FEDERAL BUREAU OF INVESTIGATION U. S. DEPARTMENT OF JUSTICE

CLASSIFICATION OF FINGERPRINTS



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This explanation of the classification of fingerprints has been prepared by the Federal Bureau of Investigation for the use of interested law-enforcement officers and agencies. The hope is felt that it will prove of particular assistance to officials who contemplate inaugurating identification files. At the same time, by describing the systems in vogue in the Bureau's Identification Division, especially in the interpretation of doubtful patterns, the publication may serve as a general reference work on fingerprint classification.

It should be remembered that the science of fingerprinting for identification purposes is based upon the variation and distinctive outlines taken by the so-called friction ridges which appear on the "bulbs" or the pad of the end joint of each finger. When inked impressions are taken of these "bulbs", the ridges appear as black lines against a white background. The patterns formed in the fingerprinting process, having definite contour and arrangement, may readily be classified into general groups, and later into specific groups, thus making it possible to separate the prints forming the collection into small subdivisions.

The Federal Bureau of Investigation views the fingerprint classification as merely a convenient vehicle or means to index the files properly. The Bureau has, of course, the largest single collection of classified fingerprints which has ever existed. In the application of its classification principles to these fingerprints, the Bureau has been careful to avoid classifying any group of prints to an <u>unrea-</u> sonable degree. While the Bureau publishes for the information of law-enforcement officers an extension to the Henry System of Classification, it does not recommend that this extension be applied to all groups indiscriminately. It is the Bureau's opinion that the best results can be attained when any fingerprint file is segregated into smaller portions affording practical subdivisions or the grouping of prints into sections which are neither too bulky or unwieldy and yet which, at the same time, lend themselves to short searches.

This treatise relative to the classification system is divided into two major portions. The first is the interpretation of the types of fingerprints and the second is the method of the classification of those types into definite groupings. These subjects will be handled separately herein.

TYPES OF PATTERNS CORES, TYPE LINES AND DELTAS

In most fingerprint patterns, there are certain focal points, known as the "core" and "delta." The ability to locate them correctly is basic in the practice of the science of fingerprints.

Illustrations 1 to 6, inclusive, show these focal points in loop patterns:



As indicated, illustrations 1 to 6, inclusive, show the cores in six loop formation patterns and are self-explanatory. This treatise, at this point, will not deal with cores in whorls. As the name implies, the "core" represents the approximate center of the pattern. In the first sketch the reader will note the inner loop of the pattern. He will notice that the core is located at the top of the shoulder of this loop on the ridge which is farthest from the delta. In the second sketch there is a rod (a ridge) within the inner loop, which rises as high as the shoulder of the loop. The core is at the top of this rod in such patterns. In the third sketch there are two such rods. In patterns of this kind the top of the rod that is farthest from the delta is the core. In the fourth sketch are three rods extending up to or above the shoulder of the loop. The top of the central rod is the core. In the fifth sketch there are four rods enclosed within the central loop and rising as high as the shoulder of the loop. The top of the third rod from the delta is the core.

The rule is: When there is an inner loop in the pattern, without rods in its center, the core is located at the top of the shoulder of this loop, on the ridge which is farthest from the delta. When the inner loop contains an uneven number of rods, rising as high as the shoulder of the loop, the top of the central rod is the core. Where the

inner loop contains an even number of such rods, the two central rods are treated as though they were connected to form a loop.

Illustration 6 shows two central loops. Following the usual method, the core could be located on the shoulder of either of these loops but for the fact that there cannot be two cores in a loop formation. For that reason, to locate the core in patterns of this kind—and for this purpose only—ridges G and H, which are really parts of two distinct loops, are considered as though they were connected at the top to form one enveloping loop, with the ridges A and B as rods within it. The core is therefore located on ridge A.

Illustration 7 is a loop pattern in which there are six rods; that is, an even number of rods rising as high as the shoulder of the loop. Applying the rule for finding the core, the two central rods are considered as connected. It will be seen that the core is at the top of the rod which is marked with a circle. The rods are thought of as connected only for the purpose of locating the core.

In describing rods within central loops of patterns there was a deliberate repetition of the phrase "rising as high as the shoulder of the loop." The "shoulder" may be defined as the turning point of the single ridge (from either side) which forms the loop. Illustration 8 shows two rods A and B. Rod A does not rise as high as the shoulder of the loop, which is indicated by the dotted line X.



Only those rods which rise as high as the shoulder of the loop are considered in locating the core.

Deltas.—The delta is the first bifurcation, abrupt ending ridge, meeting of two ridges, island, fragment, or ridge of any nature, at or nearest to the center of the divergence of two type lines, located at or directly in front of their divergence. This holds good even if such ridge, meeting of ridges, or bifurcation is, or appears to be, joined to either or both type lines, or to ridges converging upon it within the pattern.

It is realized that the science of fingerprinting cannot be learned through the mere study of definitions, no matter how inclusive they may be. For that reason diagrams have been used to illustrate this text. The definition heretofore mentioned was set out to call attention to the need for a clear understanding of the meaning of technical words.

Words are pictures of thoughts and facts which have become mental concepts. Unless the words used convey the same meaning to the mind of the reader that they do to the mind of the writer, confusion and misunderstanding will be the result. Lack of appreciation of the finer meanings of words and their shadings leads to haziness and error. Even in fingerprint work there is often misunderstanding where there is no real difference of opinion.

"Bifurcation" and "divergence" are two words which it will be necessary to use in this and the following paragraphs. Bifurcation means the forking or dividing of one line into two branches. Divergence means the spreading apart of two lines which have been running parallel, or nearly so. Where the forking is three-pronged there are two bifurcations, even if the divisions are from the same point. According to the narrow meaning of the word, which is essential to our purpose, a single line may bifurcate, but it cannot be said to diverge.

Illustration 9 shows examples of both divergence and bifurcation.



There will be other examples given as they become necessary, incidental to finding deltas or in tracing whorls.

"Delta", one of the most important words in fingerprinting, is not technically defined in the average dictionary. It has already been defined herein, but it is important that the definition be interpreted.

The dictionary says: "(1) Delta is the name of the fourth letter of the Greek alphabet (the capital form of which is 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."

When the use of the world "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 the seas or lakes, the onward sweep of the water is lessened, and the sediment, becoming comparatively still, sinks to the bottom where a shoal is formed, which gradually grows, as more and more is pre-

cipitated, until at length a portion of the shoal becomes higher than the ordinary level of the stream. The deposit continues to increase until it forms a considerable territory, separating by a great distance the two mouths which its presence has caused the river to have.

We come now to the 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 and nearest to the center of the divergence.

TYPE LINES

Illustration 10 is a typical loop. It will be noticed that lines



A and B have been emphasised in both sketches.

