FINGERPRINTS: Basics and Classification

Introduction

- Fingerprints are the impression from the friction ridges of any part of a human hand.
- Fingerprint evidence remains the most positive means of personal identification in forensics, to date.
- Though often compared with other modern innovations such as DNA, fingerprint evidence results in positive identifications whereas other evidence does not.
- Fingerprint evidence can also distinguish between identical twins.

What Are Friction Ridges?

Friction ridges appear on the palms, soles, and the ends of the fingers and toes .

These ridges are found on the palms and soles of all primates (humans, apes, monkeys, and prosimians); in primates with prehensile tails (“finger-like” tails, such as spider monkeys), friction ridges also appear on the volar surface of the tails.

Fingerprints are a reproduction of friction skin ridges found on the palm side of the fingers and thumbs. Similar friction skin can also be found on the surface of the palms and soles of the feet.

A visual inspection of friction skin reveals a series of lines corresponding to hills (ridges) and valleys (grooves).

- Structure of the Skin: Skin is composed of layers of cells. Those nearest the surface make up the outer portion of the skin known as the ***epidermis***, and the inner skin is known as the ***dermis.***

- A cross section of reveals a boundary of cells separating the epidermis and dermis.
- The shape of this boundary, made up of ***dermal papillae***, determines 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 remain unchanged throughout life except to enlarge during growth.

