Modern fingerprinting

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The History of Fingerprinting

Many persons today are aware of the uses of fingerprints, especially as a means of identification linking a suspect to a crime scene. Knowledge of fingerprints, or the patterns of friction ridge skin on the fingers, has existed for some time. This knowledge has been proposed for, and used for, various purposes.

Probably the oldest example of the recognition of fingerprints are the contract seals which were used during Hammurabi's reign in ancient Babylon. This would date the seals between 1955 and 1913 B.C. (Moenssens, 1) Also among the earliest signs of recognition of the existence of fingerprints are carvings in stone found at the edge of the Kejimkoojik Lake in Nova Scotia. (Cummins, 3) The carvings depict a human hand with simple markings which resemble ridges and flexion creases. These carvings are believed to be at least several hundreds of years old, and may be older. Carvings have been found in a Neolithic burial passage, L'Ile de Gavr'inis, which may represent fingerprints. A Chinese document seal, made of clay and containing a fingerprint, has been dated as being made no later than the third century B.C. This seal is believed to have been used as a personal mark, but not necessarily for the purpose of fingerprint identification. (Cummins, 4, 6-7) Thumb prints in clay seals may have been purely ceremonial, but many people believe that the prints were known to be distinctive. (Moenssens,
1) A clay lamp excavated in Palestine and dated as fourth or fifth century A.D. shows a human fingerprint. Whether this print was merely a result of the use of the human hand as a tool or was a form of symbolic identification of the creator with the lamp is not certain. All of these early signs of the knowledge of the existence of fingerprints are believed to have come before the scientific study of fingerprints. That is to say, the people of those times may have recognized that ridges do exist on the skin, but they did not set out to study those ridges in any systematic way.

The first scientific look at friction ridge skin did not come until 1684, with the work of Dr. Nehemiah Grew. His study was anatomical in nature. (Moenssens, 1) Grew reported on the patterning of friction ridge skin on the fingers and palms. He also described the arrangement of sweat pores along the ridges. (Cummins, 11) His work brought fingerprints to the attention of the Western World.

Grew's study was followed by the works of such scientists as G. Bidloo of Holland, in 1685, Professor Marcello Malpighi of Italy, in 1686, Christian J. Hintze of Germany, in 1751, and Bernard S. Albinus of Germany, in 1764. (Moenssens, 1) Of these, the works of Malpighi and Bidloo are the most significant. Bidloo provided a detailed description of the skin covering the fingers, while Malpighi investigated the function of friction ridge skin as a tactile organ and as a means of providing traction for walking and grasping. (Cowger, 3-4)
Following these original studies, which provided much background information, scientists began to look at the practical aspects of fingerprints. First to assert the theory that the arrangement of skin ridges is never duplicated in two individuals was J.C.A. Mayer of Germany. His study was published in 1788. The first classification system was devised by Professor Johannes E. Purkinje of the University of Breslau, Prussia. His system was devised in 1823. It was presented in a thesis which described friction ridge patterns, classified them by dividing them into nine categories, and established rules for their interpretation. (Moenssens, 1, 3)

It was not until 1858 that the practice of recording prints began. William Herschel, the British Administrator in Bengal, India, started the practice of recording the handprints of natives on contracts. In 1877, he requested permission to use his fingerprints in the jails. His request was denied by his superiors. Herschel wished to use his technique to prevent impersonation and fraudulent signatures among the natives. Herschel conducted a series of experiments over a twenty year period and came to believe that skin ridges do not change over the life of the individual. (Moenssens, 3)

In 1880, Dr. Henry Faulds began his series of writings on fingerprints. In his works, he described the prints and advocated their use for the detection and identification of criminals. (Moenssens, 3-4) In his article in Nature, Faulds described two instances in which he had used fingerprint evidence
in Japan. (Cowger, 5)

Shortly after Faulds was published, Herschel wrote to Nature claiming to be the first to recognize the individuality of prints and to realize their usefulness. A debate followed regarding who was the first to recognize these factors. Their ideas on the practical applications of fingerprints differed. Herschel used prints to prevent impersonation, while Faulds was the first to use crime-scene prints for the identification of criminals. Both are credited with making great contributions to the study of fingerprinting. (Moenssens, 5)

In 1891, Juan Vucetich's classification system was officially adopted in South America. His system was used by the La Plata police department. This system, with many local modifications and extensions, is still used in most Spanish-speaking countries. (Cowger, 5-6)

Sir Francis Galton, an English biologist, later took up Herschel's study. In 1892, he published the first textbook on fingerprints. In his book, he stated that fingerprints are never duplicated and do not change throughout an individual's life. He also described a classification system which he had developed. Although his system was never practically utilized, it did serve as a basis for future research, which eventually culminated in a workable system of classification. (Moenssens, 5-6)

At the time of the various studies of fingerprints, Alphonse Bertillon, the Chief of the Identification Division of the Criminal Police in Paris, was using a system of anthropometry.
Bertillon's system involved measuring various body parts which do not change in size during the life of an adult. This system of identification was widely used in France and abroad. When knowledge of the usefulness of fingerprints became more widespread, fingerprints were included in the Bertillonage system, but were only used in conjunction with anthropometric measurements. Although fingerprints were much more accurate than anthropometry, they were not used by themselves in Europe until after the death of Bertillon in 1914. Many people still refer to fingerprinting as Bertillonage, even though his original system had nothing to do with actual fingerprint impressions. (Moenssens, 7)

The system which replaced Bertillonage was that of Sir Edward Richard Henry, who had visited Sir Galton in 1893. Following his visit, he returned to India to institute the use of fingerprints for identification on a national level. Between 1894 and 1897, Henry devised his own classification system. India discarded Bertillonage in favor of Henry's system in 1897. It was Henry who was responsible for the incorporation of fingerprints into the Bertillonage system in 1901. (Cowger, 6) Henry's system is the system used most widely in English-speaking countries, including the United States and Canada.

**Types of Fingerprints**

There exists some variation in the categorization of
fingerprints. The term "latent" has, in the past, been applied to all unintentional impressions that are of evidentiary value. (Olsen, 114) Under this system of categorization, latent prints are divided into visible and invisible prints, and visible prints are further divided into plastic prints and prints made by the "contamination" of the skin with substances such as blood, dust, paint, ink, or grease. (Olsen, 115) Because the term "latent" actually means hidden, some groups feel that visible prints do not fall under the "latent" categorization system. (FBI^2, 175) To reduce the confusion about print categorization, a new system was devised. In this system, the phrase "evidence print" is used to define any type of print found at a crime scene or on evidence associated with a crime scene. Evidence prints are generally divided into three categories: latent prints, visible prints, and plastic impressions. (Cowger, 71)

Latent prints are also known as invisible prints, because they cannot be seen in their original form and must be developed or enhanced for collection and comparison. These prints result either from the deposition of substances, such as perspiration, body oil, hair oil, hand cream, animal fat or any other fluid on a surface or from the removal of a sticky substance from the surface. In the case of the removal of a substance, the print will appear as a "negative" of the normally expected print. (Cowger, 72) Latent prints may be left on virtually any surface if the conditions are right. The conditions involved are the nature of the deposited or removed substance, the nature and
condition of the substrate, or surface, and the condition of the skin which is to remove some material from the surface. (Cowger, 72) Invisible prints are obliterated rather easily. (Waltz, 395)

Visible prints can be seen without enhancement. (Cowger, 72) They are often found in soot, dust, blood, powder, or other similar substance. (Waltz, 395) Visible prints can, in fact, be made of any substance that contrasts sufficiently with the substrate. (Cowger, 73) As with latent prints, the same factors or conditions affect the existence of a visible print. (Cowger, 73) Also as with latent prints, visible prints are easily obliterated. (Waltz, 395)

Plastic prints, or plastic impressions, generally result from touching a semi-solid substance that is capable of retaining a three-dimensional representation of the friction ridges. (Cowger, 74) Such substances include putty, soft wax, wet paint, grease, or any other substance that can be displaced by the pressure from the ridges and will not flow back to form a smooth surface. Plastic impressions are usually visible, but may be difficult to see if the impression is shallow or if the substance is very dark or transparent. Of course, the impression must be fairly shallow because there is not much distance between the top of a ridge and the bottom of a valley on friction ridge skin. (Cowger, 74) The visibility of plastic impressions is also affected by light. The very existence of plastic prints may be affected by heating the substrate. (Cowger, 75) Plastic prints are more durable than the other types of evidence prints. (Waltz,
It is important to bear in mind that the categories of evidence prints are not mutually exclusive and categorization may be difficult. (Cowger, 71) For example, some prints may only be visible with proper lighting. If the light is considered to be an enhancement technique, the print will be categorized as latent. If the light is not considered to be an enhancement technique, the print will be categorized as visible. (Cowger, 73) Often, the only difference between a visible print and a latent print is the surface on which the print is placed. Prints made of a substance that is invisible on a white wall may be easily seen on a mirror. (Cowger, 73) The lines upon which categorization is based are not always clear-cut.