It will be observed that these lines in illustration 11 surround the loop pattern. Line A turns upward and then downward, leaving the impression on the opposite side from where it entered. It will also be observed that the line B is parallel to line A where it enters the impression, and that after reaching the point of divergence C, it turns downward and leaves the impression on the side opposite from where it entered. The lines A and B are known as type lines, and where these lines are found the delta is the ridge or part of a ridge at their point of divergence or in front of it. There are type lines in all patterns of fingerprints with the exception of some forms of arches. Where there are no type lines there can be no delta, although sometimes they are very short and careful study is required to locate them. Referring back to illustrations 1 to 6, inclusive, study the type lines shown therein to note their structure. They are marked with the letter T.

In classifying most types of fingerprints no attention is paid to any part of the print, except that portion enclosed within the type lines. This is known as the pattern area, as shown in illustration 11.

Always look for the type lines and their place of divergence in locating the delta. In illustration 12 the delta is a bifurcation, but not all bifurcations are deltas, nor are all deltas bifurcations.

Like other ridges, the type lines are not always two continuous lines, but in fact are more often broken. An instance of this is shown in illustration 12, where the type lines A and B are broken. When there is a break in a type line the ridge immediately on the outside of it is considered as its continuation, as shown by the darker markings in the illustration.



The type lines in the previous illustrations were all shown as unbroken for the sake of convenience.

In illustration 13 the dot marked "delta", being the first ridge or part of a ridge, inside of the point of divergence of the type lines and midway between them, is the delta. If the dot were not present, point B on ridge C, as shown in the illustration, would be the delta. This would be equally true whether the ridge was connected with one of the type lines, both type lines, or disconnected altogether.

In loops, the number of ridge lines between the delta and the core are counted. This is known as <u>ridge counting</u>; the result is the <u>ridge count</u>. The technical employees of the Federal Bureau of Investigation count each line which crosses or <u>touches</u> the imaginary line drawn from the delta to the core. Further, in the event there is a bifurcation of a ridge exactly at the point where the imaginary line would be drawn, two ridges are counted. A dot is counted as a ridge. "Fragmentary" ridges sometimes appearing on fingerprints as "shavings" of ridges are not considered in the Bureau as

true ridges and are not counted. Sometimes the operative is in doubt as to whether a ridge is a fragment. Usually, it is possible in such cases through the careful examination of the ridge under consideration in comparison with the other ridges to determine its true character. If the apparent "fragment" is much thinner than the surrounding ridges, it is not counted. Experience only will enable consistently accurate interpretations to be given to such characteristics. Variations in inking and pressure, of course, should be con-



sidered. If any doubt exists as to whether a "fragment" should be counted, necessary reference searches should be conducted.

It is interesting to note here how closely the technical meaning of the definitions and terms used in fingerprinting follows the broad, general meaning of the same words. For example, as will be shown later, an arch is merely what its name implies; a loop is a ridge which makes a turn; a whorl is a sort of spiral arrangement of the ridges. Similarly, a delta and a core define themselves.

In illustration 13, taking the dot as the delta, the first ridge count would be ridge C. With point B on ridge C

as the delta, the first count would be ridge D. In illustration 14 the delta is formed by a bifurcation which is not connected with either of the type lines. In illustration 15, the line which bifurcates is connected with the lower type line. In both illustrations the location of the deltas is the same, and the first ridge count is ridge C. If the bifurca-



tion were not present, the delta would be a point on ridge C, and the first count would be line D.

In illustration 16, the delta is formed by a bifurcation immediately in front of the point of divergence of the type lines. That the bifurcating line is itself a bifurcation from the upper type line X-X is unimportant, as is the fact that each fork meets the line marked "first count." This is in accord with the definition of deltas.

In illustration 17 the delta is at the apex of the V-shaped meeting of two ridges. The fact that one of the ridges, which forms the delta, is connected with the first ridge counted has no bearing, as a

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straight line from the delta to the core would pass over a white space before coming to the ridge marked "first count."

In illustration 18 the ridge which springs from the upper type line within the pattern makes a sharp turn and ends abruptly. According to the definition, the ridge ending marked "A", is the delta. It will be observed that the ridge ending at A is in exact alinement with the line of count; that is, with an imaginary line connecting the core and the delta. Starting from the delta, we do not find a white interval until we pass beyond ridge B. (It is necessary that such interval be found between ridges before such ridges may be counted.) Therefore, the ridge marked "X-X", is the first ridge count in the pattern. It should be understood that the ridge ending at A, must be in exact alinement with the line of count before this rule is effective. If there was the least break between the delta and ridge B, then B would be the first count.

Illustration 19 makes clear one of the distinctions mentioned in the foregoing paragraph. In this illustration the ridge ending in the delta is not in alignment with the line of count. Starting from



the delta, in counting, we pass over a white space before we reach ridge C, which is consequently the first ridge within the pattern. In all patterns it will be found that many ridges bifurcate, both inside and outside of the pattern area. Even to be considered as the delta, a bifurcation must be the nearest to the center of the divergence of two type lines, midway between them, and fork or open toward the pattern area. Thus in illustration 20, a ridge A bifurcates from the lower type line inside of the pattern area. At B and Cthere are bifurcations also within the pattern. Only the bifurcation at the point marked "delta" fulfills all the conditions. 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 delta, may be, it must be located midway between the two diverging type lines at or just in front of where they diverge.

We sometimes find a class of prints where a single ridge enters the pattern area with two or more bifurcations opening towards the core. In such cases where they conform to the rules defining deltas, the one nearest to the core is considered as the delta. Illustration 21 is an example of this. Ridge A enters the pattern area and bifurcates at point X and D. The bifurcation marked "D", which is the closest to the core, is the delta and conforms with the rule laid down for deltas. A and B are the type lines. A bifurcation which does not conform with the definition should not be considered as a delta irrespective of its distance from the core.

In illustration 22 we find that the bifurcation at the point marked "E" is closer to the core than the bifurcation at the point marked "D", but E is not immediately in front of the divergence of the type lines. A-A and B-B, being the only possible type lines in



the illustration, it follows that the bifurcation at D is the delta, and C is the first ridge count.

In illustration 23 (a), a sketch, the reader will recognize that A = A and B = B are the type lines and that the dot is the delta.



In illustration 23 (b), it will be noted that A - A is an unbroken type line but that type line B - B is broken where the ridges Eand D meet it. This is sometimes caused by an enlarged sweat gland exuding enough oil to keep a small part of the ridge from inking. Even if the dots were not present ridge B - B should be considered as continuous.

In illustration 23 (c), we have a very different condition as there are neither dots nor shoulders to show that the type lines are connected. The abrupt ending of the ridge E is therefore the delta.

The type lines are A - A and B - B. There must be very strong indications that ridges are connected before considering them as such. Care should be exercised to guard against the too common error of considering a dot near a division of the two type lines as a delta without first investigating the surrounding conditions. Poor workmanship will inevitably result from jumping at conclusions as to what constitutes the delta.

There have been considerable differences with regard to the location of the delta in certain classes of prints. Illustrations 24 a, b, c, and d illustrate prints of this nature. The type lines are indicated by the letters A-A and B-B.



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If one painstakingly studies the definitions, explanations, and illustrations, locating the deltas, usually regarded as one of the most difficult tasks in fingerprint work, should give little trouble.

