Latent Print Processing Guide

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Preface

Over a 36-year span, I was employed in law enforcement, having served as a patrol officer, detective, crime scene investigator, and photographer. For 25 of those years, I also worked as a latent fingerprint examiner, finally retiring in 2010 from the Florida Department of Law Enforcement as a senior crime laboratory analyst, assigned to the latent print section.

When I attended the basic police academy in 1975, we were taught almost nothing about evidence collection or fingerprint development and preservation. Over the years, things haven't changed much; my son attended the basic police academy five years ago and received about the same amount of training concerning fingerprints. This is partly due to the fact that the instructors were not fingerprint examiners, crime scene personnel, or fully qualified to teach on the subject.

During my career, I had the good fortune to meet many officers from a variety of agencies, including local, state, and federal levels of law enforcement. Invariably, their general knowledge of fingerprint processing and examination was incomplete at best. Most were only familiar with dusting and lifting and thought that identifications were made automatically by computer. Unfortunately, this too seems not to have changed much. Even in those cases where personnel were aware of the existence of additional processes, their knowledge of when and how to apply these processes was limited, and funding for training is scarce.

My intent in compiling this guide is to educate and assist those who process crime scenes and collect and process evidence. In addition, first responders need to know the potential value of evidentiary items located at the crime scene; too often, important pieces are not collected because first responders are not aware that they can be processed.

Many of those responsible for processing fingerprint evidence are not aware that multiple processes can be used on the same piece of evidence if used in the proper sequence. Having taught latent fingerprint development as an adjunct professor, I could not locate a text suitable to use in a fingerprint development course. I hope that this text may fill the void.

Acknowledgments

During my 36-year employment in law enforcement, many people have had an influence on my career. Of these, none were greater than the support of my family. Working as a police officer, I was not always able to lend support to my wife and encouragement to my children at various events because of my work schedule. I missed little league games, birthday parties, and holiday dinners, shortchanging my children and placing additional burdens on my wife. I would like to thank my wife Diane, my daughter Katie, and my son Steve for their understanding.

In addition, I would like to thank the late Michael J. Rafferty, former Chief of Forensics at the Fort Myers Regional Operations Center of the Florida Department of Law Enforcement, for encouraging me to submit various articles for publishing. He was instrumental in my joining the faculty at Edison College as an adjunct professor and becoming a member of the Crime Scene Technology Advisory Committee there. He appointed me to the Quality Assurance Committee–Fingerprint Discipline and to the committee to revise the Latent Print Analysis Training Program and Latent Fingerprint Procedures Manual. It was his advocating that cultivated my decision to write this book.

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Chapter 1

The Forensic Science of Fingerprints

Chapter Outline

FINGERPRINTS

Fingerprints are the most dynamic form of evidence in existence... They are unique, permanent, objective and exact... The results are absolute and final.

Fingerprints can be identified to the exclusion of all others, which is not possible by other forms of forensic testing. Even DNA is not as exact, where identical twins have the same DNA.

Robert Hazen, Director of the FBI Latent Fingerprint Section, 1986

The "Science of Fingerprint Identification" begins at the point where material known as a matrix is transferred from an area of friction ridge skin to an object or surface. The "Science" continues on to detection, development, and recovery of the latent print, then to comparison with existing exemplars. The comparison process proceeds until a match or no match conclusion is reached and, ideally, culminates in individualization.

BRIEF HISTORY

For over 2000 years, humankind has known the value of fingerprints as a form of personalization. Chinese craftsmen during the "Tang" Dynasty signed their work with a thumb impression.

Early scientific notices of friction ridge peculiarities include the following:

Dr Nehemiah Grew was the first European to publish friction ridge skin observations. Dutch anatomist Govard Bidloo's 1685 book, "Anatomy of the Human Body," also described friction ridge skin (papillary ridge) details.