One other type of print should be explained. That type is the inked print. The inked print is one that is made intentionally by an appropriate technique and for a specific purpose. Inked prints are generally "known" or "exemplar" prints which are taken from known persons for use in comparisons. (Cowger, 9) For example, when lifting prints from a crime scene, it is also necessary to take the prints of persons who are supposed to be present at the scene so that they can be separated from those of the perpetrator if he is a stranger to the scene. Sometimes, however, the prints are not known, and the identity of the donor is being sought. Such would be the case of prints taken from a deceased person who had no identification on him.
Inked Prints

As previously noted, inked prints are those made by an appropriate technique for a specific purpose. The donor is usually known, and these prints are generally used as examples for comparison with unknown prints. It is important for these prints to be of the best possible quality so that comparisons can be made more easily and with greater accuracy. Many methods and materials have been devised for the purpose of making exemplar prints, and all have been touted as producing the best results. The most common method of recording exemplar prints, however, is with ink. Although other techniques may be required for certain circumstances, ink generally works well because it is easy to use and produces prints of good detail and high contrast. (Cowger, 9)

The equipment required for taking inked fingerprints is limited to a few items, most of which could be improvised if necessary. However, the necessary equipment can be purchased at little expense. Those items which are essential are ink, cards or paper, a roller, an inking slab, and a pressure pad if palm and sole prints are to be taken. (Cummins, 45) A rigid plane surface on which the printing can be done is needed as well.

Printer's ink is the best ink for taking fingerprints. It produces a dark black print and contains oils which make the drying process almost instantaneous. Although mimeograph ink can be used, it is a poor substitute for printer's ink. Both writing ink and stamp-pad ink are unsuitable for fingerprinting.
The cards used for fingerprinting have become generally standardized, measuring eight inches by eight inches. The cards are printed with spaces for each print, in a fixed order, and with room for making written notes. The goal of the standardized card is uniformity for use in identification files. Paper can also be used for recording prints and can be of whatever size suits the worker's purpose for the individual case. Any paper selected should be durable, and at least one side should be slightly glazed. (Cummins, 45) For palm and sole prints, the paper cannot be so stiff as to not conform to the irregular contours of these areas. (46)

A roller is used for spreading ink. It is possible to obtain rollers designed specifically for fingerprinting work, but the soft rollers used by printers and engravers will also serve the purpose. Firm rubber rollers such as those used in photographic work are usable, but are not as well suited for fingerprinting as are the soft ones. (47)

The inking slab, or plate, is merely a plane surface, made of glass (preferably plate glass) or a sheet of polished metal such as copper or brass backed with wood, on which ink can be rolled into a thin film. The size of the inking slab varies according to the needs and preferences of the worker. Most are four to six inches wide and ten to fourteen inches long. (47)

The rigid plane surface is absolutely necessary. It is upon this surface that the card or paper is placed during the process
of printing. In most instances, a smooth table top or a sheet of glass will suffice. A special card holder is often part of the equipment found in fingerprinting offices. This holder provides a rigid surface and exposes only that section of the card which is in immediate use. (47) The surface upon which the prints are rolled should project an inch or two in front of the table itself. This allows room in which the other fingers can move as the finger being printed is rotated. (Olsen, 184)

A pressure pad is recommended over a rigid surface for printing palms or soles. The pad is generally made of sponge rubber like that which is used in many chair cushions. The pad yields to the pressure of the body part being printed and thus allows for full contact between the two surfaces, even at the contoured areas. Some devices have been designed for this purpose which use a rigid surface, a cylinder, or a convex platform. (Cummins, 47)

The table upon which the fingerprinting is done should be at a height which is suited to the standing of both the subject and the operator. A height of forty-two to forty-five inches is appropriate for most cases. Some tables may fit this height requirement; others can be modified to reach this height by the addition of a small platform to the table. (Olsen, 184)

As stated before, alternatives to the ink, ink plate, and roller combination have been suggested. Many devices have been introduced which make taking prints easier and allow for greater control over the variables involved in the printing process.
Some of these are "inkless" methods and are of two basic types. In one chemical process, a colorless chemical is placed on the skin of the finger or palm, which is then printed to the card. Another chemical, with which the paper has been impregnated, causes the print to darken so that it can be classified and compared. The other process also involves adding a chemical to the skin, but the developing chemical is sprayed onto the paper rather than being in the paper. These methods generally produce prints of lower contrast. Unless the surface of the paper is smooth, they will lack the definition that is possible with ink, because the chemicals will be absorbed into the paper. Time may cause the prints to blur as the chemicals migrate through the paper. Despite these problems, these methods do have advantages. They are much cleaner than ink. They are much easier to carry because the operator does not have to worry about inking plates, rollers, and tubes of ink that might leak, or about cleaners and paper toweling for cleaning the subject's hands. (Cowger, 19)

Another device which was designed to make inked prints without getting ink on the subject's hands is a thin, pliable membrane which has a very thin coat of very tacky ink on one side. The membrane is held in a cardboard mount similar to a photo slide mount. When printing, the inked side is placed against the fingerprint card and the finger is pressed against the inkless side. These membranes are limited in the number of prints that can be made from them before the texture of the membrane itself starts to appear in the prints. (Cowger, 19-20)
An electrically driven, soft rubber pillow can be used as an inking device. Touching the pillow allows the finger to be fully inked without rolling it, as the pillow will surround the finger. The pillow then rotates in the ink tray to maintain its thin coat of ink. The only disadvantage to this method is that it is impractical for field use. A thin sheet of plastic with a thin coat of ink can be used in place of the roller, plate, and ink tube. This device is, therefore, more convenient for carrying and produces very good results if care is used. (Cowger, 20-21)

There are several other devices and methods created to eliminate the need for, and the mess of, ink, and fingerprint technicians continue to come up with new ideas. Regardless of the method used, the operator should practice the method until he can obtain the best possible results. Some methods work better for one operator, while others work better for a different operator. (Cowger, 22)

If an operator has all of the items necessary for taking a set of inked prints and has a subject, he is ready to begin. First he must clean any old ink from the ink plate. Good impressions will not result from a film of ink that is dry or hard. After the plate has been cleaned, a small dab of ink about the size of a match head is placed on one edge of the plate, another is placed in the center, and a third is placed on the other edge. Starting at the first dab, the ink is then rolled into a thin film using the roller. The rolling should be continued until the film has a smooth, even, uniform thickness.
The roller should be lifted after two or three passes across the plate and allowed to spin in the air in order to prevent the buildup of ink where the dabs of ink were placed and are heaviest on the roller. This action allows a different part of the roller to contact the heavier areas of ink and aids in producing a smooth, even coat of ink. (Olsen, 64)

Most officers stand on the left side of the subject when taking prints. This is done simply because more people are right-handed and consequently work better toward the right. Since, however, some officers are left-handed, fingerprint stands should be constructed so that prints can be taken from either side. The officer and the subject may stand side by side, one on either side of the corner, or the officer may stand at a forty-five degree angle to the table. The printing process should be as easy and as comfortable as possible so that the best results can be obtained. (Olsen, 69-70)

The standard fingerprint card has separate places in which each finger can be rolled. It also has spaces for a plain impression of each hand. Before taking any prints, the subject should sign the card in the appropriate space. This is done so that there is no confusion about to whom the prints belong. Next, the subject's hands are cleaned thoroughly. After the ink plate has been coated, the card signed, and the subject's hands washed, the fingers are rolled individually. The procedures for inking and rolling are the same. With one hand, the officer grasps the subject's hand and keeps the fingers not being printed
tucked out of the way. With the other hand, the officer holds the end of the finger being printed to keep it from slipping and to apply light pressure. The finger is then rotated approximately one-hundred eighty degrees so that its other side is on the plate. After the finger has been inked from side to side, it is lifted from the ink plate and rolled in the same manner in which it was inked in the proper place on the card. (Cowger, 10-12)

Some operators recommend that the finger be rolled toward the body for the thumbs and away from the body for the fingers. This suggestion is aimed at attempting to roll the digit from a position of stress to a more relaxed one. The difference between the direction of roll for the thumbs and that for the fingers stems from the positions of each relative to the radial bone. Adhering to this recommendation may reduce slippage of the finger, but if an operator is more comfortable rolling all digits in the same direction and can produce a good set of prints in so doing, the direction of rotation is not significant. (Cowger, 12)

Plain impressions are placed in spaces provided at the bottom of the card. For these impressions, the fingers are not rolled. When making these impression, the subject must hold his fingers together, straight, and taut. Demonstrating to the subject the correct way to hold the hand is usually helpful. In this situation, relaxation is not desirable. Better prints may result if the operator presses on the top of the four fingers with one hand and holds the wrist or the back of the subject's
hand with the other. These actions help maintain proper contact
and control of the hand. (Olsen, 69) Plain impressions act as a
check on the order of the individual finger prints. (Olsen, 62)

In some cases, it is necessary to take impressions of the
entire ridge structure of the hands. These impressions are
called major case prints. A complete set of impressions is
sometimes required because evidence prints are left
unintentionally and may be from any area of the hand. (Olsen,
70,71) However, since recording a set of major case prints is
such a long process, it is generally only used when it is known
that the prints to which the subject's prints are to be compared
were made by areas of the hand not normally printed. (Cowger, 22)

The first step in taking a set of major case prints, also
called major criminal prints, is to make a good set of finger and
palm prints. It is important, when taking the palm prints, that
no blank areas are left. This applies particularly to the areas
of skin just below the fingers and between the thumb and fingers.
Prints of the palm should extend from the point where the
friction ridge skin begins on the ulnar side to the point where
it begins on the wrist side. It is recommended that the print
include an area of the normal skin beyond this border, so that
the palm is completely printed. If there are areas that were
incompletely printed the first time, additional prints should be
made of these areas. (Cowger, 22-23)

The second step is to make a record of all of the friction
ridge skin on the fingers and thumb, from the base to the tip of
each digit. Inking the fingers on an inking plate may be
difficult, so it may be necessary to use an inking method other
than the ink plate or roller, such as an inking film or other
device. It may also be necessary to use some support, other than
the card holder or table edge, to take prints of the entire
finger because the other fingers may not be sufficiently flexible
to be held out of the way. A clipboard which has been cut to
match the size of the card and clamped to the table so that it
extends a few inches beyond the table can be used. (Cowger, 23)