THE ARCH TYPE

This type of the nonnumerical group (the group not considered in the attainment of the primary) is composed of two individual patterns, each having its own symbol. Arches occur in about 5 percent of all prints.

Before treating of the distinctions made in the Federal Bureau of Investigation between the plain-arch and the tented-arch patterns, it is desired to indicate that the Bureau in the conduct of its identification work felt the need for a more mechanical rule in distinguishing between these types of patterns. It is for this reason that the Bureau has leaned liberally to the interpretation of certain transitional types and the classification of such types arbitrarily as tented arches. It is the Bureau's feeling that the adoption of this practice which is explained in detail below will enable more consistent interpretations to be accorded to these doubtful types which heretofore have required extensive "referenced" searches; that is, searches in more than one section of the file.

THE PLAIN ARCH

In plain arches the ridges enter on one side of the impression and flow to the other with a slight rise or wave in the center, making no upward thrust or backward looping turn. In this pattern there is neither core nor delta. The plain arch is the most simple of all fingerprint patterns, and is easily distinguished. Illustrations 25 and 25-a are examples of the plain arch.



THE TENTED ARCH

In this pattern as in the plain arch the ridges enter on one side of the impression and flow to the other, with: (a) One or more of the ridges, making an upward thrust, or (b) a looping ridge which, however, is lacking in at least one of the requisites of the looping type, as explained later.

Illustrations 26 and 26-a are examples of the tented arch.

Tented arches and some forms of the loop are often confused. It should be remembered that the <u>mere coming together of two ridges</u> does not form a recurve, without which there can be no loop. On the other hand, there are many patterns that at first sight resemble tented arches, but which on closer inspection are found to be loops, as where one recurving ridge will be found in an almost vertical position, within the pattern area, entirely free from the delta and recurving before it.

Illustration 27 is a rather unusual tented arch. Two sets of ridges appear within the pattern, rising in an almost perpendicular posi-

tion in the center, and lean toward each other at the top to form the spine of a tent.

Illustration 28 is a sketch of a pattern which shows one of the difficulties of the fingerprint science. This at first appears as a combination of two patterns. Ridge a enters on one side of the pattern, recurves at c, before formation d, which would be considered as a delta in most cases. The recurving ridge, however, does not terminate on the side of the impression where it entered,

but does terminate at b on the opposite side. This pattern is a tented arch.

Illustration 29 is a tented arch. The ridge marked "a-a", in the sketch, enters on one side of the impression and flows to the other with an acute rise in the center. The ridge marked "x" forms the



spine of the tent. The ridge marked "c" bifurcates with a at the point marked "b" and should not be considered a recurving ridge. The ridges marked "d-d" by themselves would form a tent if the rest of the pattern was absent. Notice the angle at the top of these ridges.

Some tented arches are formed in one of three ways:

(1) By a recurving ridge within a pattern area, but minus a delta, which makes it impossible to secure a ridge count from the delta to the core;

(2) By a delta formation within a pattern area, sometimes having abrupt ending ridges within the pattern area, but no recurving ridge;

(3) By a recurving ridge within a pattern area, but with the recurving ridge connected with the delta.

Illustrations 30 and 30-a are tented arches, having loop formations within the pattern areas, but are minus deltas, by reason of which it is not possible to secure ridge counts. Careful study shows that the type lines run parallel from the left in illustra-



tions 30 and 30-a and from the right in illustration 31, nearly to the center of the prints, then diverge and enclose single loops within their areas. The spaces between the type lines at their divergence show nothing which could be considered as delta formations. In these patterns, tented arches could be considered as no-count loops.

Illustration 32 shows a tented arch. In this pattern, if the recurving ridge approached the vertical it would be a one-count loop. Once



studied, however, the pattern presents no real difficulty, for it will be noticed that there are no ridges intervening between the delta, which is formed by a bifurcation, and the core, which is marked with a dark circle. Illustrations 33 and 34 are additional examples of tented arches. These two illustrations are similar in many ways. Each of the prints has within its area two abrupt-ending ridges, or prongs, but there are no loops or recurving ridges. Sometimes these prongs are erroneously considered as being connected. This confusion may result from a rule regarding the location of the core in loop patterns. The rule is that where there are two rods within an enveloping loop or loops, they are considered to be joined for the purpose of determining the core, and for that purpose only.

Illustration 35 is a loop formation connected with a delta, but has no ridge count. By drawing an imaginary line from the core, which is at the top of the prong in the center of the pattern, to the delta,



this fact is disclosed. In consequence, this pattern is considered a tented arch.

Illustration 36 is a good example of a tented arch. It is used here to show that the meeting of two ridges at an angle, resulting from their running into each other, though not maintaining their parallelism of direction, should not be confused with recurving ridges. The ridge marked "a", makes an upward turn and bifurcates at an acute angle with the ridge marked "b", which proceeds past it, and then comes to an abrupt end.

It will be noted patterns which <u>approach</u> the loop type but which iack one of the essential characteristics required in a loop (recurve, delta, and at least one ridge count) are classified as tented arch patterns. Heretofore such patterns have been classified variously as arches and tented arches, depending upon the height of the upthrust. As indicated, it is desired to bring in the tented arch group all such patterns approaching the loop type but not attaining all the requirements of the loop type. (See illustration T.) If necessary, this method may be utilized in the future to subdivide the tented arches according to the slope of the pattern, similar to the method of dividing ulnar and radial loops. When a pattern presents no loop characteristics but only the question as to whether it should be classified as an arch or a tented arch, the following procedure should prevail:



If a line perpendicular to the base ridge appears (commonly called a spike) the pattern should be classified as a tented arch. (See fig. T-2.) This rule obtains regardless of the height of the line.

If no perpendicular line appears, the pattern should be classified as an arch if the ridges which enter on one side and exit on the other form curves in following this course. (See fig. A-3.) If one or more of these continuous lines form an <u>angle</u> at the point where their direction changes from upward to downward, the pattern should be classified as a tented arch. (See second illustration in Fig. T.) Patterns showing an ending ridge or ridges which rise from one side of the impression and terminate by forming an angle with an arching ridge should also be classified as tented arches. (See fig. T-4.)

In interpreting the above rules, it should be noted that the determining characteristics are as follows:

(a) Whenever a pattern approximates a loop but does not have all the characteristics required in a loop, it should be given the preferred classification of tented arch and the referenced classification of loop if necessary. Whenever this approximating loop pattern is found, the presence of a spike or angular

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line is immaterial inasmuch as the pattern is classified as a tented arch due to the presence of the approximating loop. The spike or angular line is then merely an additional tented-arch characteristic.

(b) If, in the examination of the pattern, no approximating loop type is found, the pattern should be examined to determine



T (Tented arches)

if a spike is present. If the spike is present, the pattern is classified as a tented arch.

(c) If neither the pattern questioned loop type nor the spike appears, the curved or angular character of the arching ridges is controlling.



