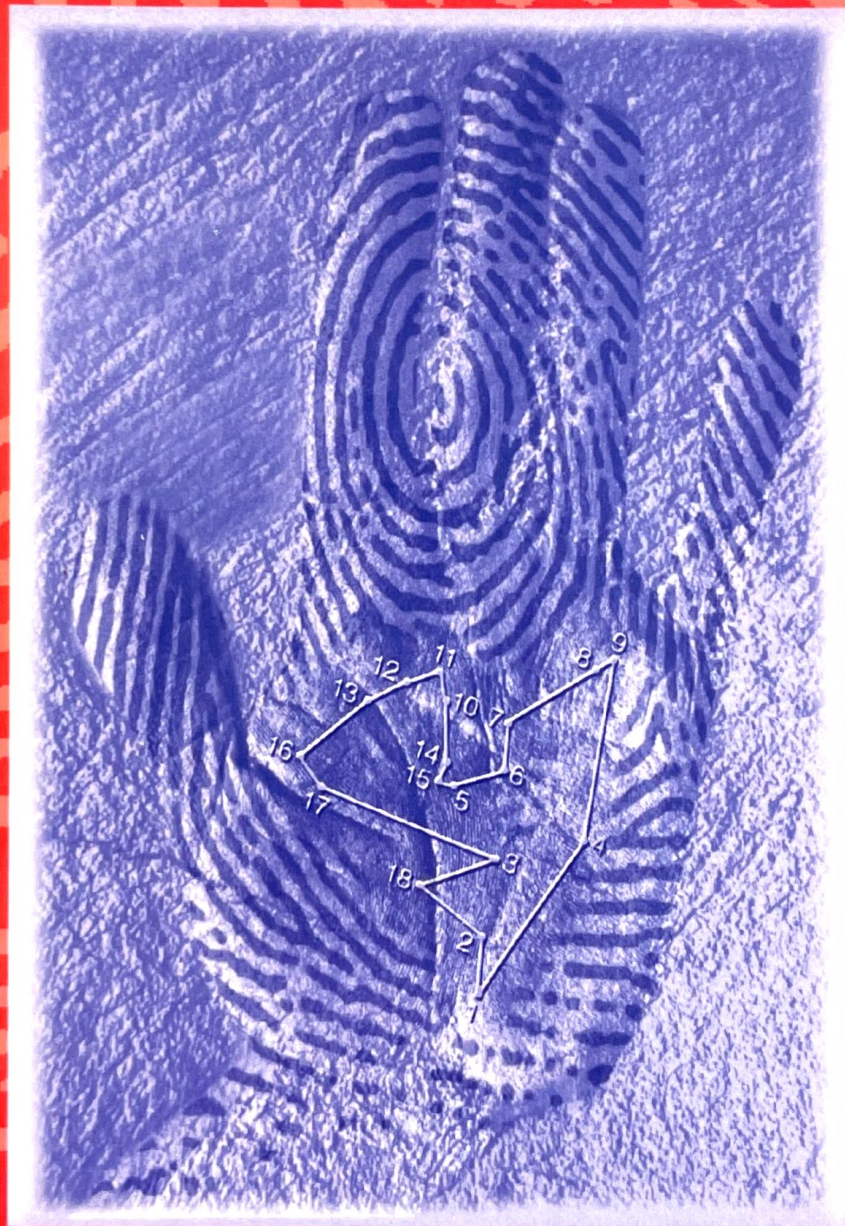


Advances in Fingerprint Technology

SECOND EDITION



EDITED BY

Henry C. Lee and R. E. Gaensslen

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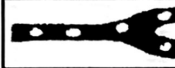





RIDGE CHARACTERISTICS	
	RIDGE ENDING
	BIFURCATION
	LAKE
	INDEPENDENT RIDGE
	DOT or ISLAND
	SPUR
	CROSSOVER

Figure 1.1 Ridge characteristics. (Drawn by John Berry.)

Introduction

The fascinating story of the development and use of fingerprints in the last hundred years will only be properly appreciated if the reader is acquainted with some knowledge of dactyloscopy; therefore I will briefly outline the basic details of this science. The inside surfaces of the hands from fingertips to wrist and the bottom surfaces of the feet from the tip of the big toe to the rear of the heel contain minute ridges of skin, with furrows between each ridge. A cross section of a finger would look exactly like the cross section of a plowed field. Whereas on a plowed field the ridges and furrows run in straight parallel lines, on the hands and feet the ridges and furrows frequently curve and, especially on the fingertips and toe ends, the ridges and furrows form complicated patterns. The ridges have pores along their entire length that exude perspiration; hence, when an article is picked up, the perspiration runs along the ridges and leaves an exact impression of the ridges, just as an inked rubber stamp leaves its impression on a blank sheet of paper.