The final step is to record the friction ridge prints from
the sides and tips of all digits. Each finger is reinked, if
necessary, placed on its side, and raised in an arc until its tip
is in contact with the paper. This is done for both sides of
each digit. Then the tip is completely printed by placing the
finger on one side and rolling the finger, on its tip, to the
other side. Finally, the finger is placed flat on the paper and
raised until it is vertical to the paper. Technically, the
order in which the operations are performed is not important, but
each print must be properly identified as to its appropriate
digit. (Cowger, 23)

Making a set of major case prints takes a great deal of care
and practice in order to produce the best results. Each operator
should develop his own technique with which he is most
comfortable. His comfort is as important as that of the subject.
(Cowger, 23, 25)

If a good ink print is not produced, there may be several
possible explanations. Problems result from improper rolling or incomplete inking. Too much ink will obscure the ridges. Too little ink will cause the ridges to be too faint to count or trace. Smearing results if the fingers are allowed to slip or twist. Prints which are too light result from the use of ink other than printer's ink. Failure to clean the fingers or inking plate properly can cause the appearance of false marks in the prints. (FBI1, 110) All of these things result from the work of an operator who either does not know how to do the work properly or does not care enough to do it properly. (Olsen, 76)

Locating, Developing, and Collecting Prints at a Scene

Gathering evidence prints from objects at the scene of a crime is obviously very different from taking inked prints. First, the prints must be located. Then they are developed. Development is the process of making a print visible. In most cases, this is the same as locating the print. The third step is to preserve the print. This simply involves keeping the print in the best possible condition. Finally, the prints are collected. This is the process of putting the print in a form that can be taken to a place where it will subsequently be compared. Often, collection is the same as preservation. These are the steps involved in processing a crime scene for prints. In some cases, processing will be fairly easy, while in others, it may be very complex and time-consuming. (Cowger, 76)
Usable prints are more likely to be developed if the operator knows the nature of the print to be developed. Latent prints pose a particular problem because they are rarely known until a certain technique has been successful. The operator often must assume the nature of the material of which the print is composed. If his assumption is wrong, the technique selected may destroy the print or render it unusable. (Cowger, 77)

It is also important to know the nature of the substrate to increase the chance of recovering the print. If both the substrate and the print respond to the developing agent, the print may be masked. If only the substrate responds, the print will be masked in such a way that further attempts at development will be futile. (Cowger, 77)

It is impossible to devise a specific development technique for a particular surface. This problem is due to the numerous combinations of conditions that can cause a print to be made. Selecting a developing agent, then, becomes a judgment decision on the part of the operator for the particular task at hand. (Cowger, 77)

In order to develop prints at a crime scene, a technician should have a complete fingerprinting kit. A serviceable kit, suitable for most crime scenes encountered by the average investigator, contains seventeen items. (Olsen, 164-168) These seventeen items are as follows:

1. A carrying case. A medium-sized one is usually adequate and can be purchased from fingerprint equipment
manufacturers and suppliers;

2. A fingerprint card holder, which is usually attached to the lid of the carrying case so that it is available for immediate use;

3. An inking device, such as a plate and roller, or the inkless devices or other materials available for taking exemplar, or comparison prints;

4. Fingerprint powders, which come in a variety of types and colors;

5. A two-cell flashlight used for searching for evidence prints and for other uses;

6. A rule or a roll tape measure. A folding-type extension rule or a twenty-five foot tape measure can be used for overall measurements to be used for the crime scene sketch. Pressure-sensitive evidence rule tapes that can be cut into desired lengths and marked with identifying information can be placed near prints on an object for identification and photographic purposes;

7. Self-sealing evidence bags and evidence identification tapes or tags. These are extra-strength polyethylene bags. Both the bag and the object are marked for identification;

8. Scissors, small shears, or a scalpel with a detachable blade;

9. Marking devices, including pencils, ball-point pens, black and white evidence markers, and an evidence
scriber with a carbide or diamond tip. These are used for marking items of evidence;

10. Brushes. Both large and small brushes should be included. Some technicians prefer fiberglass brushes over the larger hair brushes;

11. Fingerprint cards and plain bond paper for recording inked comparison prints and major case prints, if necessary;

12. Lifting materials. Lifting tape should be carried at all times and in adequate amounts. The tape can be frosted or clear, but frosted is better because data can be marked on the tape and it is easier to photograph because there is less light reflection. Black and white rubber lifters should also be carried as these serve well in lifting prints from curved surfaces. Rubber lifters produce a reversed print, however, and must be photographed and the photograph used for comparison;

13. Covers and backs for lifting tapes. White index cards on which prints developed with black powder can be placed should be carried. Likewise, black paper, such as exposed photographic paper, should be carried for prints developed with light-colored powders. Transparent and frosted lifting tape covers can be purchased from manufacturers of fingerprinting equipment;

14. A pair of wood or plastic forceps, about six inches
long;

15. A small magnifying glass for basic examination of prints is useful;

16. Graph paper can be used for accurately sketching the locations of prints, indicating measurements, and showing exact positions of objects;

17. Postmortem fingerprinting equipment, including an inker, a spoon, hypodermic syringes, a bottle of tissue-builder solvent, and a bottle of finger-tissue cleaner should be included.

There are many kinds, sizes, and shapes of brushes which can be used in fingerprinting. The four types of brushes are hair, feather, fiberglass, and magnetic powder applicators. (Olsen, 168) If hair brushes are used, the hair should be very soft and pliable. They should never contain stiff bristles, as they will cause streaks within the powdered image. Feather brushes or dusters are not as convenient or as durable as hair brushes. They must be handled with greater care. Fiberglass brushes are preferred by many technicians because they last longer and can be cleaned periodically with dishwashing detergent, as long as they are thoroughly rinsed and dried. Fiberglass brushes cost more than hair or feather brushes. Magnetic powder applicators are also called magnetic wands or brushes. They are steel rods enclosed in a sheath about the size of an old-fashioned fountain pen. When the rod is inserted in the sheath, magnetic powder is picked up with the tip of the sheath and can be applied to a
surface as with a regular brush. Extending the rod releases the powder. Magnetic brushes have the advantage of allowing only the powder to touch the surface and the print. (169) The total number of brushes included in a kit depends upon the type of brushes used and the different types and colors or powders carried. If hair brushes only are used, at least two sizes should be carried: larger ones for large areas and smaller ones for concentrated work or individual prints. It is best to use a special brush for special powders, but it is not necessary to use two different brushes for two different kinds of the same-colored powder. All brushes should be tapped or shaken clean before returned to the kit and should be kept in individual containers in the kit. This is to identify them with their intended powder and thus prevent contamination of the powders. (Olsen, 170)

Fingerprint powders are an indispensible part of any fingerprint kit, and there is a wide variety of powders available. It is not, however, necessary to carry a wide variety of powders. Most jobs can be done with one of two powders, black and a light-colored powder. Powders can be purchased ready-mixed, or be made by following formulas. Commercially-made powders are of higher quality and are more uniform than are self-prepared powders and are worth the expense, particularly when used properly, in small amounts. (170, 171)

An experienced technician can successfully use almost any powdered substance to develop latent prints. This includes even cigarette ashes. The mere fact that one technician is able to
use a certain substance for one particular instance does not, however, mean that the particular substance is a good fingerprint powder. In order to be a good fingerprint powder, a substance should provide satisfactory results under all conditions of a similar nature. A technician should select the powder for a particular surface based on a reasonable degree of predictability of the results that can be obtained with that powder. (Olsen, 212)

Many substances, such as chalk, talc, and charcoal, have been used in the past as fingerprint powders. These substances produced extremely fragile prints, lacking the holding power necessary for good prints. (Olsen, 212) Part of the so-called "holding power" of a good fingerprint powder arises from the moisture and oil content of the print residue. These are important to adhesion. (Olsen, 213) Another factor which is important to adhesion is the amount of surface area of the powder which is in contact with the print residue. The greater the contact area, the greater the adhesion. (Olsen, 214)

Magnifying glasses are also indispensible for classifying and comparing prints with accuracy and without unnecessary eye strain. Extreme magnification is not required and not desireable. A magnification of 4.5 times is sufficient for determining ridge characteristics and allows a field of view sufficient to determine the relative position of the characteristics, one to another. This is the most common magnifying power for fingerprint magnifying glasses. (Olsen, 171-
There is a wide variety of lifting materials available for use in lifting fingerprints. These require minimal training and experience for successful use. The decision about which to use depends on the color of powder used to develop the print and whether or not the print will be used as a negative for photographic enlargement. Most lifting devices come in different sizes or can be cut down to the appropriate size. (Olsen, 175, 176)

These are some of the items carried in a fingerprint kit. There are many other pieces of equipment that are used in the various development techniques. These items will be discussed with their respective techniques.

Fingerprint Development Techniques

The techniques used to develop and enhance fingerprints vary greatly. They may be powder, physical, or chemical techniques. The technique used most often at a crime scene is the use of powders. Other techniques usually require special equipment and must be conducted in a laboratory. The most important factor in the development of quality fingerprints is the skill of the technician. An experienced technician can often produce better results with poor quality, improvised equipment than can an inexperienced one with the best equipment available.