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Marcello Malpighi noted fingerprint ridges, spirals, and loops in his treatise.
John Evangelist Purkinje published his thesis discussing nine fingerprint patterns.
No mention of friction ridge skin uniqueness, permanence, or the value of fingerprints for personal identification was made by Grew, Bidloo, Malpighi, or Purkinje.
The first recorded reference to the modern use of fingerprints as a means of identification appeared in 1788 when J.C.A. Mayer wrote, "Although the arrangement of skin ridges is never duplicated in two persons, never the less the similarities are clearer among some individuals. In others the differences are marked, yet in spite of their peculiarities of arrangement all have certain likeness."
The actual use of fingerprints as a means of identification can be traced to India, where in 1858, Sir William James Herschel, a British official in India, began requiring a thumbprint of his subjects when they received goods and supplies. Although initially used as a ruse to prevent fraudulent double-dipping, he noticed that even though fingerprint patterns were similar, a close examination revealed minute differences allowing for individualization.

Other significant dates concerning the evolution of fingerprint identification:

- 1880—Dr Henry Faulds—devised methods for the taking of inked fingerprints that are still in use today.
- 1892—Sir Francis Galton—defined the five ridge detail types, now referred to as the Galton details.
- 1892—Juan Vucetich—the first recorded use of fingerprints for criminal identification (Argentina).
- 1901—Sir Edward Richard Henry—developed the Henry System of classification, a very intricate method for filing fingerprints so they may be located by means other than a subject's name.
- 1904—Fingerprints are officially introduced in the United States at the World's Fair in Saint Louis.
- 1911—Jennings versus Illinois—the first time fingerprints are allowed to be admitted as evidence in the US.
- 1924—The FBI Identification Division was formed.

DEFINITIONS

- *Friction Ridge Skin*—the portion of skin containing peaks and valleys, arranged in a pattern and located on the palmer and plantar surfaces.
- *Palmer Surface*—the palm side of hands, including fingers.
- *Plantar Surface*—the bottom of feet and toes.
- *Latent Fingerprint*—the word latent means to lie hidden or to escape notice. As it refers to crime scenes, latents are fingerprints that are involuntary

recordings of the friction ridge skin scarcely or not visible, but they can be developed for study.

- *Inked Fingerprint*—an inked fingerprint is produced when a thin film of black printer ink is applied to the tops of the ridges present on the last finger joint, after which the finger is pressed against a white card or piece of paper. This effect creates a "stamp" of the fingerprint pattern.
- *Core*—a core is present in the *Loop* and *Whorl* patterns. It is essentially the center of the fingerprint pattern. It can be identified by the innermost recurving ridge in the Loop pattern and the center of the circular pattern in the Whorl.
- *Delta*—deltas are also present in *Loop* and *Whorl* patterns and are formed between the type lines (ridges) that flow in on one side and out on the other at the bottom and the ridges that recurve to encompass the center of the pattern. Their shape is similar to a river delta.

Fingerprint Patterns—fingerprint patterns, or ridge formations, are grouped in three categories, which are then broken down into eight subcategories: Arch, Tented arch, Right and Left slanted Loop, Whorl, Central pocket whorl, Double loop whorl, and Accidental whorl.

The **three basic** pattern forms are the following:

Arch—an Arch pattern is identified by the ridges flowing *in on one side*, forming a gentle "arch," and flowing *out on the other side*.

Loop—the Loop can be distinguished by the formation of a ridge "loop" when at least one ridge flows *in from one side*, recurves, and *exits out the same side* it entered. The Loop also must have one delta.

Whorl—the Whorl is very distinct, as the ridges flow or tend to flow in a *circular pattern*. A whorl pattern contains two deltas.

TYPES OF FINGERPRINTS

The million dollar question... What types of surfaces can you get fingerprints off of?

The answer is pretty much everything: hard surfaces, soft surfaces, porous surfaces (paper), cloth, rock, even human skin. The key here is that a fingerprint is an imprint (reproduction) of a finger or a portion of friction ridge skin and is produced by the *transference* of whatever was present on the surface of that finger or portion of friction ridge skin. This could be anything from perspiration to paint to body oils or food residue. The length of time that a fingerprint will remain is dependent on the makeup of the transferred material.

