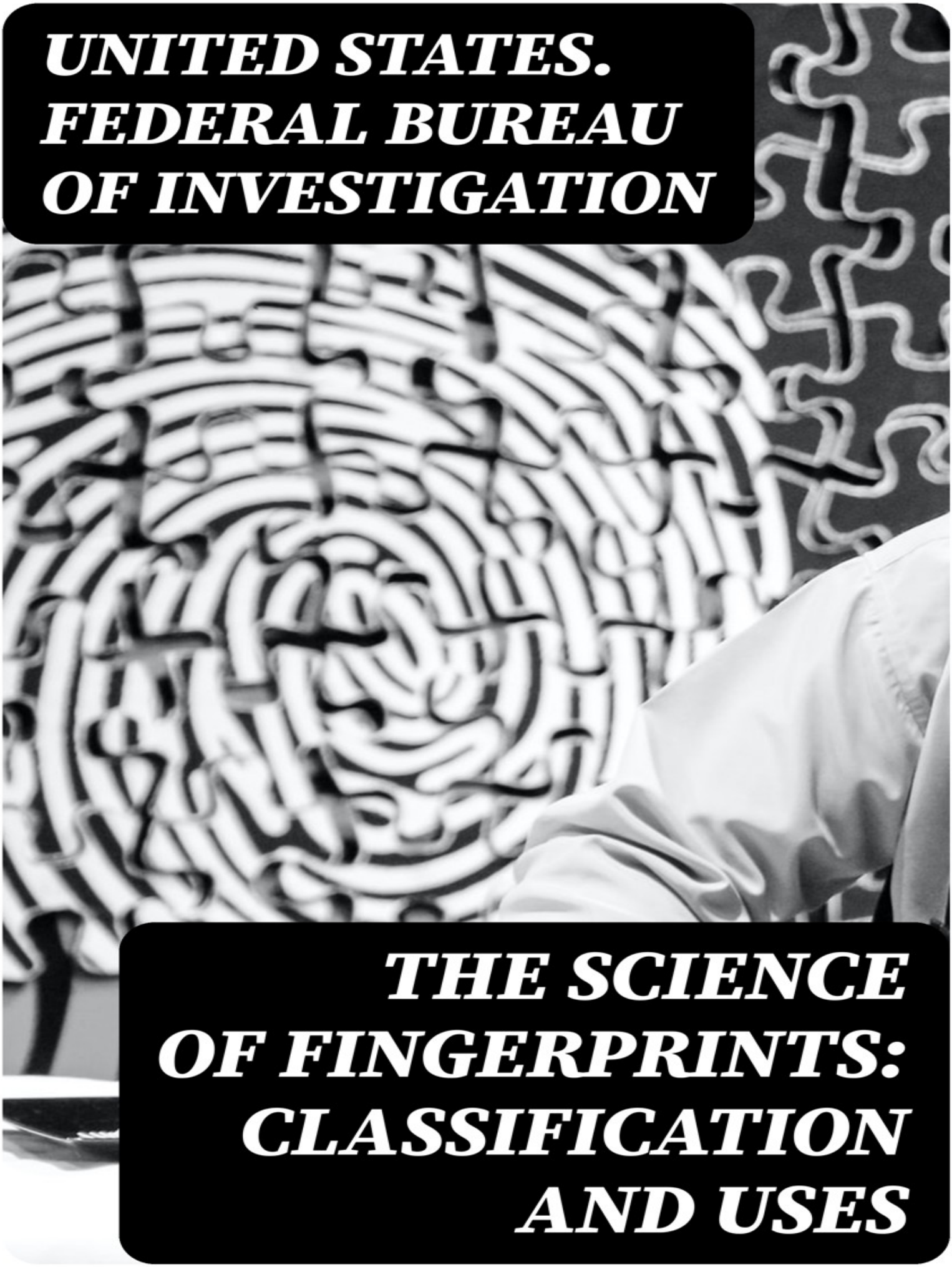
UNITED STATES. FEDERAL BUREAU OF INVESTIGATION



THE SCIENCE OF FINGERPRINTS: CLASSIFICATION AND USES

United States. Federal Bureau of Investigation

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John Edgar Hoover, *Director*

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INTRODUCTION

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This booklet concerning the study of fingerprints has been prepared by the Federal Bureau of Investigation for the use of interested law enforcement officers and agencies, particularly those which may be contemplating the inauguration of fingerprint identification files. It is based on many years' experience in fingerprint identification work out of which has developed the largest collection of classified fingerprints in the world. Inasmuch as this publication may serve as a general reference on classification and other phases of fingerprint identification work, the systems utilized in the Identification Division of the Federal Bureau of Investigation are set forth fully. The problem of pattern interpretation, in particular, is discussed in detail.