Ridges and furrows have evolved on the hands and feet to fulfill three specific functions:

1. Exudation of perspiration
2. Tactile facility
3. Provision of a gripping surface

The ridges and furrows form seven basic characteristics, as shown in Figure 1.1. Some authorities consider that only two types of characteristics

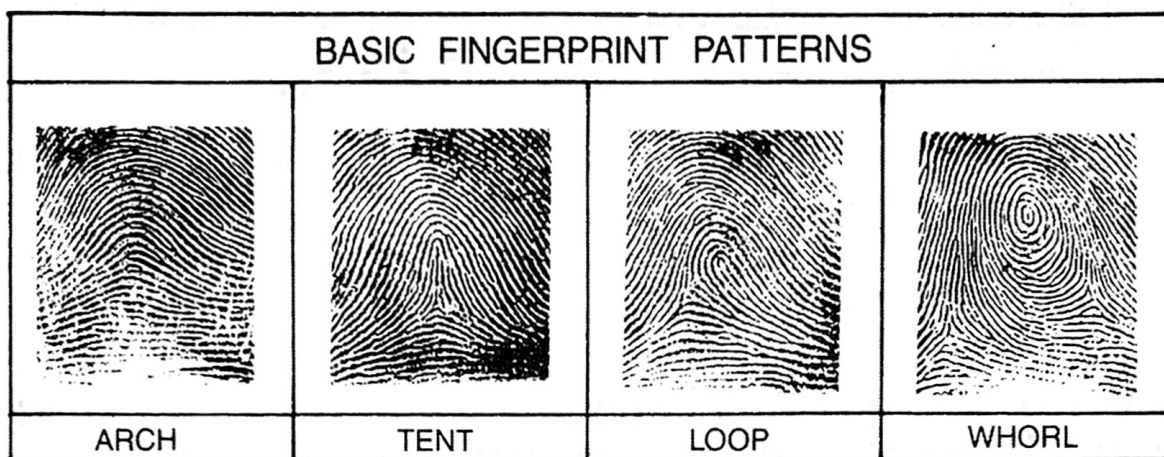


Figure 1.2 Basic fingerprint patterns.

are present, a ridge ending and a bifurcation, all other characteristics being variations of the two basic forms. I consider that my illustration defines the most important varieties of ridge detail, also known as ridge characteristics.

The ridges and furrows form patterns on the last joint of the fingers and toes, forming four basic types, as shown in Figure 1.2. There are variations of these patterns, especially with whorls, but these are the province of the fingerprint expert. Every person in the world shares these patterns — a person can have all of one type or even a mixture of all of them. The everyday use of fingers as an identification method and the production of finger and palm evidence in courts of law are based on one magnificent premise: no one has ever been found who has a sequence of ridge detail on the hands and feet that is identical to the ridge detail of any other person.

Evolution and the Elliptical Whorl (1976)

Before I researched the history of fingerprints in 1975, the earliest evidence of ridge detail on the hands and feet of humans was seen in the 4000-year-old mummies of ancient Egypt. The hands and feet of mummies have been examined on numerous occasions, and I can confirm the presence of ridge detail on the mummies' digits. Before 1975, the only other evidence reported was the presence of a small portion of palm imprint on hardened mud found in Egypt on a paleolithic site at the Sebekian deposit, Kom Ombo plain, on the east bank of the river Nile, dated around 10,000 years ago. The fact that primates have ridge detail was announced for the first time, as far as I can discover, by Joannes Evangelista Purkinje in his thesis (discussed later) published on December 22, 1823. He wrote:

In the hands of the monkeys, as well as in their prehensile tails, similar lines occur, the distinction of which adds to the knowledge of the characteristics

of all species. Zoologists, unless they consider them unimportant, will add further details.

Purkinje illustrated a palm impression and a small portion of the prehensile tail of a spider monkey.

In 1975–1976, I and my colleagues in the Fingerprint Office in Hertfordshire, U.K. — Roger Ball, David Brooker, Nicholas Hall, Stephen Haylock, and Martin Leadbetter — commenced protracted research to confirm that all species of primates have ridge detail on their hands and feet in patterns and toe ends that conform to human patterns (see Figure 1.2). We prepared a list of over 180 species of primates from the tree shrews (family Tupaiidae) to the gorilla (family Pongidae) and prepared a roster whereby, in small groups, we visited zoos and private collections, examining and in many cases taking impressions of the hands and feet of primates. This research engendered publicity in the press and television; one sarcastic writer commented in a national newspaper that Stephen Haylock was fingerprinting monks.