Fingerprints fall into different categories:

- Latent fingerprints (hidden).
- Patent fingerprints (visible).
- Plastic fingerprints (3D).
- Often these are all referred to as "latents."

WHY FINGERPRINTS ARE USED FOR IDENTIFICATION

- Friction ridge skin on the palmer and plantar surfaces of the hands and feet are **unique** to an individual person.
- The fingerprint patterns and ridge details are **permanent**. Developing in the womb at about the 12th week after conception, fingerprints do not naturally change, except in size, during the life of an individual.

HOW FINGERPRINTS ARE PRODUCED

- **Transfer of contaminants (Matrix)**—this is the primary process that produces a fingerprint on a piece of evidence. Normally, a fingertip will contain little more than a small amount of perspiration. This particular perspiration does not contain oils. The fingers coming in contact with various objects or surfaces pick up other forms of contaminants. When an object is touched, some of the contaminants will transfer to the object, leaving a "print" of the fingers.

  Examples of Matrix:

  Body oils found in the hairy areas (from sebaceous glands)
  Perspiration (eccrine glands on palmer and plantar surfaces)
  Grease
  Blood
  Paint
- **Plastic deformation**—the fingers will often leave an impression in a soft material, such as tacky paint or drying blood, soil, and candle wax (etc.).
- **Material removal**—additionally, fingers coming in contact with a dirty or dusty surface may remove that material, resulting in a clean fingerprint surrounded by the dirt or dust.

DETECTION AND DEVELOPMENT

- First and foremost in the process of fingerprint identification for the purposes of solving crimes is the detection and development of a latent fingerprint of sufficient quality to affect a fingerprint comparison. Second to this is the taking of good quality inked fingerprints for this latent to be compared to.
- Different surfaces and materials require different process techniques in order to develop that "hidden" fingerprint. Basically, there are two types of surfaces, **nonporous** (nonabsorbent) like glass, metal, or plastic and **porous** (absorbent) like paper.

  Like the composition of the matrix, the substrate can also be hard to group into a specific category. The basic categories, nonporous or porous, can actually be a widespread combination of the two. An example of this would be paper. The first reaction might be to place paper into the porous category, but paper can range in density from tissue to high-gloss magazine covers and, as such, must be processed differently.

- **Nonporous** surfaces are usually identified with the more commonly known dusting process using fine powders and a fingerprint brush, followed by applying transparent tape over the developed fingerprint and lifting it. These surfaces can also be treated by exposing the subject item to super glue fumes, which polymerize (adhere) to the latent fingerprint. Subsequently, these cyanoacrylate-treated prints can by powdered and lifted or treated with chemical dye stains, which results with them fluorescing when observed under a particular color of light supplied by an alternate light source.
- **Porous** surfaces usually require the use of a chemical reagent to develop fingerprints so that we may recover and compare them. Chemical reagents react with the contaminant, which has been transferred from the fingertip to the object. This reaction can take two forms: it either makes the latent fingerprint visible under normal lighting conditions or causes the fingerprint to fluoresce under the illumination of the alternate light source. The recovery of these fingerprints requires that they be photographed.

RECOVERY AND PRESERVATION

- The use of **photography**—it is wise to photograph all latents as they are located or developed, as additional recovery processes may alter or destroy the previously developed latent, rendering it useless. In some cases, as with forensic light source detection, iodine fuming, and silver nitrate, the results are not permanent and must be photographed, or they will eventually be lost. Photography is a permanent record, which can be reproduced many times and can be enhanced by using different types of development (dark room) techniques and software. When photographing latents, include an item in the frame, such as a coin or preferably a small stick-on scale, so that the photo can be reproduced life size when printing.
- **Lifting**—latents developed with powder can be preserved by placing a piece of clear cellophane tape over the dusted latent, causing the dust to adhere to the adhesive side of the tape. This tape is then lifted from the object and placed on a card or backer, which has a contrasting color to the powder used, resulting in a print that is in the same alignment as an inked fingerprint.
- **Casting**—fingerprints left in soft putty, drying paint, or blood can be cast using tool mark recovery methods, such as commercial silicone rubber casting material, which may include, but is not limited to, Duplicast™, Mikrosil™, or Accutrans™ (polyvinylsiloxane).