Criminal identification by means of fingerprints is one of the most potent factors in obtaining the apprehension of fugitives who might otherwise escape arrest and continue their criminal activities indefinitely. This type of identification also makes possible an accurate determination of the number of previous arrests and convictions which, of course, results in the imposition of more equitable sentences by the judiciary, inasmuch as the individual who repeatedly violates the law finds it impossible to pose successfully as a first, or minor, offender. In addition, this

system of identification enables the prosecutor to present his case in the light of the offender's previous record. It also provides the probation officers, parole board, and the Governor with definite information upon which to base their judgment in dealing with criminals in their jurisdictions.

From earliest times fingerprinting, because of its peculiar adaptability to the field, has been associated in the lay mind with criminal identification to the detriment of the other useful phases of the science. However, the Civil File of the Identification Division of the Federal Bureau of Investigation contains three times as many fingerprints as the Criminal File. These civil fingerprints are an invaluable aid in identifying amnesia victims, missing persons and unknown deceased. In the latter category the victims of major disasters may be quickly and positively identified if their fingerprints are on file, thus providing a humanitarian benefit not usually associated with fingerprint records.

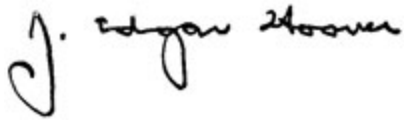
The regular contributors who voluntarily submit fingerprints to the Federal Bureau of Investigation play a most important role in the drama of identification. Their action expands the size of the fingerprint files, thereby increasing the value of the files to all law enforcement agencies. Mutual cooperation and efficiency are resultant by-products.

The use of fingerprints for identification purposes is based upon distinctive ridge outlines which appear on the bulbs on the inside of the end joints of the fingers and thumbs. These ridges have definite contours and appear in several general pattern types, each with general and specific variations of the pattern, dependent on the shape

and relationship of the ridges. The outlines of the ridges appear most clearly when inked impressions are taken upon paper, so that the ridges are black against a white background. This result is achieved by the ink adhering to the friction ridges. Impressions may be made with blood, dirt, grease or any other foreign matter present on the ridges, or the saline substance emitted by the glands through the ducts or pores which constitute their outlets. The background or medium may be paper, glass, porcelain, wood, cloth, wax, putty, silverware, or any smooth, nonporous material.

Of all the methods of identification, fingerprinting alone has proved to be both infallible and feasible. Its superiority over the older methods, such as branding, tattooing, distinctive clothing, photography, and body measurements (Bertillon system), has been demonstrated time after time. While many cases of mistaken identification have occurred through the use of these older systems, to date the fingerprints of no two individuals have been found to be identical.

The background and history of the science of fingerprints constitute an eloquent drama of human lives, of good and of evil. Nothing, I think, has played a part more exciting than that enacted by the fascinating loops, whorls, and arches etched on the fingers of a human being.



J. EDGAR HOOVER,
Director.

CHAPTER I

The Identification Division of the FBI

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The FBI Identification Division was established in 1924 when the records of the National Bureau of Criminal Investigation and the Leavenworth Penitentiary Bureau were consolidated in Washington, D.C. The original collection of only 810,000 fingerprint cards has expanded into many millions. The establishment of the FBI Identification Division resulted from the fact that police officials of the Nation saw the need for a centralized pooling of all fingerprint cards and all arrest records.

The Federal Bureau of Investigation offers identification service free of charge for official use to all law enforcement agencies in this country and to foreign law enforcement agencies which cooperate in the International Exchange of Identification Data. Through this centralization of records it is now possible for an officer to have available a positive source of information relative to the past activities of an individual in his custody. It is the Bureau's present policy to give preferred attention to all arrest fingerprint cards since it is realized that speed is essential in this service.