When searching a crime scene for prints, it is important to
determine the object of attack and the point of entry, since these will be the places most likely to reveal prints and other important information about the crime. This information will tell a technician where to concentrate his efforts. The search should be conducted intelligently, systematically, and thoroughly. An initial search should be conducted to locate evidence and a second should be conducted to collect it. Subsequent searches should be conducted to insure that all available evidence has been discovered. (Olsen, 129-130) It is important to note that this search should not be conducted solely for the purpose of finding prints, but for finding any type of evidence.

A strong light source is invaluable when searching for prints. Most prints can be located with this piece of equipment. If no prints are found with the light source, however, it is not a positive sign that none are present, and all surfaces should be processed for prints. Using a light source is always worth a try as a preliminary step. It generally works best with flat and top surfaces. Holding the light at various angles reveals disturbances in the dust. Ordinary flashlights are often used and are convenient, but they may be too weak in many cases. (Olsen, 130-131)

**Powder Techniques**

Once prints have been located, they may be powdered. Prints are generally powdered for one of three reasons. These are to
make them visible, to create a contrast so that they can be photographed, or to develop a powdered image for lifting and preserving. If evidence prints are visible, powdering may be unnecessary and may result in the destruction of the print. For this reason, prints should always be photographed if possible before any technique is used. (Olsen, 209) Photographs should be taken before each stage of an examination that may damage or destroy the print. (Olsen, 218)

The procedure a technician chooses will depend upon the objective, or goal, the nature of the surface on which the print is found, and how it can best be handled. If the print is to be photographed, a powder which contrasts with the surface will be used. If the print is to be lifted and transformed into a powdered reproduction, the powder should be selected according to its tenacity rather than its color, because after it is lifted, it can be placed on any background. In some cases, a particular powder of the same color as the surface may be used for lifting because the technician knows it will give better results. The technique used will depend on which method the technician feels is proper for the situation, according to his own experience and training. (Olsen, 209-210) If the technician has any doubts about whether or not a certain powder is the right one for a questionable surface, he may make a test print on that surface or a similar one. He simply does a blind check, in which he uses a powder to check for the presence of prints, on the surface, wipes it clean, and puts his own print on the surface. This must be
done on an area of the surface that does not interfere with the evidence print. He then tries to develop his print with what he thinks is the best powder. Doing this protects the evidence prints from destruction if the technician's choice was wrong and reinforces the technician's judgment and gives him confidence if his choice was right. These test prints should be destroyed immediately, however, to avoid any confusion of the test print with any evidence prints found. (Olsen, 211)

For those techniques using brushes, the hair of the brushes should be very soft, and free of powders from previous jobs. The brush should be cleaned by rolling the handle between the palms before each new job. If a jar contains powder which has a tendency to pack into a solid mass, the jar can be tapped lightly against a table top and spun until the powder is loose and fluffy. The jar must have a mouth large enough for the brush which is to be used, or a saltshaker cap may be used on the bottle. Saltshaker caps generally only work, however, if the surface being examined is a top surface. It is important not to use too much powder. More prints are lost because of these two causes than any other causes. Any excess powder picked up by the brush should be removed by tapping the brush with a finger while holding it over the powder container, unless a large top surface is being examined, in which case the excess powder may be dropped over the suspected area. (Olsen, 215)

Fingerprint powder should be applied smoothly and evenly to the surface, using only the tips of the bristles and very light,
short, and quick strokes of the brush. (Olsen, 215-216) The powder is spread over the surface until recognized ridges begin to appear. Often the ridges will not be conspicuous, and will need to be developed and strengthened with great care. As soon as any ridges appear, development should be very controlled and concentrated until peak development is reached. When contour or pattern flow of the ridges is visible, the brush strokes should follow the direction of flow so that the impressions are not destroyed. After the print has been developed, any excess powder is gently brushed away so that it does not destroy the clarity of the ridge detail and make the print useless for identification. If the excess powder cannot be removed with a brush, lifting tape can sometimes be used. Although the tape may also remove part of the print, that which is left may be sufficiently clean and distinct for identification. Furthermore, it may even be possible to redevelop the print with brush and powder to regain any clarity lost during the use of the lifting tape. (Olsen, 216)

Certain problems may arise when attempting to develop older prints. It is sometimes necessary to gently blow on the surface while dusting for prints in order to restore some moisture to the print residue so that the powder will adhere. If the surface is too cold, the added moisture condensates on the surface and the powder "paints" the surface as it adheres to the excess moisture. In such cases, brushing should begin only after the excess moisture has disappeared, as can be seen under a strong light. Very old prints can't be developed using normal brushing strokes.
because they do not hold the powder. One method of developing an old print is to cover the print with a fairly thick film of powder and to compress the powder with the side of the brush. Although the powder prevents the hairs of the brush from directly touching the image, the compressing action should be very gentle and the brush very soft. Flame techniques may be used as a last resort, as long as the surface being examined is not combustible. (Olsen, 217)

Powder techniques generally should be the first choice when the surface to be examined is a nonporous one. There are, however, exceptions to this general rule. If the print appears in a film of dust, oil, or grease, powder may destroy the image. (Olsen, 217) Plastic impressions in soft substances on nonporous surfaces, such as paint, will react better to photographic and lifting techniques. (Olsen, 217-218) Impressions made by bodily fluids, including dried blood, should be developed using chemical techniques. Prints found on paper and other porous items should be developed by fuming and chemical techniques instead of powder. Powder will generally only work on fresh prints, as the porous items absorb the print residue. In certain situations, however, the use of powder techniques may be necessary; magnetic powders usually produce the best results in such cases. Using a brush on paper may disturb the fibers of the paper and destroy the ridge detail of the print. Sliding a quantity of powder across the surface will solve the problem of brushing, but it may also be difficult to remove the excess powder. A magnetic powder and
powder applicator provide a solution to the problem of excess powder. (Olsen, 219-220) Again, it is impossible to establish a particular technique as always suitable for a certain surface. The decision of which method to use will depend on the judgment and experience of the technician encountering the situation. (Olsen, 218)

Large surfaces are generally processed in the same manner in which smaller ones are processed. A visual search and blind development make up the procedure. In the past, technicians have experimented with techniques designed to facilitate the processing of large areas. Two of these techniques include using atomizers or aerosol spray cans. Few technicians stick with either technique after experimenting with them because the blast of air charged with powder is not strong enough in itself to develop an image suitable for lifting or photographing, and enhancement with a brush is necessary. Furthermore, such spraying devices also tend to paint the surface being examined, forcing powder into depressions in the surface. Such areas are generally not filled by brushing techniques. Finally, unless adequate ventilation is present in the area in which these techniques are used, considerable amounts of airborne powder particles can enter the respiratory system of the investigator. (Olsen, 221-222) FBI experts prefer to use brushes in all situations because the amount of powder can be controlled more easily. (FBI\(^1\), 124) The brush and powder technique is generally considered the best technique for developing fingerprints on
nonporous surfaces uncontaminated by grease, oil, or dust. (Olsen, 223)

Magnetic fingerprint powder techniques are particularly effective on surfaces which are extremely rough or porous, such as leather. Such surfaces tend to be painted by regular powders. Magnetic powders may also be used on other surfaces, especially very smooth ones, from which regular brushing tends to remove any print residue. (Olsen, 223) Magnetic applicators provide the advantage of applying the powder without having anything other than the powder come into contact with the surface. They also allow for easy removal of any excess powder. Objects made of ferrous metals cannot be processed using magnetic powders, since the applicator magnetizes the object and the powder clings to the surface. (Olsen, 224) Prints on certain surfaces can be developed only by using magnetic powders. An excellent example is provided in the case of prints on the grooved area of a phonograph record. A regular powder would fill in the grooves and any brushing would only compress the powder into the grooves rather than removing it. With the magnetic applicator, any excess powder can be removed. (Olsen, 224-225) Care should be taken, however, to insure that passes made over the surface by the applicator remove only excess powder and not the powder adhering to the residue. Removal of too much powder will destroy ridge detail rather than enhancing it. (Olsen, 224)

Thermoplastic powders are used in the thermoplastic powdering, or fused-print technique. In this method, Xerox brand
toners or dry inks are applied to the surface. The prints are then exposed to heat and become semipermanently fused to the surface. When using this technique, the thermoplastic powders must be applied with an atomizer or a saltshaker cap. Powder can also be picked up with a brush and tapped out over the surface, as long as the brush does not touch the surface. Any brushing would remove the powders, as their adhering qualities are poor. An empty atomizer can be used to blow away any excess powder. If not all of the excess powder can be removed by using the atomizer, it may be possible to use a small cotton swab saturated with ordinary lighter fluid to gently brush away the excess powder. The brushing must be limited to the area of excess powder, should follow the direction of the ridge flow, and must be very gentle. The thermoplastic technique yields results which are of lesser quality than regular brush and powder techniques. (Olsen, 227-228)

In the past, lead sulfide techniques have been used for developing prints on paper. In these techniques, either lead acetate or lead carbonate is thoroughly brushed onto both sides of the paper. The paper is then exposed to hydrogen sulfide or ammonium sulfide fumes, which reduce the lead compound to a metallic powder. Following this treatment, the ridge structure appears as dark brown lines. All fuming should be done in a laboratory chemical fuming hood for safety. These techniques are rarely used today, as fuming and chemical techniques provide better results and the use of lead compounds over extended
periods of time may present serious health problems for the technician. Furthermore, the metallic powder does not adhere well to the print residue, so the prints must be handled with great care and photographed immediately. (Olsen, 229)

Fluorescent and phosphorescent powders may also be used in certain circumstances. Such powders appear very bright upon activation by an ultraviolet light. The bright image of the print which results from the use of these powders can be photographed. The surface upon which the prints were found will appear dark in the photograph. Fluorescent and phosphorescent powder techniques are useful for developing prints on multicolored surfaces, which would ordinarily present photographic problems for the technician. (Olsen, 230)