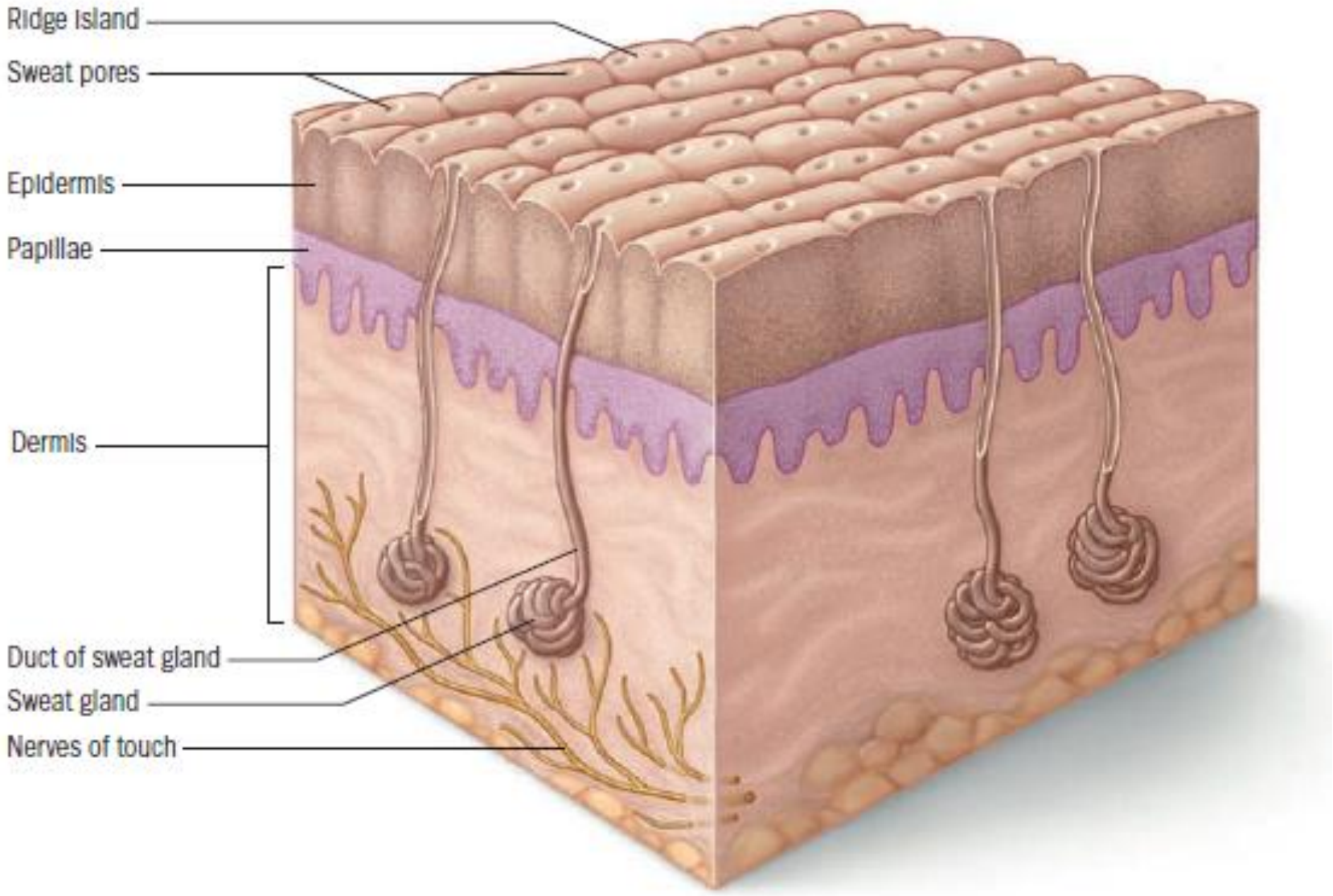


FIGURE 6–3

Cross-section of human skin.

First Principle: A Fingerprint Is an Individual Characteristic; No Two Fingers Have Yet Been Found to Possess Identical Ridge Characteristics.

Second Principle: A Fingerprint Remains Unchanged During an Individual's Lifetime.

Third Principle: Fingerprints Have General Ridge Patterns That Permit Them to Be Systematically Classified.

Changing Fingerprints Although it is impossible to change one's fingerprints, there has been no lack of effort on the part of some criminals to obscure them. If an injury reaches deeply enough into the skin and damages the dermal papillae, a permanent scar will form.

Types of Fingerprint Patterns

Fingerprint patterns are determined by the arrangement of the ridges present on the distal phalange of the finger.

The fingerprints may be categorized into three general pattern types: - arches, Loops and Whorls. The common characteristics that make up these patterns are known as pattern area, type lines, delta and core.

Basic Pattern	Pattern type	Symbol
Arch	Plain Arch	**A**
	Tented Arch	**T**
Loop	Radial Loop	**R**
	Ulnar Loop	**U**
Whorl	Plain Whorl	**W**
	Central Pocket Loop	**C**
	Double Loops	**S**
	Accidental	**X**

Loops:

A Loop is a type of pattern in which one or more ridges enter either side, recurve, touch or pass an imaginary line between Delta and Core, and tend to exit the same side as the ridge entry.

The frequency of occurrence of such patterns is 60-65%.

Types of loop

If the loop opens toward the little finger, it is called an *ulnar loop*; if it opens toward the thumb, it is a *radial loop*.

The pattern area of the loop is surrounded by two diverging ridges known as *type lines*. The ridge point at or nearest the type-line divergence and located at or directly in front of the point of divergence is known as the *delta*.

All loops must have one delta. The *core*, as the name suggests, is the approximate center of the pattern.