In order that the FBI Identification Division can provide maximum service to all law enforcement agencies, it is essential that standard fingerprint cards and other forms furnished by the FBI be utilized. Fingerprints must be clear and distinct and complete name and descriptive data required on the form should be furnished in all instances.

Fingerprints should be submitted promptly since delay might result in release of a fugitive prior to notification to the law enforcement agency seeking his apprehension.

When it is known to a law enforcement agency that a subject under arrest is an employee of the U.S. Government or a member of the Armed Forces, a notation should be placed in the space for "occupation" on the front of the fingerprint card. Data such as location of agency or military post of assignment may be added beside the space reserved for the photograph on the reverse side of the card.

Many instances have been observed where an individual is fingerprinted by more than one law enforcement agency for the same arrest. This duplicate submission of fingerprints can be eliminated by placing a notation on the first set of fingerprints sent to the FBI requesting copies of the record for other interested law enforcement agencies, thereby eliminating submission of fingerprints by the latter agencies.

If a photograph is available at the time fingerprints are submitted to the FBI Identification Division, it should be identified on the reverse side with the individual's complete name, name of the department submitting, the department's number, and it should be securely pasted in the space provided on the fingerprint card. If a photograph is to be submitted at a later date, it should be held until the identification record or "no record" reply from the FBI is received in order that FBI number or fingerprint classification can be added to the reverse side of the photograph for assistance of the Identification Division in relating it to the proper record.

The FBI number, if known, and any request for special handling, such as collect wire or telephone reply, should be indicated on the fingerprint card in the appropriate space. Such notations eliminate the need for an accompanying letter of instructions.

As indicated, the FBI's service is given without cost to regularly constituted law enforcement agencies and officers. Supplies of fingerprint cards and self-addressed, franked envelopes will be forwarded upon the request of any law enforcement officer. The following types of cards and forms are available: Criminal (Form FD-249), used for both arrest and institution records; Applicant (Form FD-258); Personal Identification (Form FD-353); Death Sheet (Form R-88); Disposition Sheet (Form R-84); Wanted Notice (Form 1-12); Record of Additional Arrest (Form 1-1). An order form for identification supplies appears each month with the insert to the FBI Law Enforcement Bulletin.

In addition to its criminal identification activities, the Bureau's Identification Division maintains several auxiliary services. Not the least of these is the system whereby fugitives are identified through the comparison of fingerprints which are received currently. When a law enforcement officer desires the apprehension of a fugitive and the fingerprints of that individual are available, it is necessary only that he inform the Bureau of this fact so a wanted notice may be placed in the fugitive's record. This insures immediate notification when the fugitive's fingerprints are next received.

The fugitive service is amplified by the Bureau's action in transmitting a monthly bulletin to all law enforcement

agencies which forward fingerprints for its files. In this bulletin are listed the names, descriptions, and fingerprint classifications of persons wanted for offenses of a more serious character. This information facilitates prompt identifications of individuals arrested for any offense or otherwise located by those receiving the bulletin.

Missing-persons notices are posted in the Identification files so that any incoming record on the missing person will be noted. Notices are posted both by fingerprint card and by name, or by name alone if fingerprints are not available. The full name, date, and place of birth, complete description and photograph of a missing person should be forwarded, along with fingerprints, if available. Upon receipt of pertinent information, the contributing agency is advised immediately. A section on missing persons is carried as an insert in the Law Enforcement Bulletin.

The FBI Identification Division has arranged with the identification bureaus of many foreign countries to exchange criminal identifying data in cases of mutual interest. Fingerprints and arrest records of persons arrested in this country are routed to the appropriate foreign bureaus in cases when the interested agency in the United States has reason to believe an individual in custody may have a record in or be wanted by the other nation. Similarly, fingerprints are referred to the Federal Bureau of Investigation by foreign bureaus when it seems a record may be disclosed by a search of the Bureau's records. Numerous identifications, including a number of fugitives, have been effected in this manner, and it is believed that the complete development of this project will provide more

effective law enforcement throughout the world. When the facts indicate an individual may have a record in another country, and the contributor submits an extra set of his fingerprints, they are transmitted by this Bureau to the proper authorities.