Physical Techniques

Another group of techniques used for developing prints are collectively referred to as physical techniques. These techniques generally do not require any chemical reaction to occur in order for the prints to be developed. The one exception to this rule is the iodine fuming techniques. These techniques are considered in the FBI fingerprint school textbook to be chemical in nature. (FBI, 132) Other sources, however, consider these techniques to be physical in nature because they involve only the absorption of the iodine rather than any true chemical reaction. (Olsen, 243) For this reason, iodine fuming techniques will be considered as physical techniques in this
Iodine development techniques are common physical techniques. They have stood the test of time and can be effective on virtually any surface. (Cowger, 93) Such techniques are not, however, successful in every instance, any more than is any other type of technique. (Olsen, 243) Many prints that can be developed with iodine can also be developed with other methods. The main advantage to iodine development techniques is that they are not detrimental to other techniques - other techniques can be used after the iodine technique without any negative effects. It is possible, therefore, to use an iodine technique to locate areas where prints may be, then to develop those areas using another method. (Cowger, 95) Another advantage to iodine techniques is the fact that the resulting images usually can be removed from the object through various means. In fact, most iodine-developed images will begin to fade immediately unless some means of preservation is used on them. (FBI\textsuperscript{1}, 132) This factor is particularly important in cases in which the prints are found on a paper document of high intrinsic or emotional value. (Olsen, 244) It is even possible, when using iodine techniques, to alternately lessen the effects of overdevelopment and to redevelop images which are faded until the best possible contrast is attained and can be photographed. (FBI\textsuperscript{1}, 132)

There are a variety of ways in which iodine can be applied to an object. One is through a fuming tube or pipe. Fuming
tubes are simple devices and are portable. This piece of equipment contains iodine crystals which are vaporized. The investigator blows into one end of the tube while moving the opposite end slowly over the surface being examined. When images begin to appear, the treatment is concentrated on the area of those images in order to enhance them. Another method is the iodine fuming cabinet, which may be heated in order to speed the vaporization of the iodine crystals. The object is placed in the cabinet, which is then closed. As the crystals are vaporized, iodine fumes fill the cabinet and the prints begin to develop. Very small objects can be placed in a self-seal polyethylene bag containing iodine crystals. At room temperature, development may take from thirty minutes to several hours. Development time may be hastened somewhat by holding the bottom of the bag with the crystals in the palm of the hand. This technique is very convenient for field work, but the investigator must be sure that the iodine crystals do not come into contact with the paper, as this will discolor the area touched and obscure any ridge detail. An iodine fuming powder made from ground porous glass impregnated with iodine can be poured over paper and left for fifteen to thirty seconds. The glass can be returned to the container and reused later. Another technique involves placing iodine-soaked silica gel in a cloth bag. The bag is then placed on a piece of porous tissue paper, which covers the suspected area. The development time for this method is generally fifteen to thirty seconds. Finally, iodine crystals can be ground into a fine
powder and applied with a fingerprint brush. The powder is removed when the prints develop or the paper begins to discolor. (Olsen, 247-250) No matter which method of application is used, the mechanism is the same. The iodine fumes are absorbed by the oily substances within the print residue. (FBI\textsuperscript{1}, 132)

Once prints have been developed with an iodine fuming technique and the best possible images obtained, the images can be fixed, or made permanent. Fixing iodine-developed prints is generally not recommended as the chances of damage to the paper and print may increase. Again, it is recommended that all prints be photographed before each step in development to prevent to loss of the print. (Olsen, 251-252)

One of the easiest methods of fixing an iodine-developed print is to seal the paper in an airtight place, such as in a plastic bag or between two sheets of glass taped at the edges. This method is not truly satisfactory because the vapors are not confined to the images but can travel through the paper over time, and because certain paper articles simply cannot be sealed in such a manner. The method does allow for returning the item in its original condition and for further treatment with ninhydrin and silver nitrate, two chemical development techniques. Another fast and effective method of fixing prints is the use of magnetic powders. A magnetic powder of a color which contrasts with the surface upon which the prints appear is applied to the developed images. Any excess powder is removed using the magnetic applicator, then the powdered images are
lightly sprayed with a clear lacquer. The lacquer should be lightly and evenly applied, as lacquer applied too heavily might run and damage the prints. (Olsen, 252-253) A third fixing method involves the use of a 1% starch in water solution. The solution is sprayed onto the surface, causing the images to turn blue. Starch can also be applied as a powder and subjected to steam for one or two seconds. (Cowger, 95) Starch may even be applied directly to the print in the form of a paste. (Olsen, 254) Yet another method involves treating the prints with a 2% solution of tetrabase in 1,1,2 trichlorotrifluoroethane. (Cowger, 95) In this method, the paper is dipped into the solution, withdrawn, and allowed to dry. The images appear in a blue-green color. The major disadvantage of this method is that the 1,1,2 trichlorotrifluoroethane causes some ink writings on the paper to run. (Olsen, 255)

Prints developed with iodine techniques can also be lifted from many surfaces, but those surfaces must be fairly smooth so that contact between the surface and the lifting device can be more complete. A silver plate is pressed into firm contact with the developed print, then the silver plate is exposed to light. The iodine in the print material reacts with the silver, forming a photoreactive product which turns dark. (Cowger, 95-96)

Iodine-developed prints can be cleared from paper rather easily. They will clear spontaneously in the air, or they can be exposed to ammonia fumes or chemical bleaching. Exposure to ammonia fumes is the quickest, easiest, and most practical method
of clearing iodine prints from paper. It can be done in a fuming cabinet, or simply by holding the stained areas over a beaker of ammonium hydroxide until the stains disappear. Ammonia fuming techniques return the paper to its original condition. Chemical bleaching techniques are generally not recommended because they may cause the ink to dissolve and discolor the paper. If the chemical bleaching techniques are to be used, they should never be used to remove iodine stains if the paper is to be treated with ninhydrin or silver nitrate at a later time. Chemical bleaching techniques will also clear prints developed with ninhydrin or silver nitrate techniques. (Olsen, 255-256)

In addition to the iodine fuming techniques, there are other physical development techniques. Chlorine, bromine, and mercuric iodine fuming techniques are similar to the iodine fuming cabinet technique. These techniques, however, produce results of lesser quality than do the iodine fuming techniques, and involve toxic substances. For these reasons, the use of such techniques is discouraged. Bacteriological techniques, involving bacteria normally found on human skin, have been experimented with, but such techniques would involve considerable time and are not practical for extensive use as an intentional development technique. It is conceivable that prints developed in this manner may be found under the right environmental conditions. Another technique which has little practical value as an intentional development technique is the heat technique. Heat may char organic substances in print residue before it chars the
surface upon which the print is found. In most instances, better results will be obtained using other methods, but in some cases, especially those involving arson, such prints may be found on surfaces for which the use of other techniques might be impossible due to extensive damage. A final physical technique is the flame technique. In this technique, certain materials which are known to produce a high amount of soot when burned are set on fire. The object being examined is held over the flame, but not touching it, and the soot adheres to the object. When an even film of soot covers the object, the object is removed from above the flame and the excess soot is brushed away with a feather duster or fiberglass brush, leaving the fingerprint impression. The flame technique is particularly useful for very old prints, and for prints on glass or metallic objects. (Olsen, 256-263)

Chemical Techniques

A third group of techniques used for the development of fingerprints includes techniques which involve chemical reactions and are, therefore, collectively labelled as chemical techniques. Many such techniques have been devised throughout the history of fingerprinting technology. Two of these techniques, however, can be used on most articles. Those two techniques are the ninhydrin method and the silver nitrate method. (FBI\(^1\), 132)

Ninhydrin development depends on the presence of amino acids in perspiration, which may be deposited in the print residue.
Ninhydrin reacts with these amino acids to form a print which may vary in color from bluish purple to an almost red color. Ninhydrin can be applied to the item being processed by dipping, brushing, or spraying in a fine mist. Images processed using this technique with no attempts to expedite the process can be expected to be fully developed in two to three days. The reaction can be accelerated through the application of moist heat, such as that produced by an ordinary household steam iron. The iron should be held about half an inch above the item so that it does not touch the article. Moist heat causes the print to be purplish in color and the ridges to be more complete. In cases in which the writings on a document cannot be destroyed and it is unknown how the inks will react to the ninhydrin solution, dry ninhydrin techniques can be used. In these techniques, ninhydrin crystals are placed on the paper in a thin layer. The paper is then placed in a humidity cabinet or the crystals are covered with a strong paper towel and a steam iron used on the paper towel for two to three minutes. It is generally not recommended that ninhydrin stains be cleared from documents, either because the article will later be processed with silver nitrate, or because the solutions used to clear the article may cause more damage to the inks than did the ninhydrin solution. If the stains are to be cleared for some reason, three clearing solutions are available. Formula X is the solution used by the Metropolitan Police Department in Washington, D.C. Chemical
bleaching techniques involving various bleaching agents can also be used. Ammonium hydroxide can also be used for ninhydrin stains. (Olsen, 290-291) The ninhydrin technique is relatively new, but it has gained wide acceptance and is the most commonly used chemical development technique. (Olsen, 276)