THE LOOP TYPE

In fingerprints, as well as in the usual application of the word "loop", there cannot be a loop unless there is a recurving or turning back on itself of one or more of the ridges. However, other conditions have to be considered. There must be a <u>ridge count</u> or the pattern is not a loop. Even more than that is necessary, for if the recurving ridge or ridges do not <u>terminate</u> or <u>tend to terminate</u> on the same side of the impression from where they entered, the pattern is not a loop.

Definition of loop.—A loop is that fingerprint type in which one or more of the ridges enter on either side of the impression, recurve, touch or pass an imaginary line drawn from the core to the delta, and then terminate on or toward the same side of the impression from whence such ridge, or ridges entered. It will be noted that the loop has one delta and one core. It is the most numerous of all types, occurring in about 65 percent of all prints.

In illustration 37, there is a ridge marked "A", which enters on one side of the impression and after recurving, passes an imaginary line drawn from the core C, to the delta D, and terminates on the same side of the impression from whence it entered, marked "B", thus fulfilling all the conditions required in the definition of a loop. X - X and Y - Y are type lines.

In illustration 38 there is a ridge, which enters on one side of the impression, recurves, and passes an imaginary line drawn from the core to the delta. It does not terminate on the side from where it enters, but has a tendency to do so. Applying the definition of a



loop, all requirements have been met with and consequently the pattern is a loop.

Illustration 39 is an 18-count loop. Illustration 40 is a 14-count loop. It is recalled that where an imaginary line drawn between the delta and the core is touched or crossed by a ridge, that ridge is counted; where the said line crosses immediately at the point of bifurcation, two ridges are counted; where the said line crosses an island, both sides of the island are counted. Care, of course, must be exercised in the exact and correct placement of the imaginary line.



In illustration 41 a ridge enters on one side of the impression, recurves and passes beyond an imaginary line drawn from the core to the delta, although in a different manner from the recurving ridge shown in illustration 38. After passing the line of count, the recurving ridge does not terminate on the side of the impression from where it entered, but has a tendency to do so, and is therefore a loop. In illustration 42, as in illustrations 38 and 41, a ridge enters on one side of the impression and then recurves. There are two rods or staples within it, each of which rises as high as the shoulder of the loop. From our study of cores, we know that the top of the rod most distant from the delta is the core, but the recurving ridge does not pass the line of count, and for that reason the pattern cannot be considered a loop.



In illustration 43 there is a ridge which enters on one side of the impression and recurves. Like the previous diagram, the recurving ridge tends to terminate on the same side of the pattern from where it entered, but it does not pass the line of count and for this reason it is not a loop. In patterns of this nature, the proper location of the core and delta is of extreme importance, for an error in the location of either might cause such patterns to be called loops. This pattern and the preceding are illustrations of tented arches.



In illustration 44 there is a recurving ridge, marked "A", which enters on one side of the impression. The ridges B-B and C-C are the type lines. As determined by rules already stated, the location of the core and the delta are shown in the illustration. If a line were drawn from the core to the delta, the recurving ridge A would pass it. This ridge does not terminate on the side of the impression from where it entered, but tends to do so, therefore the pattern is a loop.

In illustration 45 we have a print which is similar in many respects to the one described in the preceding paragraph, but here the recurving ridge A, instead of ending at the point D, continues and terminates on the <u>opposite</u> side of the impression from where it entered. For this reason the pattern is not a loop, but a tented arch.

In illustration 46 there is a ridge which enters on one side of



the impression, and, after flowing toward the center turns or loops on itself and terminates on the same side from where it entered, This pattern is a loop. The reader should carefully study the pattern, noting the location of the core C, and delta D, observing that an imaginary line drawn between these points would be crossed by the ridge forming the loop.

In illustration 47 the reader will see, at the cen-

ter of the print, a ridge which occupies a pocket. It will be noticed that this ridge marked "A", does not begin on the edge of the print, but this is of no significance. The ridge A, within the pattern

area, recurves or loops, . passes the line of count between the delta and the core, and terminates toward the same side of the impression from where it entered. It is a loop pattern, having the minimum requirements of a loop, i. e., delta, core, and one ridge count.

In illustrations 48 and 49 it will be observed that there is a ridge entering on one



side of the pattern, in each of the illustrations, which recurves and then turns back on itself. Both patterns are different from any other illustration which has been shown in this respect, but they are both loops. In each of the patterns the core and delta are marked "C" and "D." The reader should trace the type lines to ascertain why the delta is located at the point marked "D", and then apply the rule for deltas.

Illustration 50 is an example of fingerprint loops as they appear on the rolled impression portion of a fingerprint card.

Radial and ulnar.— The terms "radial" and "ulnar" are derived from the radius and ulna bones of the forearm. Loops which flow in the direction of the ulna bone (toward the little finger) are called ulnar loops and those which flow in the



direction of the radius bone are called radial loops. Another way of stating this is that on the fingers ulnar loops flow toward the littlefinger side of the hand, and radial loops toward the thumb side of the



hand. This is equally true of the right and left hand. It is necessary to understand clearly that loops are divided into radial and ulnar on the basis of the way in which they flow on the hands, not according to the arrangement on the fingerprint card.

If the reader will place the fingers of his right hand on the corresponding prints of the right hand in illus-

tration 50, he will notice that the side of each finger which is nearer to the thumb on his hand is also nearer to the thumb on the fingerprint card. In prints of the right hand, the arrangement of the

prints on the card is the same as their arrangement on the left hand, since they are in a natural position. If the hand of the reader is placed on a flat surface, the reader will notice that the thumb, the radial side, can be turned over more readily than the little-finger side. This is so because the radius bone in the wrist is the bone which rotates or moves. On the contrary, if the reader will endeavor to raise only the little-finger side of the hand from its flat position, he will notice that he has a tendency also to lift the entire forearm to the elbow. Sometimes it is easy to remember the radial and ulnar loops through this simple test.

The reader should next place the fingers of the left hand on the corresponding prints of the left hand shown in illustration 50.

Here he will notice that the arrangement of the prints on the card is the reverse of the arrangement of the prints on the hand.



The side of a finger which is toward the little finger on the hand will be toward the thumb on the print. But the classification of loops is based on the way the loops flow on the hand (not the card), so that on the fingerprint card for the left hand, loops flowing toward the thumb are ulnar, and loops flowing toward the little finger are radial, owing to the reversal of the position of the fingers of the left hand on the fingerprint card.

Loops are divided into groupings on the basis of the ridge counts, and the finger on which the loops are found, as will be explained later.

THE NUMERICAL VALUE PATTERNS

The patterns to which numerical values are assigned in deriving the "primary" in the Henry system of fingerprint classification

include the plain whorls, central pocket loops, lateral pocket loops, twinned loops, and accidentals. These patterns occur in about 30 percent of all prints. All these, excepting only the plain whorls, are called "composites", inasmuch as each contains the elements of more than one pattern. Although all the patterns named are given the same numerical values in the primary classification they are basically different in formation. However, each has at least 2 deltas and 1 core, and to this extent these prints differ from arches, tents, and loops.

The plain whorls, central pocket loops, and accidentals may be distinguished readily, but difficulty is sometimes encountered in distinguishing the lateral pocket loop from the twinned loop. Experience has shown that the distinction which has been maintained is not practicable in its application. It is noted that no real definition of the two types and no real line of demarcation between them is available. The general statement that the twinned loops exit on opposite sides of the right delta and that the lateral pocket loops exit on the same side of the right delta has been found insufficient to serve as a guide for differentiating the types. The necessity for tracing ridges around the pattern (in some cases several times) raises a serious obstacle in fingerprint work, because of the time required. By restricting the lateral pocket loop class to these patterns showing distinct side pockets it is possible to set up two distinct classes-lateral pocket loops and twinned loops. However, so few double loops show distinct side pockets that the advantage of separation is outweighed by the disadvantage of the labor involved in classification. It has been found advantageous, therefore, in the Federal Bureau of Investigation to avoid the previous distinction between lateral pocket loops and twinned loops and to include both in the general classification double loop. Accordingly, for our purposes, the numerical value patterns shall be divided into four types: Central pocket loops, plain whorls, double loops, accidentals.

THE CENTRAL POCKET LOOP

The central pocket loop is a pattern which with respect to some of its ridges is a loop but which with respect to ridges at the center is a whorl. In the approach to this type from the loop, the ridges seem to be "pinched" together, flowing out along one axis. It is the unbalanced type of pattern with one delta considerably closer to the core or "higher" than is the other delta. It is a transitional pattern lying between the loop and the whorl, in which one or more of the simple recurves of the plain loop type have recurved further, deviating from their regular course, to make a circuit and to require

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another delta limiting the second recurve or recurves. Figures 51, 52, and 53 illustrate the central pocket loop.



The beginning of the central pocket loop is illustrated in figure 55. This pattern is still technically a plain loop, however, inasmuch as

a sufficient second recurve is not present and only one delta is seen. The "sufficient recurve" is defined as one which curves so as to meet or pass through at right angles the line of exit of the loop. In figure 55 it will be noted that the innermost loop type recurve shows a tendency to recurve a second time, but that the ridge does not curve far enough to cut at right angles the axis or "line of exit" of the loop. Figure 55–a shows the minimum ridge formation which will satisfy the requirement of "sufficient recurve." It will be noted that the one-loop type ridge turns under the core and cuts at right angles the imaginary line representing the axis of the loop. This pattern is still a plain loop, however, inasmuch as there is no second delta. In this case the second recurve is a sufficient recurve and if a second delta were present the pattern would be a central pocket loop.



In figure 56 is another approximating pattern. This also bears the plain loop designation due to the lack of a second delta.

In figure 57 are found the minimum requirements of the central pocket loop. Here both the second recurve and second delta are present. Both elements are essential to the central pocket loop. Reference is made, however, to a common type of pattern which shows ridges not to be confused with the essential recurves. This pattern which is a plain loop is illustrated in figure 58. The converging ridges lend an appearance of a second delta but no real recurves are present. A test to be applied to distinguish the loops from central pockets is to point an imaginary arrow toward the core of the pattern (in a whorl, the "brow" of the innermost recurve) and if this arrow strikes an obstruction squarely, a central pocket exists. The arrow does not so strike in figure 58.

Another ridge arrangement not to be confused with the essential recurve is shown in figure 59. This also is a plain loop, as the ridges are all connected.



THE PLAIN WHORL

The plain whorl is a pattern of ridges which form at least 1 complete circuit and 2 deltas. See figure 60. Minimum requirements of the plain whorl are illustrated in the two lower prints in figure 60. They may be spiral, oval, circular, or have some other variant of a circle.

THE DOUBLE LOOP

The double-loop pattern is defined as one which contains two separate loops and two deltas. In smaller files no distinction need be made between the various types of whorls. However, the distinctions made by the Bureau have been devised for reference and use, if necessary. In distinguishing between the double loop, plain whorl, and central pocket loop types consideration must be given to the meaning of the word "separate" as it refers to the loops. The word "separate" here means that both shoulders of each loop must be free from the shoulders of the other loop. In this connection the mere fact that an additional ridge may connect one side of one loop to a side of the other does not prevent the pattern from being a double loop. The only requirement is that both shoulders of each loop be free from attachment to the shoulders of the other loop. Figures 61 and 62 illustrate the double loop.



If the shoulders themselves are free from each other, the fact that an additional ridge connects them does not interfere with their classification as double loops. Figure 63 illustrates such a double loop.



It is not essential that both sides of each loop be of equal length. As long as both loops show complete shoulders on each side as in figure 64 the pattern is classified as a double loop.



THE ACCIDENTAL

The accidental type is one which contains two or more different patterns. It is a combination of either loop and tented arch, loop and exceptional arch, loop and whorl, loop and central pocket loop, double loop and central pocket loop, or other such combinations. It also includes those unusual patterns which may not be placed by definition into other classifications. Several accidentals are illustrated in figures 65 and 66. Accidentals often possess three deltas. In tracing them, the extreme deltas only are considered, the tracing beginning at the extreme left and proceeding toward the extreme right delta until the character of the tracing is determined.

Certain patterns may be found which contain ridges conforming to the definitions of more than one of the patterns described. In such



cases the order of preference (if any practical distinction need be made) should be: 1, Accidental; 2, double loop; 3, central pocket loop; 4, plain whorl.

Figure 67 illustates a pattern which shows the characteristic two loops of the double loop type. The pattern also satisfies the technical requirements of the central pocket loop. It is to be classified according to the order of preference as a double loop.





WHORL TRACING

The technique of whorl tracing depends upon the establishing of the two focal points—the deltas. When both points have been located the ridge emanating from the lower side or point of the left delta is traced toward the right delta until the point opposite or



nearest the right delta is reached. The number of ridges between this point and the right delta are then counted. If the ridge tracing passes inside (to the left) of the right delta and three or more ridges intervene between the ridge traced and the right delta the tracing



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is designated as an "Inner tracing "—I. See figure 68. If the ridge traced passes outside (below) the right delta and three or more ridges intervene between the ridge traced and the right delta the tracing is designated as an "Outer tracing "—O. See figure 69. All other tracings are designated "Meeting "—M. See figure 70.

Certain questions have arisen as to the procedure to be followed in questionable ridge tracings.

Point of delta.—Tracing begins at the point of the left delta. See figure 71. In no instance is a tracing to begin on a type line. In



figure 72 tracing begins at the short ridge which is the left delta. It is true that inasmuch as the short ridge ends immediately the type line is next followed, but this is only because the type line is the next



lower line. Its status as a type line is independent and has no bearing on the fact that it is being traced.

This point is illustrated further in figure 73. This pattern shows an inner tracing. It will be noted that the point of delta at the left is that point on the first recurve nearest to the center of the divergence of the type lines, the "obstruction" cited when the delta was explained.

It will be noted further that tracing begins at the point of delta on the left and continues toward the right passing inside of the right delta and that three ridges intervene between the ridge traced and the right delta. This shows the tracing to be an inner tracing. If the type line were traced (which would be the incorrect procedure) only two ridges would intervene between the line traced and the right delta, resulting in an erroneous meeting tracing. Figure 74 presents an interesting example of the application of this rule. This illustration shows an inner tracing.

<u>Ridge endings.</u>—When the ridge traced ends abruptly, and it is determined that the ridge definitely ends, the next lower line is traced from the point immediately below the point at which the ridge previously traced ended. The tracing therefore when the ridge definitely ends is dropped to the next lower line. See figure 75, which shows a meeting tracing. In this connection it should be

observed that the rule for dropping to the next lower line applies only when the ridge definitely ends. Short breaks in a ridge which may be due to improper inking, the presence of foreign matter on the ridges, enlarged pores, or worn ridges should not be considered as definite ridge endings. The determination of what constitutes a definite ending will depend, of course, upon the good judgment of the classifier. Figure 76 shows an inner tracing in which the ridge



traced shows several small breaks in the ridge which are of the type caused by disease or wear. When the question arises as to whether a break encountered in the ridge tracing is a definite ending or whether there has been an interference with a natural impression, the whole pattern should be examined to ascertain whether breaks



are general throughout the pattern. If they are found to be common, consideration should then be given to the possibility that the break is not a definite ridge ending. Appropriate reference tracing should be done in all such cases.

Bifurcations.—Whenever the ridge traced bifurcates, the rule for tracing requires that the lower limb proceeding from the bifurcation be followed. This is illustrated in figure 77.

CLASSIFICATION RULES

It is not intended to cover in this treatise the more detailed extension developments. The procedure and rules pertaining to that subject are published by the Federal Bureau of Investigation in the pamphlet entitled "Modification and Extension of the Henry System of Identification", which covers the more complex subdivisions. This pamphlet will be furnished to any law-enforcement officer upon request.

It should be recalled that when using fingerprints for identification purposes in a filing system, it is necessary to maintain an accurate arrangement in each case or segregation of the prints according to their characteristics so records received subsequently may be searched or compared with those in the files without regard to name or descriptive data. Generally, the interpretations accorded to the patterns as hereinbefore explained and the classification rules which follow are based upon the system originally devised by Sir E. R. Henry.

THE PRIMARY CLASSIFICATION

There appears on page 35 a regular fingerprint card with certain numerical values appearing in the fingers of this chart. It should be observed that the first 2 fingers are given a numerical value of 16 each, the next 2 fingers a value of 8 each, the next 2 a value of 4 each, the next 2 a value of 2 each, and the next 2 a value of 1 each. It should be observed also that fingers 2, 4, 6, 8, and 10 contain the letter N, indicating that the values of these even-numbered fingers relate to the numerator column, whereas the uneven fingers of 1, 3, 5, 7, and 9 relate to the denominator column.

On the fingerprint card shown below, it will be noted that the primary classification, 9 over 1, is derived by ascertaining that there is only one whorl appearing in the numerator, and that appears in the right ring finger, which gives the numerator the value of 8, and then by adding 1, which is arbitrarily assigned, 9 is obtained for the numerator. As there are no whorls in the denominator, 1, which is arbitrarily assigned, is given, thereby attaining 9 over 1 as the primary classification.

To attain the primary classification, a print which is to be classified is first examined to determine the fingers in which the whorls appear. If no whorl appears anywhere on the card, a primary classification of 1 over 1 is arbitrarily assigned. When we speak of the word

"whorl" here, we mean all types of whorls, including the plain whorls, the central pocket loops, the dual loops, and the accidentals. We mean also inner, meeting, and outer whorls. To repeat, if no whorl appears on a fingerprint card, a primary classification of 1 over 1 is given arbitrarily. If one whorl appears, the value of the finger in which the whorl is located is used in the attainment of the primary and to this value, for consistency,



there is always added the 1 over 1 value assigned to a nowhorl group. This primary classification may appear to be complex to the novice in fingerprint work. It requires rather close study and thought and can be learned best by illustrations. For example, let us assume that there is a whorl only in the right index finger. The value of this finger is always 16. The 1 over 1 is added to this value carried forward to the numerator line or column, resulting in a primary classification of 17 over 1. If a whorl appears in the

right thumb and right index finger, the primary classification is 16 over 16, plus 1 over 1, or 17 over 17. If whorls appear in both index fingers, the primary is 16 over 2, plus 1 over 1, or 17 over 3. If whorls appear in both thumbs and both index fingers, the primary is 21 over 19; i. e., 16 plus 4, plus 1 over 16 plus 2, plus 1. If whorls appear in all fingers, the primary is 16 plus 8, plus 4, plus 2, plus 1, plus 1, or 32 for the numerator over the same digits for the denominator. In other words, the primary can extend from 1 over 1, the no-whorl group to the 32 over 32, the all-whorl group.

There are 1,024 primary classifications from the 1 over 1 group to the 32 over 32 group. It should be noted here that the primary classification tells the expert the fingers in which whorls do appear and by the same token because of the arrangement of the values given to fingers solely for the purpose of determining the primary, it tells him fingers in which whorls do not appear. In other words, for example, a primary of 5 over 17 could mean only one thing and that would be whorls in both thumbs.

It has been stated that there are 1,024 possible primary classifications. This does not mean that there are 1,024 even subdivisions of prints according to these primaries. The contrary is true. Just as there are a preponderance of loops when the types of prints are considered, so there are a preponderance of certain primaries, notably 1 over 1 or no-whorl group, the 17 numerator and the 32 denominator groups. As a matter of fact in the 1 over 1 group alone, there usually would be found about 18 percent of the total number of fingerprints in any identification bureau. This condition exists because the fingerprint records in which whorls do not appear in any finger are quite frequent. On the other hand, there are a number of very unusual primaries which are rarely seen. It follows, therefore, that when the operative is classifying a print in the 1 over 1 group where he is dealing with all loops, he must extend or complete the classification much more thoroughly and bring it up to component parts which he would not have to consider in connection with a smaller group. This same theory should represent the underlying thought in the attainment of any classification; that is, the classification should be regarded in a sensible light and extended only insofar as the needs of the group concerned may require. The successful application of this thought sometimes is the measure of the efficiency of the fingerprint bureau.

THE SECONDARY CLASSIFICATION

Even in the smaller collections of fingerprints, it will be found that the groups which are arranged under the individual primaries filed in sequence from the 1 over 1 to the 32 over 32 combination will be too voluminous to permit expeditious searching. Reference has just been made to the sequence in the filing of fingerprints. This is an all-important subject. The sequence must be arranged properly at all times to provide for most accurate work. In the primary classification the denominator remains constant until all numerator figures have been exhausted through the figure 32. To illustrate, all prints containing a primary of 1 over 1 are filed together. These are followed by 2 over 1, 3 over 1, 4 over 1, and so on until 32 over 1 is attained. Next in filing order would be found the prints bearing the 2 denominators; that is, 1 over 2, 2 over 2, and so on. Eventually, through the use of each denominator figure, the expert will find that he is filing the 32 denominators, such as 1 over 32, 2 over 32, 3 over 32, until 32 over 32, the highest possible primary is reached. As indicated, however, these groups do not provide adequate subdivisions even for the smaller files.