Eventually, Leadbetter and I contacted Professor and Mrs. Napier, who have now retired to a Scottish island. Professor Napier was a professional writer and a world-renowned expert on the hand; his wife Prue was also a writer and worked in the British Natural History Museum on Cromwell Road, London. We discovered that her terms of reference covered a section of the museum denied to ordinary visitors where thousands of deceased primates, many of them stuffed with straw, were placed in wide receptacles in an air-conditioned hall. Mrs. Napier explained that a “rule” existed whereby when a primate died in England, the skin was sent to the museum. This “rule” has been in existence for many years. For example, Roger Ball and I used a fingerprint-lifting technique to obtain the entire length of ridge detail from the prehensile tail of a red howler monkey that had died in 1829. Figure 1.3 shows an enlarged section of the lift.

The museum authorities gave permission for Roger Ball, Stephen Haylock, Martin Leadbetter, and me to examine all the stuffed primates in the huge collection. Working in pairs and using our vacation days, we eventually examined the hand and foot surfaces of all the primates. In a few instances we lifted ridge details from the hands and feet of selected specimens. This was done by carefully smoothing several layers of acrylic paint over the surfaces and waiting for each layer to dry before peeling it off. When we returned to the Fingerprint Office in Hertfordshire, the acrylic lifts were dusted with aluminum powder and then lifted with transparent tape and placed on transparent Cobex, forming a negative duly processed in the Camtac machine, producing a positive impression, i.e., ridges were black and furrows and pores were white. After 18 months of research, we had become



Figure 1.3 Portion of the prehensile tail of a red howler monkey (1829).

the first researchers, as far as I can ascertain, to examine and record the hands, feet, and prehensile tails of every species of primate.

In a later section, I shall discuss the fingerprint pioneer Dr. Henry Faulds (pronounced “folds”) in some detail; but in the present context I believe it is enormously interesting to report that on February 15, 1880, Faulds wrote to evolutionist Charles Darwin requesting his aid in obtaining the finger impressions of lemurs, anthropoids, etc. “with a view to throw light on human ancestry.” On April 7, 1880, Darwin replied to Faulds:

Dear Sir,

The subject to which you refer in your letter of February 15th seems to me a curious one, which may turn out interesting, but I am sorry to say that I am most unfortunately situated for offering you any assistance. I live in the country, and from weak health seldom see anyone. I will, however, forward your letter to Mr. F. Galton, who is the man most likely that I can think of to take up the subject and make further enquiries.

Wishing you success,
I remain, dear Sir,
Yours faithfully,
Charles Darwin

The “Mr. F. Galton” referred to in the letter from Darwin in due course became an authority on fingerprint matters in England and was part of an establishment clique that sought to revile Faulds (to be described later). However, note the amazing chain of events: ... fingerprint pioneer Faulds ... primates’ fingerprints ... Charles Darwin ... Mr. F. Galton (later Sir Francis Galton) ... fingerprint pioneer!

During the summer of 1976, I was, as always, fully occupied in my work as a fingerprint expert in Hertfordshire, specializing in searching for the ownership of finger imprints found at crime scenes, known in the U.S. by the particularly apt expression “cold searching.” Many identifications are made as the direct result of suspects being named by investigating police officers, but it is thrilling for a fingerprint expert, even a grizzled veteran like myself working with fingerprints for 37 years, to delve into the unknown and give the police a named person for the crime they are investigating, a name completely fresh and unknown to them, which we refer to as being “out of the blue.” Some astute detectives, when given the name as the result of a successful search, attempt to give the impression that somehow “they had an idea” that the name supplied to them was at that time under serious review. Fingerprint experts do not like this because the identification might have been made after laboriously searching perhaps thousands of fingerprint forms.

So in 1976 my position was that I had been scanning hundreds, possibly thousands, of fingerprints every working day for almost 22 years and at the back of my mind was the ever-present thought that all primates have “human type” finger impressions — after all, we are all primates — and, prompted by the letter from Faulds to Darwin, some original thoughts occurred to me.

