SCOTT'S

Fingerprint Mechanics

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By

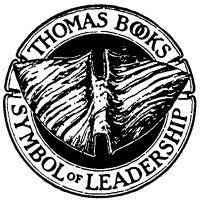
ROBERT D. OLSEN, SR.

Special Agent in Charge
Latent Fingerprint Division
United States Army
Criminal Investigation Laboratory
Fort Gordon, Georgia

With a Foreword by

WALTER R. SCOTT

Retired Lieutenant in Charge
Criminal and Photographic Laboratory Division
Police Department
San Diego, California



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To
Law Enforcement Officers
and
Their Profession

Foreword

THE WORD *fingerprint* brings to mind two concepts: (1) the presence of natural ridge patterns on the skin of the undersides of the tips of the fingers and (2) the reproduction of those ridge patterns for purposes of visibility and identity.

Nature has supplied an abundance of ridges with unlimited variations on the skin of the fingers, and it is a recognized fact that no two fingers bear identical ridge patterns. These facts make it possible to use the ridge patterns for easy, simple, and positive identification.

The pages of this book are intended to describe and illustrate the various methods and techniques which have been found applicable and effective in recovering or reproducing latent finger impressions, as well as to identify the person whose finger made the impression.

Included in the text at the end of each chapter is supplemental classroom instructional material in the form of true-false questions and completion sentences to place additional emphasis on points covered in the text.

Walter R. Scott
San Diego, California

Preface

Fingerprint Mechanics, written by Lieutenant Walter R. Scott of the San Diego Police Department, was published in 1951, by Charles C Thomas, Publisher. The book has been acknowledged as one of the most outstanding texts pertaining to fingerprinting that has ever been published. In 1971, a reviewer made the following statement about the book: "*Fingerprint Mechanics* is a well-written, easy-to-understand 'how to' and 'why' book. The author tells it like it is without useless and non-productive theory." Mr. Scott's book gained wide recognition because it was practical and provided the information essential to good fingerprint work.

It is a great responsibility to write a revision of a book which has been long recognized as a classic in its field. Considerable revision has been made because of the development of new and improved techniques and equipment in the intervening twenty-six years, but, hopefully, the same practical approach has been maintained.

The purpose of this book is to provide the basic knowledge of fingerprint identification and latent fingerprint techniques necessary to recover latent prints at crime scenes. Everyone, from the first officer on the crime scene to the prosecutor in court, must be conscious of the value of fingerprint evidence. Physical evidence has become increasingly important in our criminal justice system. Fingerprint evidence must be considered as having particular significance, because it can positively establish the identity of a specific individual in a case.

Regarding physical evidence, the most important person in any investigation is the officer at the crime scene responsible for collecting and preserving the physical evidence. It is hoped that all investigators, those just beginning their careers as well as experienced investigators, will find the material in this book of value

in their daily activities. Some of the latent fingerprint techniques listed are experimental today, but twenty-six years ago many techniques now commonly in use were not even dreamed of.

R.D.O.

Acknowledgments

THIS BOOK is a product of the accumulative experience of thousands of investigators, police officers, and laboratory personnel, as reflected in professional and technical journals. Students and investigators who wish to increase their knowledge of fingerprint identification and to keep abreast of new developments should subscribe regularly to professional and technical journals pertaining to forensic science. Each new generation of investigators is fortunate to have the collective knowledge of previous generations of investigators at its disposal in the available technical literature.

I have received much help and kindness during the writing of this book, and I wish it were possible to acknowledge everyone who has graciously contributed to it. However, only a partial listing is possible. Much information was gained from informal conversations with many members of the American Academy of Forensic Sciences and the International Association for Identification. I am grateful to all those who have shared their knowledge and experiences with me.

I am especially indebted to Mr. Walter Scott and Mr. Payne Thomas for the opportunity to write this revised edition of Mr. Scott's book. I am deeply indebted to Andrew J. Brooks, Jr., of the Chicago Police Department, who has contributed immeasurably to this book. Andy's assistance has been indispensable.

I am much indebted to the following for the use of copyright material: R. E. Stockdale, editor of the *Journal of the Forensic Science Society* (P.O. Box 41, Harrogate, North Yorkshire, England HG1 2LF), for permission to reprint the article appearing in Section 107, and Michael A. Prieto, CAREERCO Institute of Applied Science and James A. Roberts, San Diego Police Department (retired), for permission to reprint the article appearing in Section 132. It is particularly gratifying to have a contribu-

tion by Mr. Roberts, as he and the San Diego Police Department were involved in the preparation of the original text by Mr. Scott.