After the primary classification, therefore, the fingerprints are further subdivided by the secondary. Before explaining the secondary further it should be noted that after the primary is attained the entire remaining portion of the classification is based upon the arrangement of the impressions on the cards according to right hand over left hand. The arrangement of the even over the uneven fingers is discarded after the primary has been attained. The secondary appears in the classification line to the right of the fractional figures which represent the primary. It is shown in the formula by capital letters representing the basic types of patterns appearing in the index fingers of each hand; the right hand for the numerator and the left hand for the denominator. If arches appear in the index fingers, the capital letters A are used; if tended arches, T; if radial loops, R; if ulnar loops, U; and if whorls, W. Of course, in many instances various combinations would be attained, such as A over A, T over R, U over W, W over U, and so on. The sequence of the secondary classification is explained in the modification and extension to the Henry system issued by the Bureau. It should be noted that the letter appearing in the secondary classification column indicates the basic type of pattern and not any subdivision of that type, such as I, M or O. It should be noted also that under the Henry system where whorls of any species appeared in the index fingers they were not represented in the secondary classification formula because the primary classification upon analysis reflected that whorl types appeared in such fingers. However, in the Federal Bureau of Investigation where it has become necessary to use the whorls for extensive subdivisions, the Henry rule has been modified and these patterns are entered in the secondary classification the same as any others. It is recommended that the officers studying this

treatise classify several sets of fingerprints through the primary and secondary. At this point it is desired to mention that when the operative is classifying impressions, markings are indicated at the bottom of each of the ten characteristics to reflect the type of each pattern. The ridge counts or tracings then are entered on the top of each of the 10 blocks where loops or whorls appear.



In the method of deriving the secondary classification of U over R in the chart shown above, it will be noted that the right index finger is an ulnar loop, while the left index finger is a radial loop, thereby making the secondary classification an ulnar over radial, or U over R.

SECONDARY CLASSIFICATION

(Small letter group)

When arches, tented arches, or radial loops appear in any finger or fingers other than the index, they are designated by the small letters a, t, or r brought up into the classification formula in their proper relative positions immediately adjacent to the secondaries. Under the Henry system these small letters are brought up only in the 1 over 1 groups. However, in the Federal Bureau of Investigation, they are used in conjunction with the secondary in the case of each primary and they appear as small letters adjacent to the secondary on the right or left of the secondary, dependent upon the fingers where they occur. Thus, if a radial loop would appear in the right thumb, the small letter r would be brought up in the numerator column of the classification and placed just to the left of the capital letter representing the secondary. Similarly, if an arch or a tented arch or a radial loop would appear in the middle, ring, or little finger of the hand the small letter representing any of these characteristics would be brought into the classification line and placed to the right of the secondary, in the numerator column if in the right hand and the denominator column if in the left hand. If two or more of these small letter patterns appear they are so indicated, as for example 1 rU2aThe so-called small-letter groups, indicated as small letters 1 IIm.

because they are actually brought up in the classification line whenever they are found in their proper relative positions, are of importance in the classification scheme. It is recalled that the arches, tented arches, and radial loops are of relatively infrequent occurrence. Generally speaking, where they occur, since they are of such rare occurrence, their very presence enables the classifier to dispense with the usual subsecondary classification and the major division, which are used in the larger files. In a sense, the small letters themselves act in lieu of the subsecondaries to take the place of such extensions. The filing order for these patterns also is indicated in the Bureau's modification and extension.

On the fingerprint chart shown on the next page, it will be noted that the secondary classification is T over Ra. The secondary is obtained by determining that the right index finger is a tented arch and that the left index finger is a radial loop, thereby making it T over R. In conformity with the rules mentioned above, the arch pattern, which appears in the left middle finger, is brought up in the classification adjacent to the secondary, thereby making it T over Ra.

THE SUBSECONDARY CLASSIFICATION

(Groupings of loops and whorls)

In most groups or collections of prints it is necessary to further divide the secondary groups. This is accomplished by ridge countings in loops or ridge tracings in whorls. The first of the groups filed in order which it will be necessary to so subdivide usually will be the $\frac{1}{1}\frac{R}{R}$ arrangement where no small letters appear. Under the Henry system of classification the subsecondary depended on the number of ridges intervening between the delta and core in the loops of the index and middle fingers of both hands only in the groups of prints in which the index and middle fingers were paired; that is, of the same pattern. For example, under the Henry system only the index finger would be



considered for the attainment of the subsecondary if the middle finger proved to be of a type different from that appearing in the index finger. However, this subdivision under the basic Henry, as it is commonly called, has been extended generally by the Bureau to include the counts in the loops of the ring fingers as well as in the index and middle fingers. Of course, if the middle or ring fingers were radial loops, and not ulnar loops, the radial loop would be shown by a small letter r which would act in lieu of a subsecondary. This portion of the classification, which is generally known as a subsecondary, appears

on the classification line to the right of the secondary after a space has been skipped, taking the forms of the capital letters I and O, representing groupings of inner and outer counts for the loop types. In the capital letters I, M, and O, they represent inner, meet, and outer ridge tracings in the whorl types. It is noted here that the groups falling within the attained whorl tracings also are used for the subsecondary classifications when whorls are involved. It is noted again that the intervening ridges are counted between the deltas and the cores in loops and traced from left delta to right (deltas), always in whorls.

When counting the ridges in the loops, if the number of ridges intervening is from 1 to 9, inclusive, in the index fingers, the loop is designated as an inner and the capital letter I is brought up in the classification line in the numerator for the right hand and the denominator for the left. If the count is over 9 in the index finger, the pattern is designated as an outer and the capital letter O is similarly brought up. In the middle fingers the count for the inner is from 1 to 10, inclusive, and in the ring finger from 1 to 13, inclusive. Any fingers showing ridge counts of over 10 in the middle fingers or over 13 in the ring fingers are considered as outers, designated by O. A loop subsecondary, for example, would be $\frac{OII}{IOO}$. Analyzing this subsecondary, the expert would know that in the index, middle, and ring fingers of the right hand he had counts of over 9 ridges, under 11, and under 14 ridges, while in the left hand he had counts in the index, middle, and ring fingers of under 10 ridges, over 10 ridges, and over 13 ridges, respectively. The subsecondary classification, therefore, relates to the groupings of the prints when the loops are concerned. At first the operative may experience some difficulty in knowing whether the I and O arrangement in the subsecondary relates to loops or whorls when he is analyzing a classification. However, if he will consider the fact that the primary itself indicates fingers in which whorls appear, he should have no difficulty in determining the correct arrangement.