The second major chemical development technique is the silver nitrate technique. Silver nitrate reacts with sodium chloride, or salt, found in perspiration in the print residue to form silver chloride. Silver chloride is white, but upon exposure to light, it breaks down into silver and chlorine, leaving a reddish-brown impression. (FBI, 135) Silver nitrate is applied either by dipping, for smaller objects, or by swabbing, for larger objects. An article being dipped should only be submersed until the surface is completely wet, as soaking for an extended time will only lengthen the drying time required. Swabbing can be done with a paint brush or with cotton balls and forceps. Exposure to sunlight while applying or drying the solution should be avoided, to prevent development of the entire surface. (Olsen, 296) After the silver nitrate is applied, the surface is blotted to remove any excess solution and allowed to air-dry. (Cowger, 100) The light source which is used to develop the prints may be as simple as normal room light or sunlight, or as specialized as an iodine cobalt light or a photographer's light. Sunlight offers the advantage of rapid development, but may occur too quickly if only one investigator is processing several items of evidence. (FBI, 136) Silver nitrate
impressions should always be removed from papers after they have been photographed. Removal is necessary because, as the silver nitrate remains on the paper and is exposed to light, the stains will become darker and will obscure any writings or prints on the article. (Olsen, 302) There are many solutions available for the removal of silver nitrate stains. Those containing mercury should be used with caution, as many of them are highly poisonous. Mercuric nitrate and mercuric chloride solutions are two poisonous clearing solutions. As with ninhydrin stains, chemical bleaches may be used to remove silver nitrate stains. Whenever a bleaching technique is used, the paper should be washed with water, then placed between two blotters and ironed. (Olsen, 302-306) Other, less common methods of chemical development have also been recommended. Osmium tetroxide can be used in an aqueous solution or as a fuming technique. It reacts with the oils and fatty substances in print residue to form gray-black images. Ruthenium tetroxide also reacts with fatty substances in prints, producing black images. It, too, can be used as an aqueous solution or as a fuming technique. These and other chemical techniques have been used and are suited to certain situations, but their use is limited by expense, potential for health hazards, or lack of satisfactory results. (Olsen, 308-309)

Lifting Techniques

After evidence prints have been developed using one of the
techniques previously described, they may be lifted. At this
time, however, only prints developed through the use of powders or
iodine fuming techniques can be lifted satisfactorily. Research has
been initiated to develop lifting methods for chemically-developed
prints, but no effective method has yet been developed. Before
lifting a print, it should be photographed as a precaution against
losing the print while attempting to lift it. If possible, the print
should be left on the object upon which it was found and the object
transported to the lab for evidence purposes. (Olsen, 369)

There are basically three types of fingerprint lifters which are
commonly used to lift images developed with powders. Although
others exist, they are not as commonly used, nor as practical and
versatile as the three main types. Those three major types are rubber
lifters, lifting tapes, and hinge lifters. (Olsen, 370)

Rubber lifters are the most versatile of the three types, but are
not as commonly used as lifting tape or hinge lifters. Rubber
lifters are pieces of elastic sheet rubber with an adhesive
coating on one side which picks up the powder particles on the
print. The adhesive side is covered with an acetate cover which is
returned to its position to protect the lifted print. Rubber
lifters can be purchased in various sizes, and can be cut to the
size needed. They are available in white or black and the color
is chosen according to contrast with the developed print.
Rubber lifters are particularly useful in situations in which the
prints to be lifted are found on an uneven surface, especially multidirectional, curved surfaces such as a doorknob. (Olsen, 371) Rubber lifters produce a reversed image which must be photographed and reversed for comparison.

Lifting tapes are made of durable plastics which are stronger than regular household or office tapes. They are available in transparent or translucent, and in black or white opaque. Translucent tapes are easier to write on and are often more conducive to photographing the prints than are transparent tapes. Tapes may be used merely to protect the developed images on the surface rather than for lifting them. Opaque lifting tapes must be mounted on clear pieces of acetate. Translucent and transparent tapes, however, may be mounted on a wide variety of covers, chosen for contrast with the image. Lifting tapes are sold in ten-yard rolls of varying widths. (Olsen, 372-373)

Hinge lifters are transparent sheets of .005 Mylar with special adhesive surfaces. Hinge lifters are attached to their covers by a hinge on one side, and a thin plastic separator covers the adhesive side. When the lifter is used, the separator is removed and discarded. The lifters have black or white rigid vinyl covers, or transparent acetate covers. The hinge of the lifter is marked as to the proper viewing side. This insures that those lifters with transparent covers are not viewed from the wrong side by mistake. (Olsen, 373)

When selecting a lifter size, the investigator should allow plenty of room for the image, as well as space for labelling. A
lifter which is overly large is not desirable, as it is more awkward to handle and thus allows greater room for error. (Olsen, 375) When using lifting tape, the tape should be applied to each print according to the most advantageous position. This will generally be lengthwise rather than crosswise. The tape should be applied in such a way as to insure perfect contact between the tape and the surface. If the print is found on a rough surface, a finger or a soft pencil eraser may be used to force contact. Air pockets must be avoided, as they may interfere with identification. When removing tape from a roll, it must be done steadily. Stopping may cause marks on the tape that will lessen the quality of the image. The same rule holds for removing covers from rubber lifters. Tape which has been cut from a roll must be kept under control, as it may stick to objects and/or pick up particles that will detract from the accuracy of the impression. (Olsen, 376-377)

When a fingerprint is lifted, it is only the powdered image which is being removed from the surface. The actual evidence print remains on the surface and may even be redeveloped and lifted two or more times. Although less powder adheres to the print residue with each lift as its adhesive qualities diminish, the second lift may be more legible than the first because the tape has already removed foreign substances or excessive amounts of powder which detract from the clarity of the print. As when removing the lifting tape from a roll or the cover from rubber lifters, removing the lifter from the evidence print should be
done in a single, smooth motion. When replacing the cover on rubber lifters, the cover is applied in the same way in which the lifter was applied to the print. Again, it is important to eliminate any air bubbles from the lift. (Olsen, 380-381)

Prints lifted using transparent lifters may be used as a photographic negative. The lifted image appears the same as would an inked print. When the image is photographed, the image on the film is reversed in color. When the negative is used to make a photographic print, the image is again reversed, returning it to its original form. Photographic reproductions provide a more permanent record of the images. (Olsen, 384)

Prints developed with iodine can also be lifted. After the iodine-developed images are photographed as a precautionary measure, they may be transferred to a sheet of silver by pressing the iodine image and the sheet of silver into firm contact. The iodine and silver react to form silver iodide. This reaction forms a faint image which darkens upon exposure to strong light. This image is a reversed image of the original and must be photographically reversed. (Olsen, 387-388) As previously stated, lifting is generally not recommended. If lifting is necessary, it should be done with great care.

Fingerprint Patterns

Fingerprints are classified into groups, and all of the members of those groups share some recognizable general
Prints are classified so that they may be filed in such a manner as to allow for specialized searching rather than having the examiner search through every print on file. The two most commonly used classification systems are modifications of those devised by Henry and Vucetich. (Cowger, 35) The Henry system is the one used in the United States.

In the system used most widely in the United States, there are three large general groups of patterns. These three basic patterns are the arch, the loop, and the whorl. Each of these is further divided into subgroups. Arches may be plain or tented. Loops may be radial or ulnar. Whorls are divided into plain whorls, central-pocket loops, double-loops, and accidental whorls. Before these patterns are further explained, there are certain technical terms which should be understood. (FBI², 4)

The pattern area is that part of the fingerprint which is used in classification. The area includes cores, deltas, and ridges. The pattern area is present in all patterns, but in many plain and tented arches, it may be impossible to define. Pattern areas in loops and whorls are enclosed by type lines. Type Lines are the innermost ridges which start parallel, diverge, and surround the pattern area. Type lines are often broken rather than continuous. If there is a definite break in a type line, the ridge immediately outside of it is considered to be its continuation. It is important to note the difference between a divergence and a bifurcation when locating type lines. A divergence is the spreading apart of two lines which have been
running parallel. This pattern is necessary for a type line to exist. A bifurcation is the splitting of one line into two or more branches. Lines which meet and end in an angle are never type lines, as they do not run parallel to one another. (FBI², 4-8)

Focal points are points found within the pattern area. The two focal points are the delta and the core. The delta is the point on a ridge which is at or in front of, and nearest to, the center of the divergence of the type lines. The delta may be a bifurcation, an abruptly ending ridge, a dot, a short ridge, a meeting of two ridges, or a point on the first recurving ridge which is closest to the center and in front of the divergence of the type lines. The delta is never located at a bifurcation which does not open toward the core. If there is a ridge which runs between the type lines toward the core, the delta is located on the end nearest the core. If the ridge does not run between the type lines where they are parallel, but is located entirely within the pattern area, the end nearest the point of divergence is the delta. (FBI², 8-12) The core is the approximate center of the finger impression, and is placed upon or within the innermost sufficient recurve of the print. There are a few rules for the selection of the core of a loop. If there is no ending ridge or rod which rises as high as the shoulder of the loop within the innermost sufficient recurve, the core is located on the shoulder of the inner loop which is farthest from the delta. The shoulders of a loop are the points at which the recurring
ridge curves. If both shoulders are equidistant to the delta, the core will be placed on the center of the sufficient recurve. If there is an uneven number of rods rising as high as the shoulders within the innermost sufficient recurve, the core is located on the end of the center rod. If the number of such rods is even, the two center rods are treated as though they were connected with a recurving ridge and the core is placed on the end of the rod farthest from the delta. (FBI², 12-13) A ridge count can be made of the ridges lying between the delta and the core. A white space must appear between the delta and the first ridge counted. If there is no such space between the first ridge and the delta, that ridge is disregarded and the next one occurring after such a space becomes the first counted ridge. (FBI², 17)

Having defined these terms, the types of patterns can now be explained. The plain arch is the simplest of all the fingerprint patterns. Basically, a plain arch consists of ridges which enter on one side of the impression and flow out on the other side, with a rise in the center. (FBI², 31) More specifically, the ridges flow from one side to the other with no (1) angles of 90 degrees or less, (2) ridges that recurve and exit on the same side from which they entered, or (3) upthrusting ridges which do not follow the general flow of the ridges. (Cowger, 37) The tented arch may be only slightly more complex than a plain arch, or it may be much more complex. The complexity of tented arches increases as they approach the appearance of a loop pattern.
(Cowger, 39) There are three types of tented arches. These occur when ridges at the center form an angle of 90 degrees or less, when the ridges in the center form an upthrust that does not follow the general ridge flow, or when the ridges possess only two of the three essential characteristics of a loop. (FBI², 34) In the third type of tented arch, any one of the three requirements of a loop may be missing.