I had recently read Prue Napier’s book *Monkeys and Apes*, wherein she illustrated every primate, describing the physical similarities and differences that occur in geographically separate areas, such as South America (only South American primates have ridge detail on their prehensile tail strip), Japan, Africa, Sumatra, Gibraltar, India, and Madagascar. I perused books on plate tectonics, averaging the estimated dates of the separation of Madagascar from the East African coast, and calculated that this occurred 50,000,000 years ago. Madagascan primates, I mused, differ physically from African primates, but they also bore ridge detail on their hands and feet. One fingerprint pattern that frequently occurs on primates in all geographical areas is the elliptical whorl (Figure 1.4), which is also found on human finger impressions. I must stress that arches, tents, loops, and whorls (see Figure 1.2) are also found on primates, but I “latched onto” the elliptical whorl as the basis for my sudden inspiration. Surely, if East African and Madagascan primates have elliptical whorls (among other patterns), only two theories could account for this phenomenon:



Figure 1.4 Elliptical whorl.

Theory 1: Before the distribution of certain land masses between 50,000,000 and 100,000,000 years ago, ridge detail was present on the hands and feet of our subprimate ancestors.

Theory 2: At some undetermined moment in time, perhaps allied with the emergence of *Homo sapiens*, primates all over the world suddenly developed ridge detail on their hand and foot surfaces, all species having associated patterns.

I submit that Theory 2 does not even require the remotest consideration, unless one is prepared to put forward a subtheory of Divine Intervention; but even then, cynically, why would God suddenly decide to gratuitously hand out ridge detail? I forwarded details of Theory 1 to Professor Napier and to Professor Beigert, Zurich, Switzerland, for their consideration. I met with Professor Napier, who kindly presented copies of his relevant publications.

In *Monkeys Without Tails*, Professor Napier considers that the development of tree climbers like *Smilodectes* required, among other physical developments, “replacement of sharp claws by flattened nails associated with the development of sensitive pads on the tips of the digits.” He wrote to me:

I am quite sure that fingerprints are as old as you suggest, particularly if the evolution of the monkeys is put back to the Eocene. The chances of evolving the “human” primate pattern are very high by means of the simple process of evolutionary *convergence* which your thesis strongly suggests ... it is obviously a basic pattern of Nature.

For many years Professor Beigert has published numerous books concerning ridge detail on the hand and foot surfaces of selected primates. He also forwarded to me copies of his literature and wrote, making the following observations:

I agree with you that dermatoglyphics on palma and planta of primates have to be dated very early. In my opinion in the Paleocene, 50,000,000–60,000,000 years ago.

In his book *The Evaluation of the Skull, Hands and Feet for Primate Taxonomy* (1963), Professor Beigert writes:

Much less attention has been given to the fact that among the other sense organs, the touch receptors underwent a significantly higher development.

My thesis was published in *Fingerprint Whorld* (July 1976) and in my esoteric annual publication *Ridge Detail in Nature* (1979); both publications were circulated to fingerprint bureaus, universities, and museums all over the world. No one has claimed prior publication of my theory regarding the fact that subprimates bore ridge detail before the separation of land masses.

I therefore submit that ridge detail appeared on the hands and feet of our subprimate ancestors over 100,000,000 years ago (a new 1987 estimate for the separation of Madagascar from Africa is closer to 200,000,000 years) and that our subprimate ancestors developed ridge detail on their hands and feet to facilitate the evolutionary requirement for grip, tactile facility, and the exudation of perspiration.

Neolithic Bricks (7000 B.C.)

Dame Kathleen Kenyon carried out excavations in the ancient city of Jericho, and in her book *Archaeology of the Holy Land*, referring to houses dated between 7000 B.C. and 6000 B.C., she reported

The bricks of which the walls were constructed were made by hand (not in moulds, as is usual later), in shape rather like a flattened cigar, with the surface impressed with a herringbone pattern by pairs of prints of the brick-layer's thumbs, thus giving a keying such as is provided by the hollow in modern bricks.

In *Paphos — History and Archaeology* by F. G. Maier and V. Karageorghis, dealing with excavations in Paphos, birthplace of Aphrodite, reference is made to the walls of the ancient city, eighth century B.C.



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Fingerprints constitute one of the most important categories of physical evidence, and one of the few in which true individualization is possible. During the last two decades, many new and exciting developments have taken place in the field of fingerprint science, particularly in the realm of methods for developing latent prints and in the growth of imaging and AFIS technologies. This fully updated Second Edition of the bestseller, *Advances in Fingerprint Technology*, covers major developments in latent fingerprint processing, including physical, chemical, instrumental, and combination techniques. Written by a renowned group of leading forensic identification and criminalistics experts, this valuable work presents exciting progress in fingerprint technologies, and in fingerprint comparison and identification.



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