Proceeding now to the groupings of whorls for the subsecondary, it is observed that under the original classification systems the tracings were brought up only where the whorls were paired in the index and middle fingers. However, where the files so necessitate, it is entirely proper to bring up the whorl tracings in the index, middle, and ring fingers of both hands where whorls are present. If there is a combination of loops and whorls the types of patterns appearing are considered and then there are entered in the subclassification formula the proper symbols to indicate whorl tracings or loop counts in combinations. For example, let us assume that we are considering a fingerprint card having only one whorl, a meet, which appears in the index finger of the right hand, and that all other patterns are ulnar loops. In the numerator column of the subsecondary there would be entered the letter M, indicating a meeting whorl in the right index finger, and following the letter M there would be entered immediately an O and an I, indicating an ulnar loop of over 10 ridge counts in the middle finger and an ulnar loop of less than 14 ridge counts in the ring finger. In this connection the Federal Bureau of Investigation desires to point out specifically that in the smaller



files the subsecondary classifications should not be extended to their full scope. It is believed that greater efficiency can be attained if the patterns of the index and middle fingers only are considered and then brought up only if they are paired. To attempt to extend files unnecessarily, frequently results in error and in confusion in the filing arrangements.

On the fingerprint chart shown above, it will be noted that the subsecondary classification is *IOI* over *IOO*. This classification is

derived as explained above. Also see next chart, which contains information as to whether the pattern is an inner or outer.

THE MAJOR DIVISION

It is desired to point out initially that the major division probably would not be required in any collection of prints except possibly in certain 1 over 1 groupings until the said collection had reached about 300,000 cards. Where necessary then the major division may be applied. It is similar in its application to the subsecondary classification although it pertains only to the thumbs. Where whorls appear in the thumbs the major division (which is written always immediately before the primary) designates the whorl tracing. For example, a major division of I over M in the case of a primary classification of 5 over 17 would reflect definitely an inner whorl over a meeting whorl in the right thumb over the left thumb. Where loops occur in the thumbs a table is utilized in determining whether the said loops fall within the small, medium, or large size groups. An expanding table is applied to the right thumb where large loops occur in the left thumb. For the convenience of the reader there appears below a chart indicating the subsecondary table and also the major division table to be used only in the case of loops. It is desired to point out at this time that the changing or increasing counts appearing in the index, middle, and ring fingers in the subsecondary and in the expanded table for the major division are employed because such counts afford a more equitable distribution of prints within the groups indicated for filing purposes. This chart should be studied carefully.

On the fingerprint card shown on page 45, the major classification of S over M is obtained by counting the ridge counts in the right thumb, 9 counts, and according to the chart shown on page 44, 9 counts will fall in the S group, while in the left thumb it appears there are 12 ridges, thus falling in the M group.

THE FINAL CLASSIFICATION

It is, of course, desirable to have a definite sequence or order of filing the prints even where the subdivided groups appear. This order is attained through the use of the final which is based upon the attainment of the ridge count of the loop in the right little finger and the indication of that count at the extreme right of the numerator in the classification column. If a loop does not appear in the right little finger, the left little finger may be used for the count which then would show in the denominator column. If no loop appears in either of the little fingers then the ridges of the whorl in the right

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$ \frac{1N}{RIGHT} \begin{cases} 1 - 17 = S \\ 18 - 22 = M \\ 23 \text{ AND OVER } = L \end{cases} $					
		LEFT	HAND		
І. Тнимв	2. INDEX FINGER	3. MIDDLE FINGER		4. RING FINGER	5. LITTLE FINGER
1 - 11 = S 12 - 16 = M 17and over = 026	- 9 = I 0 and over = 0	- 0 = I and over = 0		1- 13 = I 14 and over = 0	
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LEFT HAND		L. THUMB	R. THUMB	RIGHT HAND	

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CLASSIFICATION OF FINGERPRINTS

little finger may be counted from the left delta to the core and used as a final. Of course, the ridge counts of the whorl would be required only in dealing with a large collection as loops usually appear in either the right or the left little finger. All prints appearing in a designated primary, secondary, and subsecondary group are then arranged in numerical sequence according to the final number. For example, let us assume that there are 15 prints having a final of 14



in a 10 ulnar loop group. These all would be arranged together to be followed by prints having a final of 15 and so on.

The fingerprint chart shown below shows there are 17 ridge counts in the right little finger, and the 17 is placed in the numerator space, while if there were no loop in the right little finger and there was one appearing in the left little finger, the number of ridges in the left finger would be counted, and then be placed in the denominator of the classification.

THE KEY

If the group of prints becomes so large that too many are found filed which have the same final, the said prints may be arranged in numerical sequence by the use of a key, which in the Federal Bureau of Investigation is the result of the ridge counting of the first loop appearing in a set of prints, the little fingers excepted, and which is placed on the classification line as a number at the extreme left of



the formula. This key may be considered as a control figure for filing and also in the searching of prints. It limits the necessity of the searching procedure to apply only to prints having counts closely related to it.

From the chart shown above, it will be noted that 9 is the key count and that it is obtained by counting the ridges in the first loop which appears on the fingerprint card, exclusive of the little fingers. and in this particular chart it will be noted that the first loop appears in the right thumb.

There is set out below a completed classification in a 10 ulnar loop group. This classification is illustrated in order that the arrangement of the various symbols may be studied.

Key	Major division	Primary classifica- tion	Secondary classifica- tion	Subsec- ondary classifica- tion	Final
9	$\frac{S}{M}$	$\frac{1}{1}$	$\frac{U}{U}$	$\frac{IOI}{OOI}$	14

GENERAL

In actual practice the operative does not conduct searches of fingerprints according to the exact final and key or even to the exact subdivision concerned. Generally speaking, it is necessary to search a fingerprint card two counts above and below the final attained. This action is taken as a precaution against any error which may have occurred in the counting of the final either because of visual misinterpretation or the presence of poor and not completely legible prints being handled currently or in the files. It is desired to point out that any apparently necessary "reference" search should be conducted by the thorough operative. In the Federal Bureau of Investigation, for example, all border-line cases in the subsecondary and major divisions are referenced to the various combinations in which they possibly would be found. Similarly, all transitional or doubtful patterns are referenced to their proper possible combinations. While it is a fact that referencing is a general practice and is needed in the proper conduct of any fingerprint bureau, the Federal Bureau of Investigation has endeavored to outline definite rules in order to dispense with the necessity of any unnecessary references and at the same time has endeavored to adapt for its technical employees instructions which are as mechanical or definite as is possible of attainment. Every fingerprint operative should, of course, endeavor to adhere to a standardized interpretation rule. Consistency in fingerprint interpretations frequently is the measure of success in this work. The Federal Bureau of Investigation will be glad to answer any questions which the recipients of this treatise may desire to direct to the Bureau in an endeavor to clarify possible questions of doubt.

When the fingerprint expert is searching the current print through the fingerprint files in order to make an identification, he will fix in mind from the current print some outstanding characteristics and when searching the fingerprints on file, he will look for these same characteristics. When he does find a fingerprint card in the files with a characteristic resembling that on the current print, he will examine the prints closely to determine whether they are identical. The characteristics which the searcher will generally seek are patterns which contain short ending ridges, or bifurcations, or islands. By detecting such characteristics as these, the searcher is able to make quick identifications.