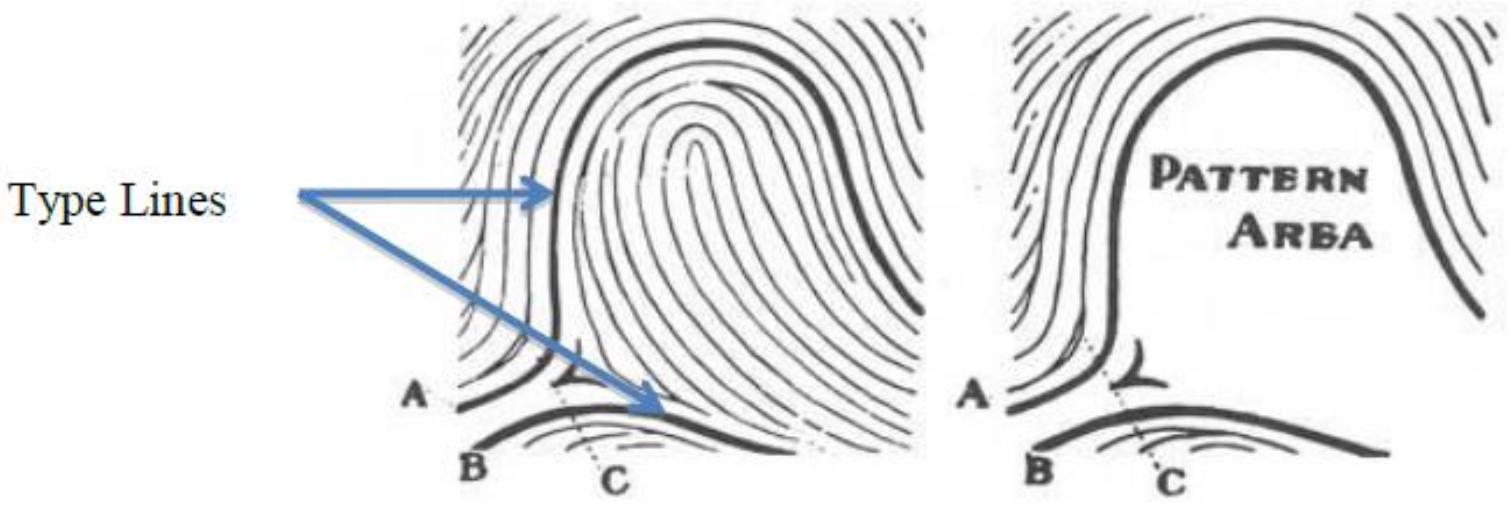


Fig 1: Type Lines and Pattern Area

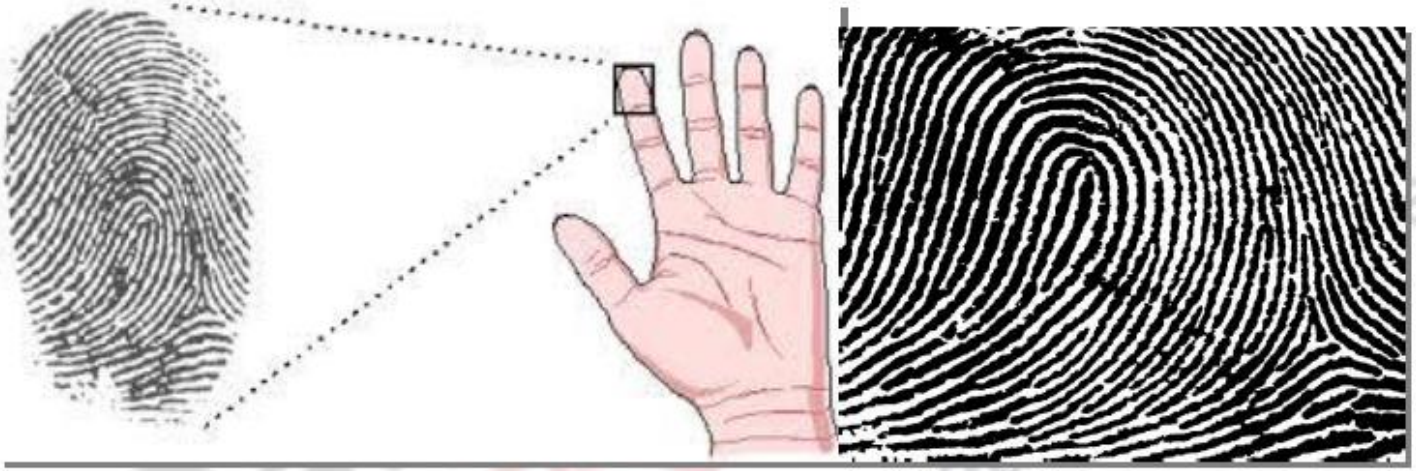


Fig 4: Showing Radial Loop Pattern

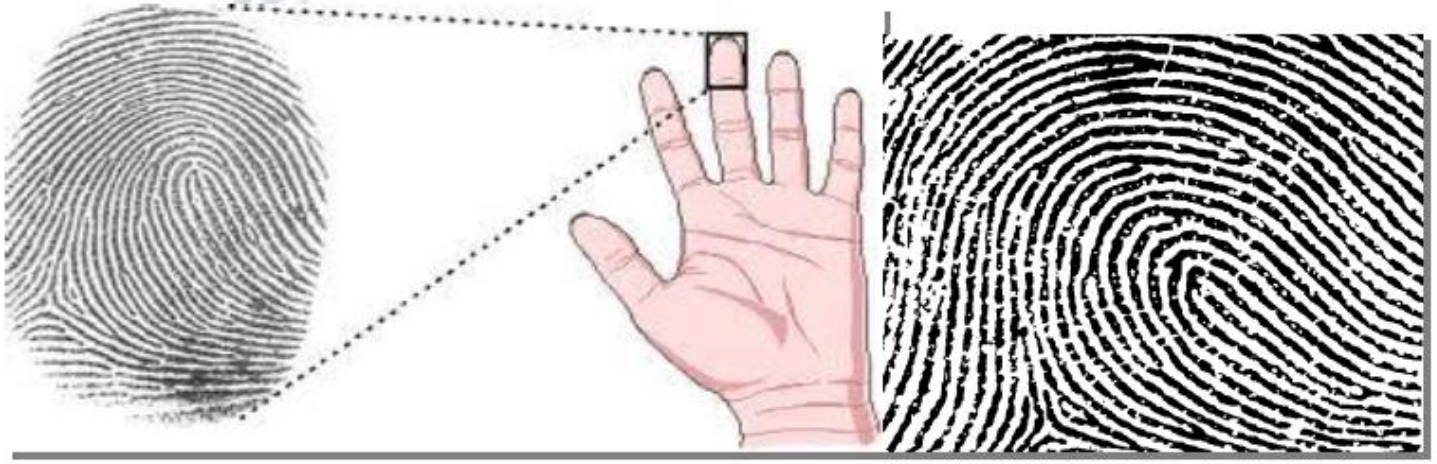


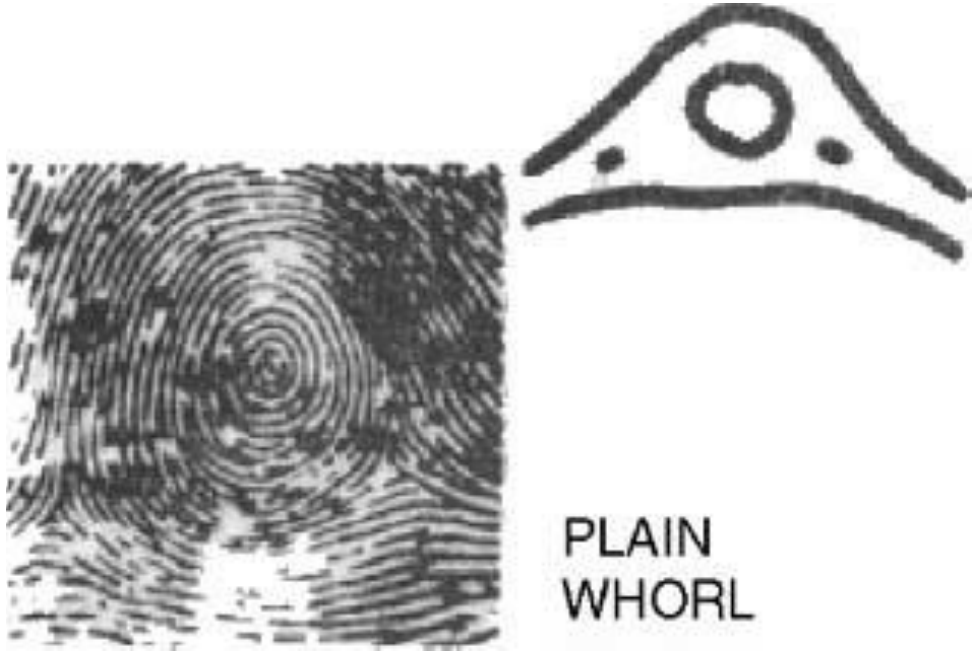
Fig 5: Showing Ulnar Loop

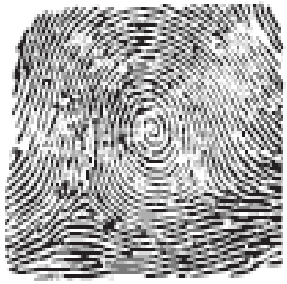
Whorls

- All whorl patterns must have type lines and at least two deltas.
- Whorls are divided into four distinct groups, plain,
- central pocket loop, double loop, and accidental.