In very rare cases persons without hands are arrested. A file on footprints is maintained in the Identification Division on such individuals.

In view of the fact that many individuals in the underworld are known only by their nicknames, the Identification Division has for years maintained a card-index file containing in alphabetical order the nicknames appearing on fingerprint cards. When requesting a search of the nickname file, it is desired that all possible descriptive data be furnished.

The Latent Fingerprint Section handles latent print work. Articles of evidence submitted by law enforcement agencies are processed for the development of latent impressions in the Latent Fingerprint Section. In addition, photographs, negatives, and lifts of latents are scrutinized for prints of value for identification purposes. Photographs of the prints of value are always prepared for the FBI's files and are available for comparisons for an indefinite period. Should the law enforcement agency desire additional comparisons it needs only advise the FBI Identification Division, attention Latent Fingerprint Section, and either name or submit the prints of the new suspect. It is not necessary to resubmit the evidence. When necessary, a fingerprint expert will testify in local court as to his findings. Should a department have any special problems involving the development or preservation

of fingerprints at a crime scene, the experts are available for suggestions. In connection with the Latent Fingerprint Section there is maintained a general appearance file of many confidence game operators. Searches in this file will be made upon request. In furnishing data on a suspect, the agency should make sure that complete descriptive data is sent in. Photographs and other material on individuals who may be identical with those being sought will be furnished to the interested departments.

During the years many persons have voluntarily submitted their fingerprints to the Identification Division for possible use in the case of an emergency. These cards are not filed with the criminal fingerprints but are maintained separately. Such prints should be taken on the standard fingerprint form entitled "Personal Identification" (Form FD-353). No answer is given to Personal Identification fingerprint cards.

The fingerprint records of the FBI Identification Division are used liberally not only by police agencies to obtain previous fingerprint histories and to ascertain whether persons arrested are wanted elsewhere, but by prosecutors to whom the information from the Bureau's files may prove to be valuable in connection with the prosecution of a case. These records are likewise of frequent value to the judge for his consideration in connection with the imposition of sentence. Obviously, the ends of justice may be served most equitably when the past fingerprint record of the person on trial can be made known to the court, or information may be furnished to the effect that the defendant is of hitherto unblemished reputation.

It should be emphasized that FBI identification records are for the *OFFICIAL* use of law enforcement and governmental agencies and misuse of such records by disseminating them to unauthorized persons may result in cancellation of FBI identification services.

CHAPTER II

Types of Patterns and Their Interpretation

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Types of patterns

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Fingerprints may be resolved into three large general groups of patterns, each group bearing the same general characteristics or family resemblance. The patterns may be further divided into sub-groups by means of the smaller differences existing between the patterns in the same general group. These divisions are as follows:

I. ARCH	II. LOOP	III. WHORL
a. Plain arch.	*a.* Radial loop.	*a.* Plain whorl.
b. Tented arch.	*b.* Ulnar loop.	*b.* Central pocket loop.
		c. Double loop.
		d. Accidental whorl.

Illustrations 1 to 10 are examples of the various types of fingerprint patterns.

1. Plain arch.

2. Tented arch.

3. Tented arch.

4. Loop.

5. Loop.

6. Central pocket loop.

7. Plain whorl.

8. Double loop.

9. Double loop.

10. Accidental.

[Figs. 1-10]

Interpretation

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Before pattern definition can be understood, it is necessary to understand the meaning of a few technical terms used in fingerprint work.

The *pattern area* is the only part of the finger impression with which we are concerned in regard to interpretation and classification. It is present in all patterns, of course, but in many arches and tented arches it is impossible to define. This is not important, however, as the only patterns in which we need to define the pattern area for classification purposes are loops and whorls. In these two pattern types the pattern area may be defined as follows:

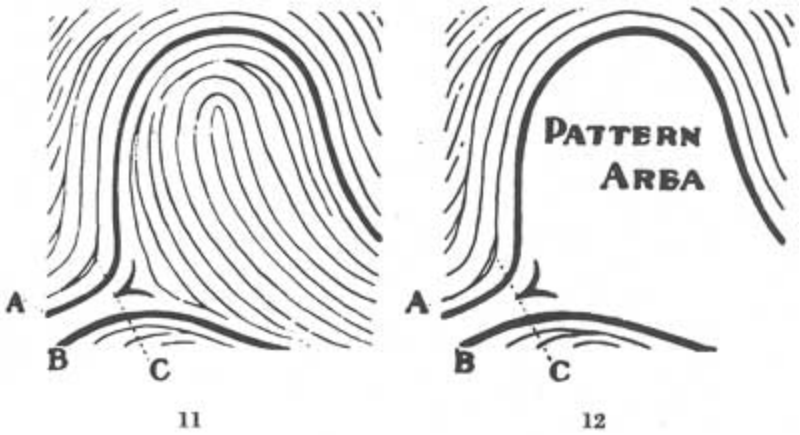
The pattern area is that part of a loop or whorl in which appear the cores, deltas, and ridges with which we are concerned in classifying.

The pattern areas of loops and whorls are enclosed by type lines.

Type lines may be defined as the two innermost ridges which start parallel, diverge, and surround or tend to

surround the pattern area.

Figure 11 is a typical loop. Lines A and B, which have been emphasized in this sketch, are the type lines, starting parallel, diverging at the line C and surrounding the pattern area, which is emphasized in figure 12 by eliminating all the ridges within the pattern area.

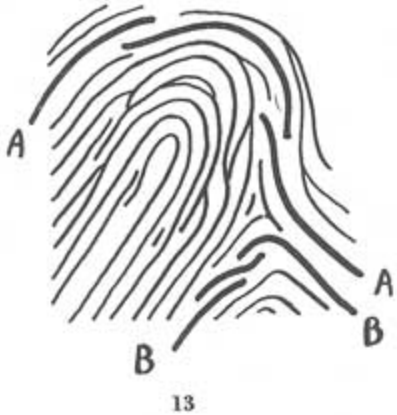


11 12

[Figs. 11-12]

Figures 72 through 101 should be studied for the location of type lines.

Type lines are not always two continuous ridges. In fact, they are more often found to be broken. When there is a definite break in a type line, the ridge immediately *outside* of it is considered as its continuation, as shown by the emphasized ridges in figure 13.



13

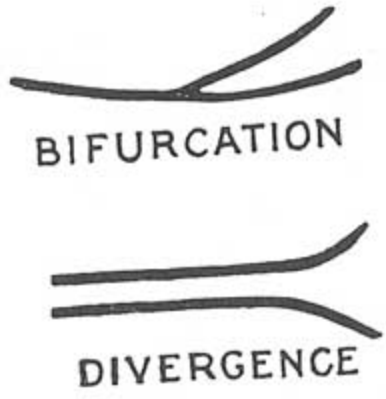
[Fig. 13]

Sometimes type lines may be very short. Care must be exercised in their location. Notice the right type line in figure 14.

14

[Fig. 14]

When locating type lines it is necessary to keep in mind the distinction between a divergence and a bifurcation (fig. 15).



15

[Fig. 15]

A bifurcation is the forking or dividing of one line into two or more branches.

A divergence is the spreading apart of two lines which have been running parallel or nearly parallel.

According to the narrow meaning of the words in fingerprint parlance, a single ridge may bifurcate, but it may not be said to diverge. Therefore, with one exception, the two forks of a bifurcation may never constitute type lines. The exception is when the forks run parallel after bifurcating and then diverge. In such a case the two forks become the two innermost ridges required by the definition. In illustration 16, the ridges marked "A—A" are type lines even though they proceed from a bifurcation. In figure 17, however, the ridges A—A are not the type lines because the forks of the bifurcation do not run parallel with each other. Instead, the ridges marked "T" are the type lines.

16

[Fig. 16]

17

[Fig. 17]

Angles are never formed by a single ridge but by the abutting of one ridge against another. Therefore, an angular formation cannot be used as a type line. In figure 18, ridges A and B join at an angle. Ridge B does not run parallel with ridge D; ridge A does not diverge. Ridges C and D, therefore, are the type lines.