In order for a pattern to be classified as a loop, it must have three features. It must have one, and only one, delta. It must have a ridge which exits on the same side from which it entered. Finally, it must have at least one ridge which crosses a line drawn between the core and the delta. (Cowger, 41) A ridge count provides another characteristic feature of the loop category. (47) Loops can be further divided into radial and ulnar loops. This characteristic is determined by the side of the hand from which the ridges enter and to which they exit. Radial loops are loops which flow from and toward the thumb side, or radial bone side, of the hand. Ulnar loops are loops which flow from and toward the little finger side, or ulnar bone side, of the hand. (FBI², 30) The slope of the loop has also been referred to as a right slope or a left slope. This description may cause confusion, however, as the right or left directional description will be opposite for the right and left hands. For this reason, the terms radial and ulnar are always used in the classification of prints. (Cowger, 49)

Whorls are the most complex of the fingerprint patterns. A
whorl is any pattern in which there are two or more deltas with a recurve in front of each. Basically, a whorl is any pattern which does not conform to the definition of any other patterns. Whorls are divided into four subclasses. Those subclasses are the plain whorl, the central-pocket whorl, the double-loop whorl, and the accidental whorl. (Cowger, 49)

The plain whorl has two deltas and at least one ridge which makes a complete circuit around the pattern area. This circuit may be a spiral, an oval, a circle, or any variation of a circle. An imaginary line drawn between the two deltas must touch or cross at least one of the recurving ridges within the inner pattern area. (FBI\textsuperscript{2}, 48)

A central-pocket whorl is fairly similar to a plain whorl. The difference is that a line drawn between the two deltas will not cross or touch any ridge that is inside the type lines of the delta nearer the core. In the central-pocket whorl, one delta is substantially closer than the other to the center of the pattern. (Cowger, 52-53)

A double-loop whorl is a combination of two distinct loop patterns. (Cowger, 53) In the double-loop, there are two separate and distinct sets of shoulders and two deltas. (FBI\textsuperscript{2}, 60) The shoulders of the two recurving ridges must not be intertwined with each other. (Cowger, 55)

An accidental whorl has three or more deltas, or has all of the characteristics of two or more different pattern types, excluding the plain arch, with two or more deltas, or conforms to
none of the pattern definitions. The plain arch is excluded from the second type of accidental whorl because it is more of a lack of a pattern than a pattern. All prints have friction ridges which run from one side to another under the basic pattern. If these ridges were not excluded, every pattern other than the plain arch could be considered an accidental whorl. (FBI², 63)

Ridge tracings may be conducted on whorls. In this procedure, a ridge is traced from the left delta toward the right delta. If three or more ridges lie between the traced ridge and the right delta above the right delta, the whorl will have an inner tracing and will be called an inner whorl. If three or more ridges lie between the two below the right delta, the whorl will have an outer tracing and will be called an outer whorl. If the traced ridge lies within two ridges above or below the right delta, it is called a meeting whorl. If the ridge being traced stops before reaching the right delta, the next lower ridge is used to continue the tracing. If the ridge bifurcates, the lower branch is used for tracing. (Moenssens, 17) Ridge tracings provide an additional characteristic for whorls.

**Fingerprint Classification**

The patterns described above are the basis for the classification of fingerprints. A set of prints is assigned symbols representing the patterns present in that set. These
symbols are put into a classification formula, which appears as a series of letters and numbers in the form of a fraction. The actual process of classification is divided into six steps. These steps are: (1) primary classification; (2) secondary classification; (3) subsecondary classification; (4) major division; (5) final classification; and (6) key classification. The formula obtained is used as the basis for filing prints. (Moenssens, 18-19)

In primary classification, the different types of pattern groups are divided into non-numerical patterns and numerical patterns. The non-numerical patterns are plain and tented arches, and all loops. The numerical patterns are all of the whorl-type patterns. The ten fingers are numbered one through ten and paired off, with the odd-numbered fingers making up the denominator of the fraction and the even-numbered fingers making up the numerator. Thus, the fraction appears as follows:


The numerical patterns are then assigned a number according to the fingers upon which they occur. If the numerical pattern is found on fingers 1 or 2, a value of 16 is assigned; if on fingers 3 or 4, a value of 8 is assigned; if on fingers 5 or 6, a value of 4 is assigned; if on fingers 7 or 8, a value of 2 is assigned; if on fingers 9 or 10, a value of 1 is assigned. Non-numerical patterns do not receive a value. To obtain the primary classification, the numbers in the numerator are totalled and one
is added. The numbers in the denominator are totalled and one is added. The fraction which results from these operations is the primary classification. (Moenssens, 19-21) For example, if there are no whorls on the fingers, the primary classification would be 1 over 1. If there was a whorl on the right index finger, the value would be 16. When the fraction 1 over 1 was added, the primary classification would be 17 over 1.

The secondary classification subdivides large groups of fingerprint sets having the same primary classification. Unlike the primary classification, the secondary classification and all of the remaining classifications do not use the pairings or the even-numbered-in-the-numerator, odd-numbered-in-the-denominator, fractional setup. These other steps in classification consider the digits in their natural sequence, thumb to little finger, and place the right-hand fingers in the numerator and the left-hand fingers in the denominator. (Moenssens, 21)

Secondary classification is based upon the patterns appearing on the two index fingers. The classification itself consists of capital letters representing the types of patterns appearing on those fingers. Arches are represented by "A," tented arches by "T," radial loops by "R," ulnar loops by "U," and all whorl-type patterns by "W." Because any one of the five types may appear on each of the two index fingers, there are twenty-five possible combinations. (Moenssens, 21) These are:

<table>
<thead>
<tr>
<th>ATRUW</th>
<th>ATRUW</th>
<th>ATRUW</th>
<th>ATRUW</th>
<th>ATRUW</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAAA A</td>
<td>TTTT T</td>
<td>RR RR R</td>
<td>UUUU U</td>
<td>WWW WWW</td>
</tr>
</tbody>
</table>
The secondary classification also includes lower-case letters for arches, tented arches, or radial loops, represented with an "a," "t," or "r," respectively, which appear on fingers other than the index fingers. In the formula, the lower-case letters are placed in their relative positions adjacent to the capital letter of the secondary classification. If a pattern appears on the thumb, its symbol will precede the capital letter. If a pattern appears on the middle, ring, or little fingers, their symbols will follow the capital letter. Dashes are used to indicate the absence of these patterns. If two or more letters of the same type immediately follow one another, coefficients can be used, making a tUr2a secondary classification become tUr2a. (Moenssens, 21-22) The small-letter groups are extremely important to classification, since they occur with relative infrequency, constituting only seven to ten percent of all patterns. Due to their rarity, the presence of these patterns may allow a classifier to dispense with subsecondary classification and the major division. (FBI2, 91) The secondary classification appears immediately to the right of the primary classification in the formula. (FBI2, 89)

Subsecondary classification further divides groups having the same primary and secondary classifications. (Moenssens, 22) Division is accomplished by considering the ridge counts of loops and the ridge tracings of whorls. Only six fingers, the index, middle, and ring fingers of each hand, or numbers 2, 3, 4, 7, 8, and 9, are involved in the subsecondary classification. (FBI2,
The subsecondary classification is represented by the symbols "I," "M," or "O." The ridge tracings of whorls are indicated as "I" if they are inner, "O" if they are outer, or "M" if they are meeting. The ridge counts of loops are indicated by "I" for inner, or "O" for outer. This classification depends on the number of ridges counted in each loop and the finger upon which the loop appears. Loops are considered "inner" if the ridge count is from 1 to 9 on the index fingers, from 1 to 10 on the middle fingers, or from 1 to 13 on the ring fingers. They are "outer" if the ridge count is 10 or higher on the index fingers, 11 or higher on the middle fingers, or 14 or higher on the ring fingers. Dashes are used in the classification to indicate the absence of loops or whorls on the fingers. (Moenssens, 22) It is acceptable to use the same symbols, "I" and "O," for both loops and whorls because the information regarding to which type of pattern the symbol refers can be obtained from the primary classification. (FBI\textsuperscript{2}, 91)

The major division of classification is determined by the patterns appearing on the thumbs. (Moenssens, 22) If one or both of the thumbs has a pattern other than a loop or a whorl, there will be no major division for that set of prints. (23) When whorls appear on the thumbs, the whorl tracing, represented by "I," "M," or "O," is used. When loops appear, however, the ridge counts are classified as small, medium, or large, and are indicated by the letters "S," "M," or "L." A table is used to determine which designation the prints will be assigned. That
The table is as follows:

<table>
<thead>
<tr>
<th>Left Thumb (in denominator)</th>
<th>Right Thumb (in numerator)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 11, inclusive, S (small)</td>
<td>1 to 11, inclusive, S (small), 12-16, inclusive, M (medium), 17 or more, L (large)</td>
</tr>
<tr>
<td>12 to 16, inclusive, M..............</td>
<td>12-16, inclusive, M</td>
</tr>
<tr>
<td>17 or more, L.........................</td>
<td>17 or more, L</td>
</tr>
</tbody>
</table>

(FBI², 92-93) The major division is placed immediately to the left of the primary classification in the formula. (Moenssens, 22)

The final classification depends upon the type of patterns appearing on the little fingers of each hand. If a loop appears on either little finger, the ridge count of that loop is the final classification and is placed either in the numerator, if it appears on the right hand, or the denominator, if it appears on the left hand. If loops appear on both little fingers, the ridge counts for both will be used. If no loops appear, a ridge count of a whorl pattern on the right little finger can be used. Whorl ridge counts are generally only used for a few sections of the files, usually the all-whorl sets. (Moenssens, 23) The final classification appears at the extreme right of the classification formula. (FBI², 93)

The key classification consists of the ridge count of the first loop appearing on the fingerprint card, beginning with the
right thumb. The little fingers are excluded from this step in classification, and are used exclusively for the final classification. The ridge count of the first loop is placed to the far left of the classification formula and is always placed in the numerator, no matter on which hand the loop appears. (Moenssens, 23)

A few of the largest bureaus which use fingerprint classification, including the FBI, use additional steps, or extensions of the classification formula, to further subdivide extremely large groups of fingerprints which have not been sufficiently reduced by the basic classification procedure. (Moenssens, 23) One of these extensions is the second subsecondary division, which is placed above the subsecondary classification in the formula. The symbols for this division are also put into fractional form. For this division, ridge counts of any loops on the index, middle, or ring fingers are completed and values of small, medium, or large are assigned according to a table. That table is as follows:

<table>
<thead>
<tr>
<th>Index</th>
<th>Middle</th>
<th>Ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5, inclusive, S</td>
<td>1-8, inclusive, S</td>
<td>1-10, inclusive, S</td>
</tr>
<tr>
<td>6-12, inclusive, M</td>
<td>9-14, inclusive, M</td>
<td>11-18, inclusive, M</td>
</tr>
<tr>
<td>13 or more, L</td>
<td>15 or more, L</td>
<td>19 or more, L</td>
</tr>
</tbody>
</table>

(FBI², 94-95) A second extension is the WCDX extension, used for large whorl groups, which refers to the types of whorls appearing on the fingers. The type of whorl is indicated by "W," "C," "D," or "X," for whorls appearing on the index fingers, and "w," "c," "d," or "x," for whorls appearing on all other fingers. These
symbols are also placed above the subsecondary classification and in fractional form in the formula. The third extension is the special loop extension. This extension is used for the all-loop group. It considers the ridge counts of fingers 2, 3, 4, 7, 8, 9, and, if necessary, 10. Values are assigned to the ridge counts according to the following table:

<table>
<thead>
<tr>
<th>Ridge Count</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4, inclusive</td>
<td>1</td>
</tr>
<tr>
<td>5-8, inclusive</td>
<td>2</td>
</tr>
<tr>
<td>9-12, inclusive</td>
<td>3</td>
</tr>
<tr>
<td>13-16, inclusive</td>
<td>4</td>
</tr>
<tr>
<td>17-20, inclusive</td>
<td>5</td>
</tr>
<tr>
<td>21-24, inclusive</td>
<td>6</td>
</tr>
<tr>
<td>25 and over</td>
<td>7</td>
</tr>
</tbody>
</table>

The values are put into fractional form according to the hand on which the loops appear and are placed above the subsecondary classification in the formula. In addition to these extensions, fingerprint groups may be divided according to sex and an arbitrary age grouping. (FBI², 95-96)

Fingerprint Comparisons

The comparison of prints is based upon two types of characteristics present within the prints. Those two types are class characteristics and individual characteristics. Class characteristics are those general pattern types used for classification. Even though there may be a large number of persons having the same classification formula, there are more persons who have different classifications. The classification
process succeeds in greatly narrowing the number of possible matches. (Cowger, 129) Comparing class characteristics is the first step in comparing fingerprints.

For any comparison to result in the identification of the donor of a print, individual characteristics must be compared. These individual characteristics have been referred to as minutae, "Galton's details," or simply as "points." When comparing two prints, individual characteristics are considered according to their location, general appearance, orientation, and interrelationship. (Cowger, 142) The Federal Bureau of Investigations, as well as some other authors on the subject, generally consider there to be only three types of individual characteristics. These three types are the ending ridge, bifurcations, and the dot. Any other individual characteristics are considered to be combinations of those three types. Other groups have given names to certain combinations of the three basic types to form twelve different types of characteristics. (Cowger, 143) Below are the names and illustrations of some of the individual characteristics. (Cowger, 145)

Ending Ridge

Bifurcation (Fork)

Island Ridge, or Short Ridge
Comparison of the individual characteristics begins with the location of a reference point. This reference point may be a highly apparent landmark, such as a core, or it may be another prominent characteristic, such as areas of convergence or divergence, creases, scars, or a small group of closely related minutiae. (Cowger, 172) From this reference point, other individual characteristics can be located and compared according to their location, general appearance, orientation, and interrelationship.

Identification is based upon how closely two prints match with regard to the minutiae. There is some question, however, about what constitutes a positive identification. (Cowger, 148)
There is no real basis for requiring a certain number of individual characteristics to match in order to establish a positive identification. Yet many agencies have established standards for the minimum number of shared characteristics, some of which are more tradition than requirement. These standards range from three to eighteen. (Cowger, 147) In order to solve the dilemma of what constitutes a positive identification, some agencies have set an unusually high number of common characteristics, while others require that two or more examiners concur on the results of a comparison. (Cowger, 148) The most important factor in determining a positive identification, it would seem, is that the examiner be as objective as possible and report only those conclusions which are fully justified by the evidence. (Cowger, 149) From there on, the court and the jury will decide whether that evidence is sufficient.

Fingerprint Evidence in the Courts

The ultimate goal of many instances of the fingerprint work previously described, from locating prints and developing them, to classifying and comparing them, is the use of those prints in identifying the perpetrator of a crime and providing evidence in court for the prosecution of that perpetrator. Although this is not the only use of fingerprint technology, it is the primary one for the purpose of this paper. Bearing this in mind, it is important to discuss certain legal aspects of court use of
Fingerprint technology.

Fingerprint evidence has been held to be admissible in United States courts since 1905, in the case of State v. Miller. The first American appellate decision upholding the use of such evidence was handed down by the Illinois Supreme Court in 1911, in the case of People v. Jennings. Since these early decisions, fingerprint evidence has gained widespread acceptance. Today, many courts take judicial notice of the fact that fingerprints offer a means of positive identification. According to a 1941 decision of the Texas Court of Criminal Appeals, the uniqueness of all fingerprints is sufficiently established that responsibility lies with the defendant to prove the contrary. (Moenssens, 111-114)

Although fingerprint evidence is widely accepted, it is not necessarily the key to a conviction that many people would like to believe. In many cases, it is used merely to tie the defendant to the scene of the crime. (Waltz, 402) When used in conjunction with other evidence, a conviction may be obtained, but fingerprint evidence in itself is rarely sufficient for a conviction. If a prosecutor is attempting to justify a conviction based solely or primarily on fingerprint evidence, he must show that the defendant's fingerprints were found at the scene of the crime "under such circumstances as to exclude any reasonable possibility of consistency with innocence." (Moenssens, 118) The general rule for the necessary supporting evidence is that the prosecutor must show that the surfaces upon
which the latent prints were found were generally not accessible to the defendant. (Waltz, 400)

As with all scientific evidence, fingerprint evidence must be testified to by a qualified expert. The qualifications of the expert, his training and experience, must be established before his testimony is admitted. There are no exact rules to determine when a person becomes an expert at fingerprint work. Generally, an expert will have received training from a law enforcement agency training school, a recognized fingerprint school, the armed forces, the FBI, or from being taught by recognized experts. Work experience adds to the expert's credibility. In the end, however, it is up to the court and the jury to decide on his credibility. (Moenssens, 127-130)

Related to the testimony of an expert witness are experimental courtroom demonstrations and the use of photographs and fingerprint record cards. In the past, courtroom demonstrations have been conducted to illustrate the uniqueness of individual fingerprints and the reliability of comparisons. Since fingerprint evidence is widely accepted and these factors generally acknowledged, such demonstrations are rarely used today except in cases where the expert's qualifications are in dispute or the ability to obtain a print from a particular object or surface is doubted. Photographs are generally held admissible as evidence of where prints were found at a crime scene if they are properly authenticated. Fingerprint record cards, if properly authenticated, are also held admissible. If, however, these
cards make mention of the defendant's prior criminal record, that information must be masked so as not to prejudice the jury. (Moenssens, 133-134)

If used properly, fingerprint evidence can be a valuable tool in prosecution. In a limited number of cases, it can be used as the primary basis for conviction. In a far greater number of cases, it can be used to tie a person to a crime scene and, in conjunction with other evidence, lead to a conviction. In either instance, it provides convincing support for a successful prosecution.

Conclusion

Fingerprinting technology is a valuable tool in criminal investigations. It is also, however, a very complex science. A good deal of training and experience is necessary for any of the aspects of the science. Although fingerprinting has existed for a long time, and new methods of identification have arisen since its conception, fingerprinting is not likely to be replaced as an investigatory and prosecutory tool. Its wide applicability and continued technological advances in the field will insure its use for a long time to come.
References