- A plain whorl and a 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 circle.
- If an imaginary line drawn between the two deltas contained within these two patterns touches any one of the spiral ridges, the pattern is a plain whorl.

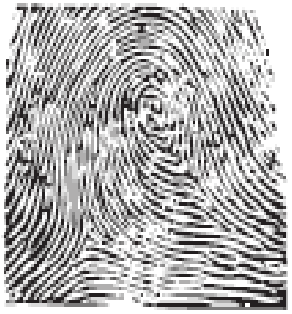
- If no such ridge is touched, the pattern is a central pocket loop.

Fig 6: Plain Whorl Pattern

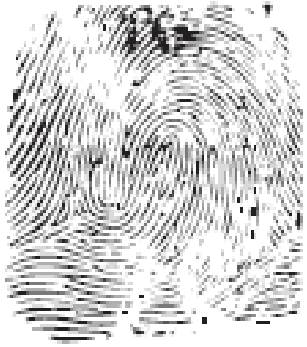




Plain whorl



Central pocket



Double loop

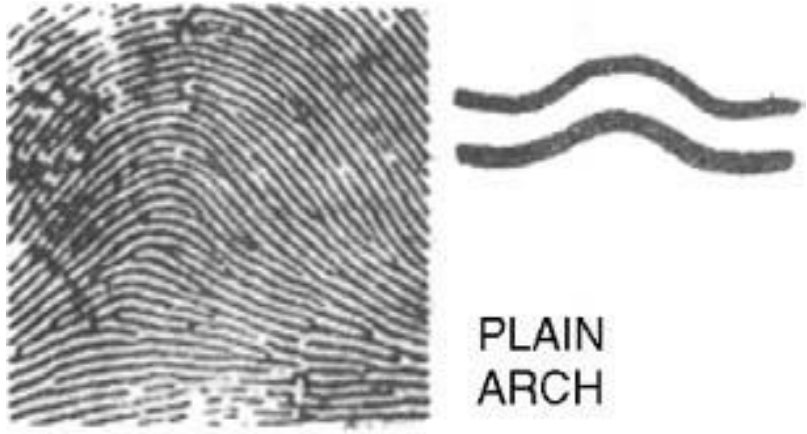
Accidental

FIGURE 6–6
Whorl pattern

Arches

Arches, the least common of the three general patterns(5%).

- ✓ They are subdivided into two distinct groups: plain arches and tented arches.
- ✓ The plain arch is the simplest of all fingerprint patterns; it is formed by ridges entering from one side of the print and exiting on the opposite side.
- ✓ Generally, these ridges tend to rise in the center of the pattern,
- ✓ forming a wavelike pattern.
- ✓ 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.