18

[Fig. 18]

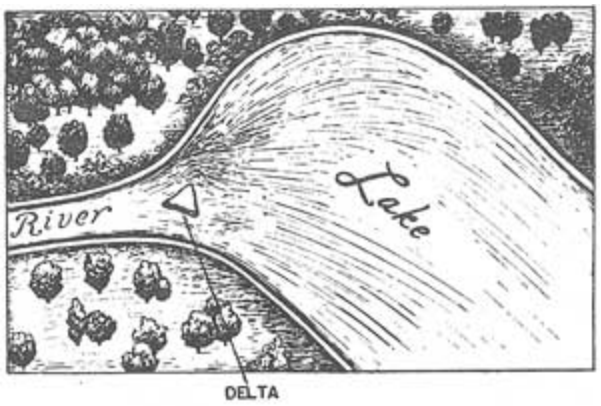
Focal points—Within the pattern areas of loops and whorls are enclosed the focal points which are used to classify them. These points are called delta and core.

The delta is that point on a ridge at or in front of and nearest the center of the divergence of the type lines.

It may be:

- A bifurcation
- An abrupt ending ridge
- A dot
- A short ridge
- A meeting of two ridges
- A point on the first recurving ridge located nearest to the center and in front of the divergence of the type lines.

The concept of the delta may perhaps be clarified by further exposition. Webster furnishes the following definition: "(1) Delta is the name of the fourth letter of the Greek alphabet (equivalent to the English D) from the Phoenician name for the corresponding letter. The Greeks called the alluvial deposit at the mouth of the Nile, from its shape, the Delta of the Nile. (2) A tract of land shaped like the letter "delta," especially when the land is alluvial, and enclosed within two or more mouths of a river, as the Delta of the Ganges, of the Nile, of the Mississippi" (fig. 19).



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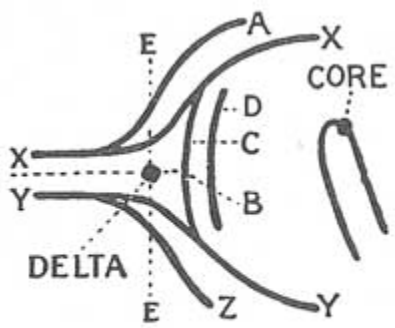
[Fig. 19]

When the use of the word "delta" in physical geography is fully grasped, its fitness as applied in fingerprint work will become evident. Rivers wear away their banks and carry them along in their waters in the form of a fine sediment. As

the rivers unite with seas or lakes, the onward sweep of the water is lessened, and the sediment, becoming comparatively still, sinks to the bottom where there is formed a shoal which gradually grows, as more and more is precipitated, until at length a portion of the shoal becomes higher than the ordinary level of the stream. There is a similarity between the use of the word "delta" in physical geography and in fingerprints. The island formed in front of the diverging sides of the banks where the stream empties at its mouth corresponds to the delta in fingerprints, which is the first obstruction of any nature at the point of divergence of the type lines in front of or nearest the center of the divergence.

In figure 20, the dot marked "delta" is considered as the delta because it is the first ridge or part of a ridge nearest the point of divergence of the two type lines. If the dot were not present, point B on ridge C, as shown in the figure, would be considered as the delta. This would be equally true whether the ridges were connected with one of the type lines, both type lines, or disconnected altogether. In figure 20, with the dot as the delta, the first ridge count is ridge C. If the dot were not present, point B on ridge C would be considered as the delta and the first count would be ridge D. The lines X—X and Y—Y are the type lines, not X—A and Y—Z.



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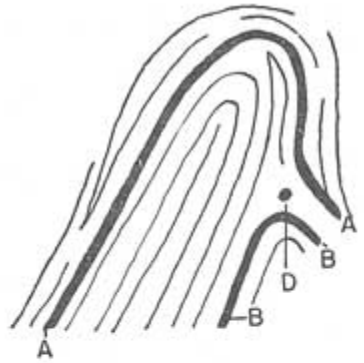
[Fig. 20]

In figures 21 to 24, the heavy lines A—A and B—B are type lines with the delta at point D.