I gratefully acknowledge the assistance of the following personnel of the U.S. Army Criminal Investigation Laboratory System: Charles E. Cooper, Gideon Epstein, Curtis L. Flood, Larry L. Flinn, Edward R. German, Roy E. Haas, Ernest D. Hamm, Kenneth J. Hoag, Paul E. Llewellyn, Jr., Edward B. Mizelle, Paul M. Norkus, Harold V. Page, Daniel W. Smith, Jr., Paul F. Spangler, James H. Stopper II, Thomas J. Tomich, Jr., Ralph T. Turbyfill, Arthur J. Varriale, and John C. Wilson.

I owe a particular debt of gratitude to my wife, Pamela, without whose assistance as reviewer, typist, and critic, this book could not have been written. I am also grateful to my children, Malcolm, Robby, Pam, and Beth, who donated much of their time with their father in order that he may write this book.

R.D.O.

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SCOTT'S

Fingerprint Mechanics

Chapter I

Fingerprint Identification

1

WHAT ARE FINGERPRINTS?

FINGERPRINTS are the most positive means of identifying individuals. Of all the methods of identification, fingerprinting alone has proved to be both infallible and practical. Fingerprint identification is best known to the general public for its application in criminal investigations; however, that is only one aspect of its usage. Fingerprinting may also provide the means for positive identification of deceased persons and disaster victims in cases where injury or other circumstances preclude visual identification. Footprinting of infants may assist in the identification of babies when parents claim errors in hospital maternity wards. Fingerprints on documents may assist in establishing the authenticity of the documents in civil actions.

Fingerprints are impressions made by the end joints of the fingers and, therefore, are reversed reproductions of the skin surface details. The palmar surfaces of the hands and the plantar surfaces of the feet have ridged skin formations called *papillary* or *friction ridges.* The characteristics and their position and relationship to each other vary from person to person and even between fingers on the same hand.

Fingerprints are permanent. The papillary ridges of the hands and feet form on the fetus before birth and, except for size, remain unchanged throughout life and even after death, until decomposition of the skin destroys them. Injury and disease may damage or alter the ridges, but only if the underlying dermis is damaged and even then not normally to the extent of preventing identification.

Fingerprint evidence is fragile. Fingerprint evidence is perhaps the most sought-after evidence encountered in criminal investigations. It is evidence of the most delicate nature; it is highly destructible; it may be cleverly developed, improved, and intensified, or just as easily destroyed. Success in recovering fingerprint evidence depends not only on the equipment used, but

upon the experience, imagination, interest, knowledge, skill, and versatility of the person working with the evidence.

A fingerprint technician must know which method is best in each situation as it arises and what technique to apply and when. The technician must be quick to recognize the point at which a latent print is developed to its peak, so that it will not be inadvertently or unwittingly destroyed.

The first officer at a crime scene must be *fingerprint conscious.* That officer must have knowledge of the value and possibilities of fingerprint evidence if it is to be preserved and protected for investigators who follow.

Every fingerprint technician who has developed latent fingerprints has most likely experienced the misfortune depicted in Figure 1. Good latents are easily brushed away. A valuable lesson is learned when this happens; the technician's attitude toward latent prints is more respectful thereafter. Experience is a good teacher—with fingerprint evidence it is the best.

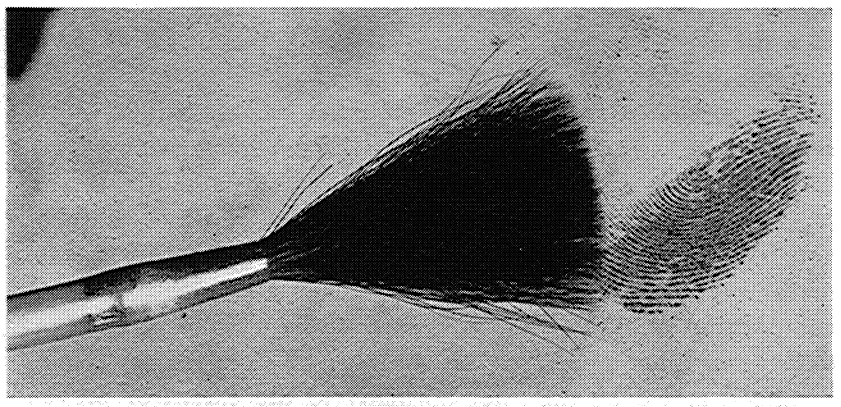

Figure 1. Fingerprint evidence is the most common type of physical evidence encountered in criminal investigations. It is extremely delicate: It may be improved or intensified, or it may be brushed away.