Plain Tented

FIGURE 6–7
Arch patterns.

Ridge Characteristics

The individuality of a fingerprint is not determined by its general shape or pattern but by a careful study of its ridge characteristics (also known as minutiae).

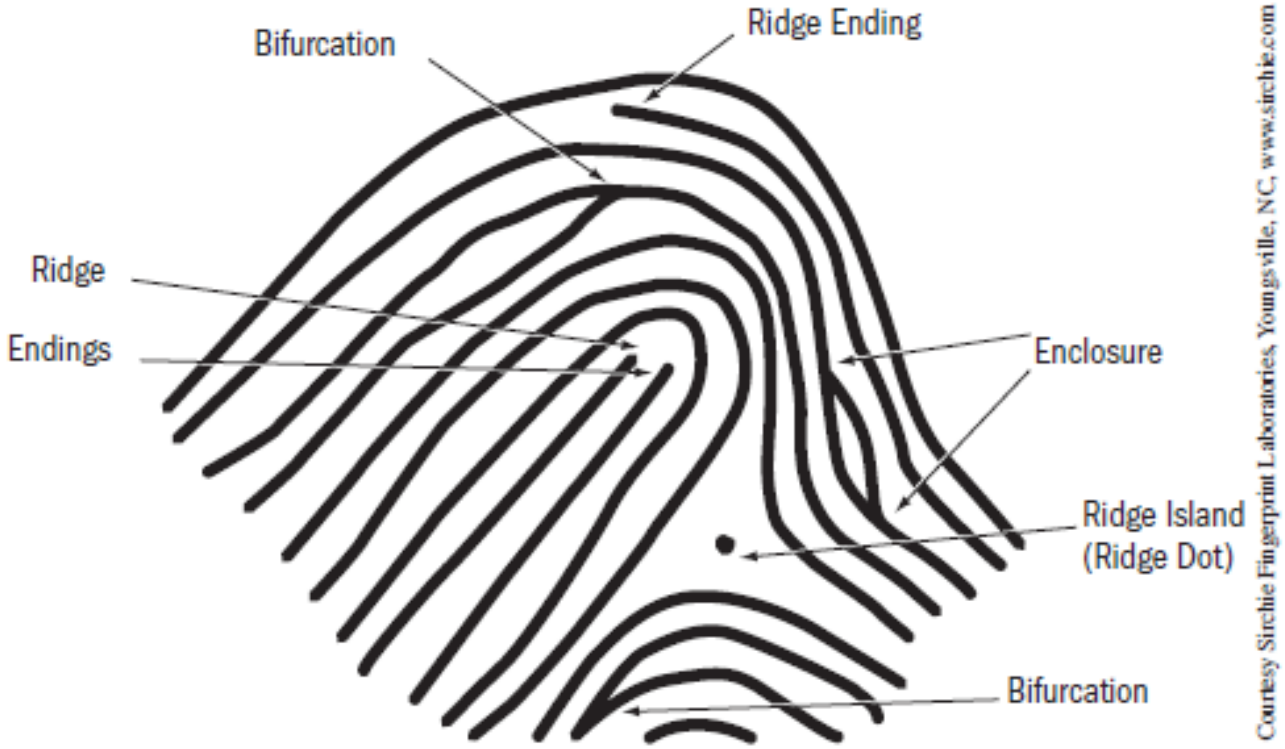


FIGURE 6–1

Fingerprint ridge characteristics.