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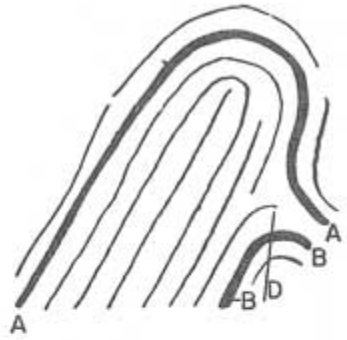

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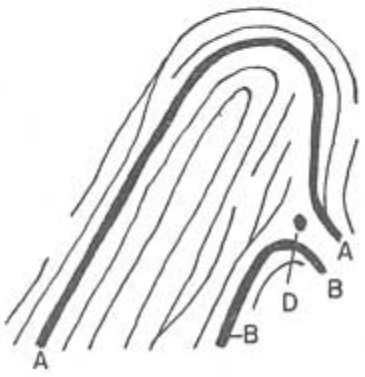

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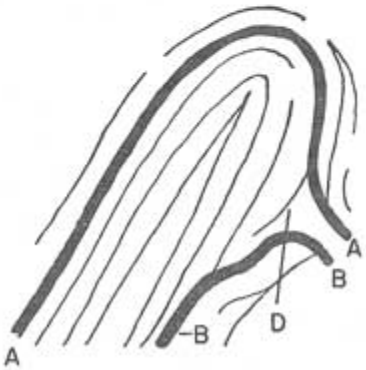

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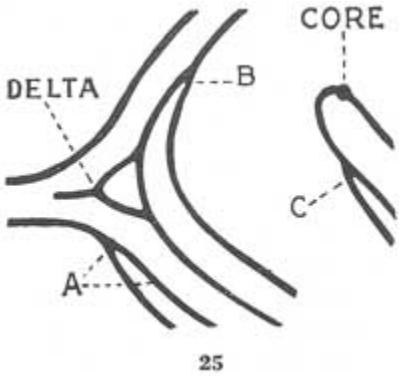
[Figs. 21-24]

Figure 25 shows ridge A bifurcating from the lower type line inside the pattern area. Bifurcations are also present within this pattern at points B and C. The bifurcation at the

point marked "delta" is the only one which fulfills all conditions necessary for its location. It should be understood that the diverging type lines must be present in all delta formations and that wherever one of the formations mentioned in the definition of a delta may be, it must be located midway between two diverging type lines at or just in front of where they diverge in order to satisfy the definition and qualify as a delta.

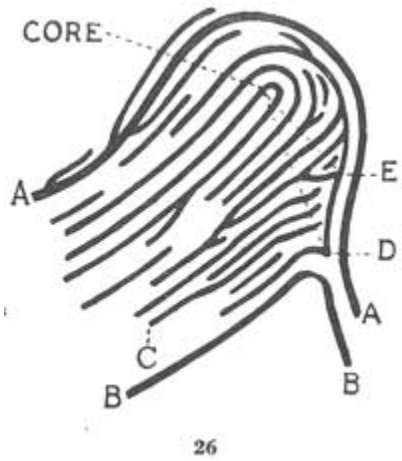


[Fig. 25]

When there is a choice between two or more possible deltas, the following rules govern:

● *The delta may not be located at a bifurcation which does not open toward the core.*

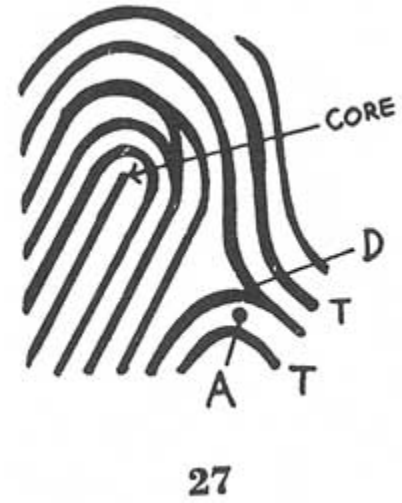
In figure 26, the bifurcation at E is closer to the core than the bifurcation at D. However, E is not immediately in front of the divergence of the type lines and it *does not* open toward the core. A—A and B—B are the only possible type lines in this sketch and it follows, therefore, that the bifurcation at D must be called the delta. The first ridge count would be ridge C.



[Fig. 26]

● *When there is a choice between a bifurcation and another type of delta, the bifurcation is selected.*

A problem of this type is shown in figure 27. The dot, A, and the bifurcation are equally close to the divergence of the type lines, but the bifurcation is selected as the delta. The ridges marked "T" are the type lines.



[Fig. 27]

● *When there are two or more possible deltas which conform to the definition, the one nearest the core is chosen.*