2

THE PAPILLARY SYSTEM

The *papillary* system of glands, ducts, ridges, and pores evolved perhaps because of the necessity of increasing friction where it was most needed, on the palms of the hands and the soles of the feet. The ridges of the palmar and plantar surfaces are commonly referred to as *papillary* or *friction* ridges. The word *papillary* is derived from *papilla* meaning a small, elongated, nipple-shaped protuberance, as the papillae of the tongue, or in this instance, the protuberances of the dermis forming the ridges of the skin on the fingers, palms of the hands, and soles of the feet.

A dry, hard, smooth, ridgeless skin surface affords little or no friction, whereas skin elevated into ridges continuously moistened by glandular activity affords maximum natural friction. Friction ridges make it possible for the fingers and palms to hold objects; they increase the friction between the skin and the object handled; they make for better contact. Without the moistened friction ridges, it would be difficult to pick up or hold light objects. Friction ridges are found on the palmar and plantar skin surfaces of all primates.

Friction ridges begin to form on the human fetus during the third and fourth months of fetal life, when the fetus is at least 90 mm in sitting height (Miller, 1968). The ridges begin as raised apertures around the pores and then are joined together into rows forming the ridges. The pores may open anywhere across the ridge surface, but they are most often found near the midline. A pore near the edge is the exception. Pores may also open on the skin surface apart from the ridges, with only a single raised aperture. A single pore appears as a dot in a fingerprint. In some instances, only two or three pore apertures may fuse together, forming a short ridge.

Pores are the openings of the sweat gland ducts and number about 2,700 per square inch on the palmar and plantar surfaces

of the body. The depressions between the ridges are called *furrows.* They appear in an inked fingerprint as the white or blank spaces between the lines made by the ridges. Figure 2 is a diagrammatic sketch of a cross section of a friction ridge. The furrows are the sloping edges on either side of the ridge which, as a rule, are flat.

When the skin is damaged to the extent that both the epidermis and the dermis are disturbed, a permanent scar may result with attendant alteration of the ridges involved. A permanent scar may be recognized in a fingerprint by the characteris-

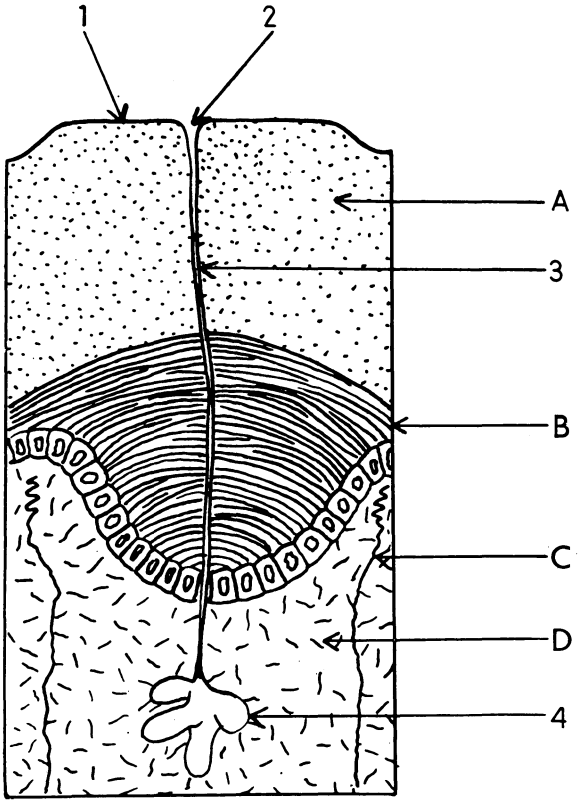

Figure 2. Diagrammatic sketch of a section of skin. Papillary system: (1) ridge surface, (2) pore, (3) duct, and (4) sweat gland. Papillary skin: (A) epidermis, (B) stratum mucosum, (C) nerve, and (D) dermis.

tic curl or puckering of the ridge endings on either side of the scar. The ridge endings on either side of a temporary scar or crease end abruptly and are straight, with the ridge endings pointing toward the continuation of the ridges on the other side of the temporary scar or crease. Scars provide additional and valuable means of identification. They may have a bearing on classification, depending upon the extent of damage to the ridges and to the pattern area upon which classification is based.