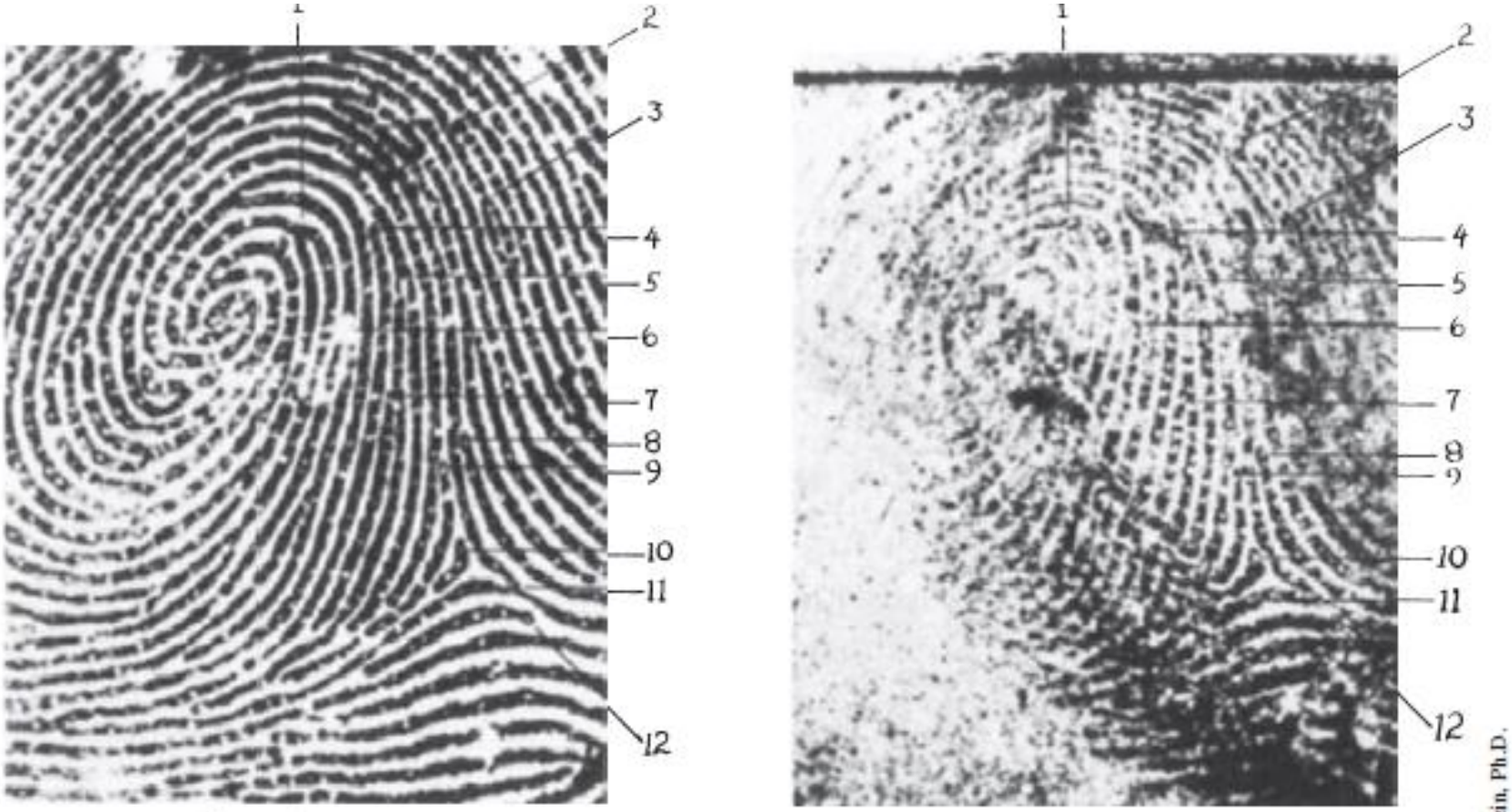


FIGURE 6–2

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

Ridge Comparisons

For years, experts have debated how many ridge comparisons are necessary to identify two fingerprints as the same. Numbers that range from 8 to 16 have been suggested as being sufficient to meet the criteria of individuality