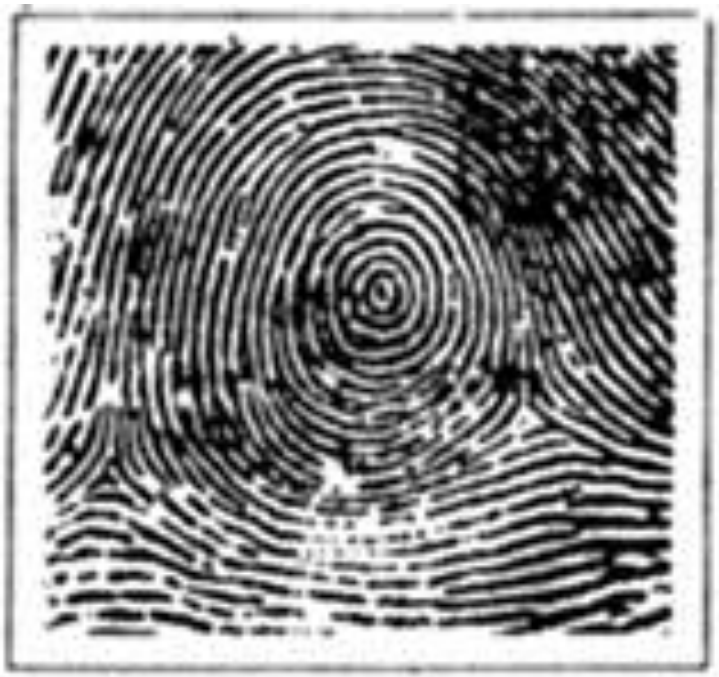
Mixed

1. ?

2. ?

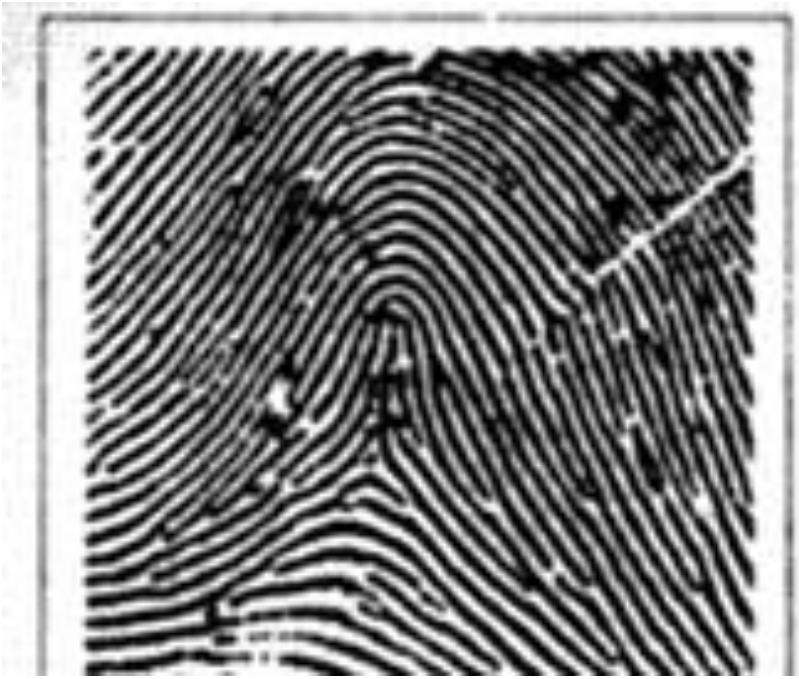
3. ?

4. ?



5. ?

6. ?



	L Pinky	L Ring	L Middle	L Index	L Thumb	R Thumb	R Index	R Middle	R Ring	R Pinky
Finger Number	10	9	8	7	6	1	2	3	4	5
Value (if Whorl)	1	1	2	2	4	16	16	8	8	4

Henry Classification $\frac{1+(\text{Sum of whorled, EVEN finger value})}{1+(\text{Sum of whorled, ODD finger value})}$ = Primary Grouping Ratio

System Formula:

ex. An individual has a fingerprint record with a LWAALALWLA pattern series (the series begins with Finger 1, the right thumb and ending with Finger 10, the left pinky), the corresponding classification ratio would be 19:1

	L Pinky	L Ring	L Middle	L Index	L Thumb	R Thumb	R Index	R Middle	R Ring	R Pinky

Finger Number	10	9	8	7	6	1	2	3	4	5
Value (if Whorl)	1	1	2	2	4	16	16	8	8	4
Pattern Type	Arch	Loop	Whorl	Loop	Arch	Loop	Whorl	Arch	Arch	Loop
Finger Value	0	0	2	0	0	0	16	0	0	0

ex 1+(Sum of Even Finger value) = 1+16+2 = 19

1+(Sum of Odd Finger value) 1+(0) 1 or 19:1

Fingers