3

FRICTION RIDGES ARE THE BASIS OF IDENTIFICATION

The friction ridges of the fingers form patterns divided or classified into three major groups of patterns: arches, loops, and whorls. About 60 percent of all fingerprint patterns are loops, 35 percent whorls, and 5 percent arches. Classification of fingerprints by pattern types is only one stage in the process of identification. Pattern types are class characteristics, as all fingerprints within a particular pattern-type grouping meet the classification requirements for that group.

Positive identification, or elimination, of fingerprints is dependent upon the individual ridge characteristics in a fingerprint, their relative position to each other, and whether or not there are any dissimilar characteristics that cannot be explained. Figure 3 is a line-drawing sketch of the different types of individual ridge characteristics upon which an identification may be based.

There is no common agreement among authorities in the field of fingerprint identification of the different types of ridge characteristics or their terminology. The Standardization Committee of the International Association for Identification recommended that only five types of ridge characteristics be accepted as standard: ridge endings, bifurcations, short ridges, enclosures, and islands (dots). Osterburg (1964) recommends ten types of ridge characteristics which, in addition to the aforementioned, are: deltas, bridges, double bifurcations, trifurcations, and spurs

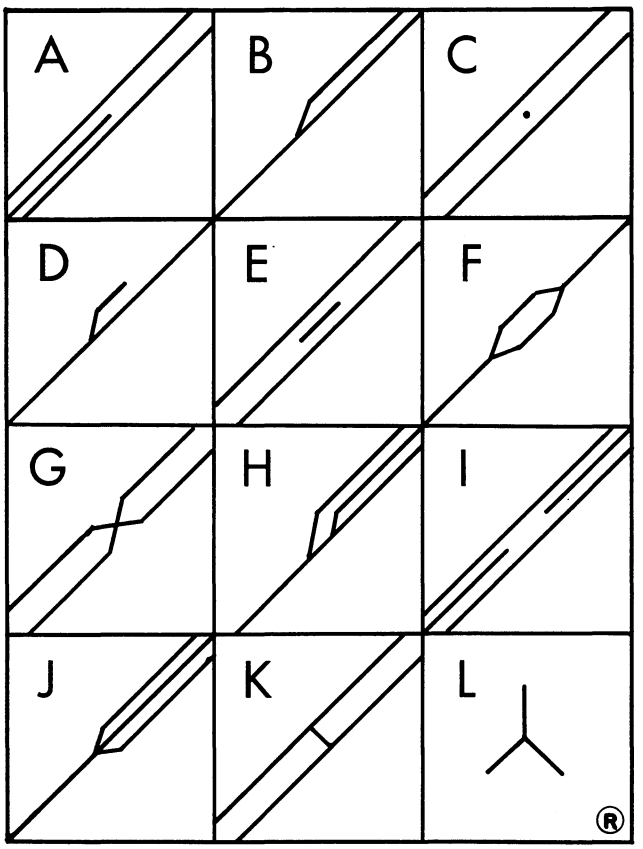

Figure 3. Schematic representation of friction ridge characteristics. (A) ridge ending, (B) bifurcation, (C) dot, (D) spur, (E) short ridge, (F) enclosure, (G) ridge crossing, (H) double bifurcation, (I) ridge break, (J) trifurcation, (K) bridge, and (L) triradius.

(hooks). Others may wish to include prominently diverging ridges, recurving ridges, and incipient, or nascent, ridges as additional types of ridge characteristics.

Basically, there are only three types of ridge characteristics; all other characteristics are combinations of one or more of these three basic types. The three basic types of ridge characteristics are ridge endings, bifurcations, and dots. Thus, a short ridge is two ridge endings, and a spur is a bifurcation and a ridge ending. However, a spur is certainly more uncommon than either a

ridge ending or a bifurcation. Consideration must be given to characteristics that are less common than others.