FINGERPRINT IDENTIFICATION

- To identify a fingerprint is to say that a particular unknown fingerprint matches a second known or unknown fingerprint in all details. Upon identification, the examiner is affirming that two fingerprints have been produced by the same individual.

- An example of the method to complete this process is as follows:
- Identify **class characteristics**—this involves determining the shape, ridge flow, and pattern type of a fingerprint. These are called level 1 details. Being able to determine the class characteristics can immediately eliminate a fingerprint as a possible candidate. Knowing that your subject fingerprint is a particular pattern type can eliminate all other pattern types from consideration. Pattern identification—shape and ridge flow can be a strong indicator of pattern type and even right or left hand or palm. Subtle ridge flow curvature can sometimes be enough to identify the source of the questioned friction ridge.
- Identify **ridge details**—once it has been determined that the class characteristics of two fingerprints are similar, an examination for identical ridge detail is performed. **Ridge or "Galton" details**, level 2 details, are located in one fingerprint. Usually a pair of prominent details is chosen to make the search easier, and the location and ridge spacing is carefully noted. An attempt is then made to locate these details on the second fingerprint. They must be the same in both fingerprints in order to proceed. After concluding they are identical, a third detail is located and compared, then a fourth, and so on. Sometimes level 3 details are present in both the latent and inked fingerprint and can also be used to affect identification. Level 3 details consist of pore detail and individual ridge shape. When the examiner is satisfied that a sufficient quantity of matching detail is present, a positive identification is declared. **No minimum** number of points has been set by US authorities.

AFIS (Automated Fingerprint Identification System)

- A computer system that has the ability to sort through thousands of fingerprint cards and retrieve exemplar, or known, fingerprints that are *similar* to the questioned fingerprint. The system should be more accurately referred to as a computer-aided fingerprint identification system, as AFIS does not automatically identify fingerprints; the identification is done by a latent fingerprint examiner.
- Upon the arrest of an individual, the fingerprints are searched against a database containing the fingerprints of persons previously arrested. Many times people give false information at the time of arrest, and with the AFIS system, these incidents are detected and the arrested party is found to have an arrest warrant or is in violation of their probation.
- Additionally, latent fingerprints are entered into the AFIS system and are searched against the database. The computer generates a list of **possible** candidates and displays the fingerprints associated with that list. This affords us the ability to solve crimes when there is not an initial suspect.

Chapter 2

Developing Fingerprints

Chapter Outline

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CHEMICAL AND PHYSICAL PROCESSES

Skin Structure

- Dermis and epidermis—Friction ridge skin is comprised of two main layers: the dermis and epidermis. The epidermis is the exterior or outer layer. The dermis lies under the epidermis next to muscle tissue. Contained in these main layers are several other layers and the **eccrine** glands, which secrete perspiration (see Figure 1).
- Epidermal cells are produced in the basal layer, sometimes called the generating layer, and migrate toward the surface, where they eventually exfoliate (slough off). This generating layer contains the template for the fingerprint pattern and details. A laceration passing through the generating layer will result in the formation of a scar (see Figure 2).
- Horny skin cells are also called epithelial cells and are valuable for DNA examinations.

Chemical Composition of Perspiration

98.5–99.5% water (salt (sodium) is the second largest component)

- Eccrine Glands:
  Palmar and **Plantar** surfaces of hands and feet
  Inorganic:
    Halides (mainly chloride)
    Ammonia
    Sulfate
    Phosphate
    ***Sodium**
    Calcium
  Organic:
    ***Amino acids**
    Urea
    Lactic acid
    Sugars
    Creatine
    Choline
    Uric acid
    Riboflavins
    Pyridoxin
- Sebaceous Glands:
  Hairy body areas
  Organic:
    ***Fatty acids**
    Glycerides