The terminology for the different ridge characteristics is as varied as the choice of types of characteristics. One fingerprint examiner may call a ridge that splits into two ridges a bifurcation, while another may term that particular characteristic a forking ridge. The differences of opinion regarding the types and terminology of ridge characteristics need not be a matter of any great concern. The resulting conclusion of whether or not a particular print was made by a specific individual is the same, regardless of terminology or definitions of type of characteristics. Essentially, all characteristics, including scars and creases, which appear consistently from one fingerprint to another made by the same finger may be used for identification.

4

EVERY FINGER BEARS ITS OWN TRADEMARK

Each of the ten fingers on every person's hands bears its own individual and distinctive trademark in its ridge pattern and characteristics. No two leaves on a tree are found to be exactly identical in every detail, and no two fingers have ever been found identical in their ridge patterns and characteristics. The basis for this fact may be found in the principle of biological variation, proposed by Charles Darwin, that no two living things are ever exactly alike. This principle is supported by the science of statistics and theories of probability.

The ridges that constitute each person's trademarks go unnoticed in everyday life; they receive no particular attention, but they play a very important role in identification, both civil and criminal. Ironically, the occasions that the attention of the average person is directed towards their trademarks are for the most part associated with criminality and law enforcement and, subconsciously, with the stigma of guilt. However, in many instances, fingerprints may establish innocence.

Figure 4, a photograph of a finger, symbolizes the science of fingerprints and the methods and techniques involved in using

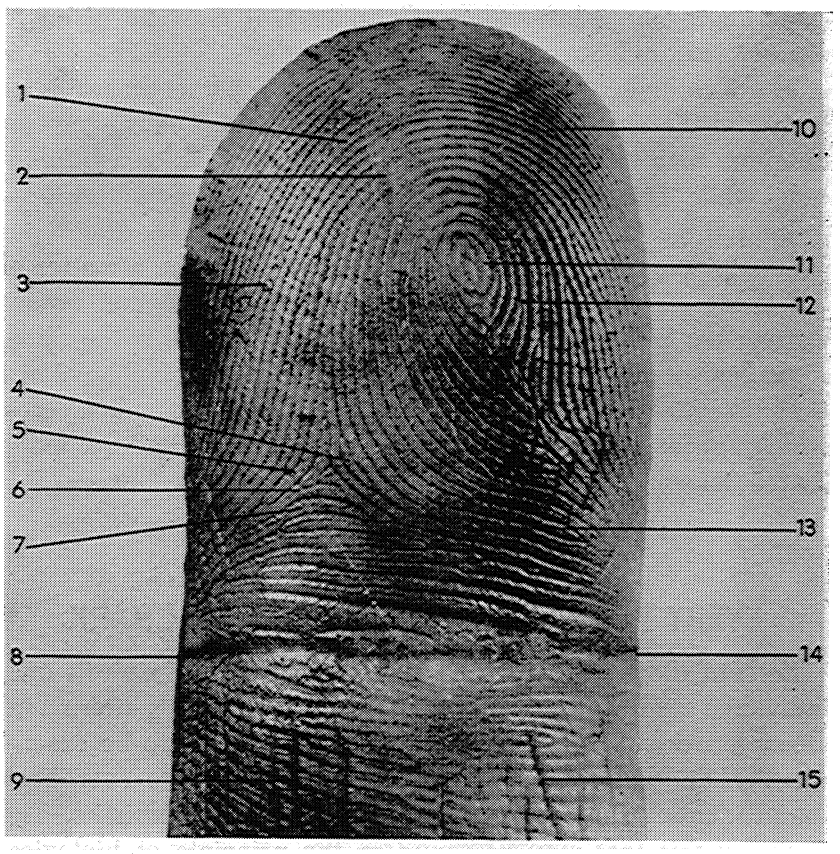

Figure 4. Photograph of a fingertip showing ridge characteristics or "trademarks" by which identification is made. Characteristics pointed out by numbered lines are described in the text.

the ridges to establish identity. The object of the photograph is to create at this early stage a fingerprint consciousness and familiarity in the minds of those whose duty is to search out and recover fingerprint evidence. A number of ridge formations and characteristics are pointed out by the numbered lines around the photograph; the points are explained in the following pages.

FINGER TRADEMARKS

The finger in Figure 4 displays a central pocket loop-type whorl pattern. Characteristics or trademarks are as follows: