
ADVANCES IN FINGERPRINT TECHNOLOGY

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*To Robert D. Olsen, Sr.
1934 to 1989
Latent fingerprint examiner, author,
researcher, colleague, friend.*

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PREFACE

This book was originally planned as a fourth volume in the *Advances in Forensic Sciences* series, three previous volumes of which have been published. The move to Elsevier Science Publishers, and the subject matter of this work, however, make it a natural addition to the Elsevier Series in Forensic and Police Science, and we are very pleased to introduce it in that context.

Fingerprints is an area in which there have been many new and exciting developments in the past several years. Fingerprints constitute one of the most important categories of physical evidence, and are among the few that can be truly individualized. Fingerprint individuality is widely accepted by scientists and courts alike.

Creative applications of principles derived from physics and organic chemistry have resulted in a variety of new chemical and instrumental methods for developing latent fingerprints. In addition, various systematic approaches for the further enhancement of latent prints on a great variety of different surfaces have been proposed. These are discussed in detail in Chapters 3, 4, and 5. In Chapter 3, detailed procedures have been provided.

Another major advance has been the development and relatively widespread implementation of automated fingerprint identification systems (AFIS) technology. This subject is covered in Chapters 6, 7, 8, and 9. AFIS makes possible for the first time the ability to search large files for single fingerprints, such as latents typically recovered from crime scenes. As of July, 1990, there were 62 AFIS installations in the

United States—29 De La Rue Printrak, 26 NEC, and 7 North American MORPHO.*

In an effort to include material on the theory as well as the application of AFIS technology, we originally asked all three major vendors of AFIS systems—North American MORPHO, De La Rue Printrak, and NEC—to contribute chapters describing their systems and technology. Two companies responded, and contributed the material for Chapters 8 and 9. We have edited these chapters to emphasize the descriptions of the features of the individual AFIS systems. These chapters were included as information for readers, and not as any sort of commercial endorsement by us or by Elsevier.

In addition to AFIS, Live-Scan and Image Transmission networks have also been introduced in the law enforcement community. These have enabled new technological development in a live-scan booking process, with electronic transmission of fingerprints from the booking site to the state or national files, and a response from those files about fingerprint identifications back to the booking site within hours. However, these new developments have not yet been thoroughly tested and evaluated, and are only briefly discussed in several chapters.

It is essential that new developments be seen in their proper perspective, and this is provided in Chapter 1. The ultimate and crucial step in a fingerprint examination—identifying the latent print—is thoroughly discussed in Chapter 2. The effective presentation of fingerprint evidence to the courts, without which all the scientific and technological advances would be pointless, is covered in Chapter 10.

It is with a sense of sadness and loss that we dedicate this volume to the memory and lifetime work of Robert D. Olsen, Sr., who passed away unexpectedly before the book could be published.

We thank all the contributors to Volume 4 for their excellent work and their patience in bringing this work to completion. We also thank the staff at Elsevier, and especially our acquisitions editor, David Dionne, for making the transition to a new publisher smooth and efficient. And we again thank our wives, Margaret and Jacqueline, for their continued love and patience.

Henry C. Lee
R.E. Gaensslen

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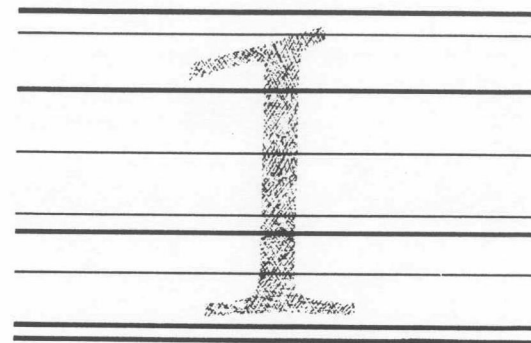
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THE HISTORY AND DEVELOPMENT OF FINGERPRINTING

John Berry, FFS, BEM

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, and 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 them, 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 are present, a ridge ending and a bifurcation, all other characteristics being variations of the two basic forms. I consider that my illustra-

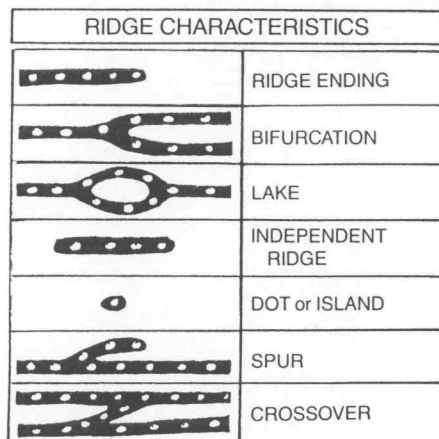


FIGURE 1.1
Ridge characteristics. Drawn by John Berry.

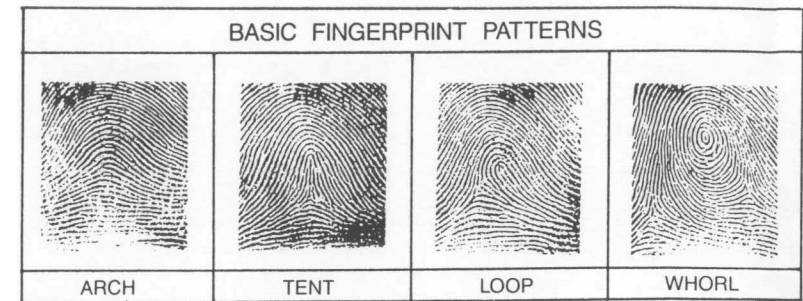


FIGURE 1.2. Basic fingerprint patterns.

tion 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 4,000-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 Jan 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 charac-

teristics 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 1975–76, 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 (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 black and furrows and pores white. After 18 months of research, we had become the first researchers, as far as I can

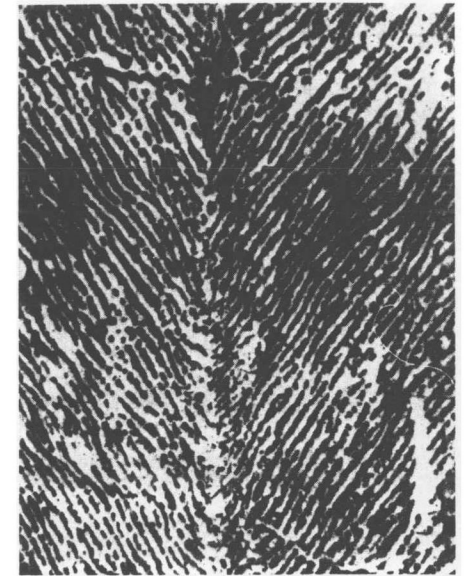


FIGURE 1.3
Portion of the prehensile tail of a red Howler monkey (1829).

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 United States 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 (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 he wrote to me, 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, 7,000 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 7,000 B.C. and 6,000 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.

The bricks, carefully laid and accurately jointed, are of near uniform size and of dark brown clay. A distinctive bright red-clay mortar was used. Many bricks have impressed fingerprints on their lower side.

Prehistoric Carvings, 3,000 B.C.

Recently I discovered details on two archaeological items that proved to my entire satisfaction that early humans were cognizant of patterns on their fingertips. However, before discussing them, I wish to report on the work of "a distinguished fingerprint authority," a certain Mr. Stockis, who published a treatise in the early 1920s in which he attempted to justify his claims that persons who carved patterns on standing stones in dolmen on Goat Island, Brittany, France, were aware of ridge detail on their digits. The carvings he illustrated depicted symbolic arches, tents, loops, and whorls.

The so-called Stockis theory was investigated by the eminent fingerprint expert Professor Harold Cummins, from the United States, who reported

If it be true that Neolithic men really noted fingerprint patterns, and with the attention to minute detail which is claimed, credit is due to them for a spontaneous interest and keenness in such observation hardly matched by the average man of the present day.

In his critique of the Stockis theory, Professor Cummins acknowledges that pottery making could have revealed ridge detail to Neolithic humans and accepts that the carvings are "highly suggestive" of fingerprints; he even concedes that this could have been associated with hand worship. But he concludes that although ridge detail can be noted in the carvings, there are other features included that definitely do not refer to dermatoglyphics. He concluded that "sound evidence that the carved designs had their origin in fingerprints appears to be wanting."

The first of my discoveries concerns a national monument at New Grange, Republic of Ireland (Eire), that I wrote about in the 1984 edition of *Ridge Detail in Nature*:

The national monument at New Grange dates from around 3,000 B.C. and features a huge man-made mound with a narrow passage leading to an inner burial chamber. An opening is located above the entrance so that for just a few moments at dawn on 21st December each year the rays of the rising sun penetrate along the passage to illuminate the burial chamber. A postage stamp issued on 4th May 1983 depicts patterns at the monument incised in stone. I note that the four basic fingerprint patterns are shown, together with numerous deltas. Is it mere coincidence that these patterns are found on the design, or was the interest of a pre-Celtic artist kindled by a perusal of his fingerprint patterns?

In *Ridge Detail in Nature* (1986) I illustrated and described for the first time in a ridge detail context a carving on a standing stone on Goat Island (Figure 1.5). I wrote:

Megalithic tombs and architectural monuments were built in Western Europe around 4,000 years ago, and the richest carvings are found in Brittany, north western France. It is thought that inspiration for the remarkably decorated tombs came from Spain and Southern France. A dozen characteristic symbols on the tombs represented important items in the lives of the megalithic builders, including axeheads, horns, yokes, the sun, etc. This photograph of carvings from Gavrinis is covered with symbolic representations, and the seemingly superimposed shape at the bottom of the carving shows a tent pattern. Ridge detail is scarce, but pores are quite clear on the ridges, being especially noticeable on the ridges draped over the central spine. I have no doubt that this particular carver was aware of patterns on finger tips, possibly superimposing one of his own patterns, as clear and precise as any of English wood-carver Thomas Bewick's fingerprint representations. (Bewick is discussed later.)

I do accept there is the slight possibility that the New Grange designs could be coincidental, although I do believe that the artist was conversant with patterns plainly visible on the ends of his fingers or the fingers of his associates; but I certainly do not have any doubts whatsoever that the person who carved the tent pattern (Figure 1.5) was aware of fingerprint patterns. This megalithic monument, carved in France at about the same time as the pyramids were being built, convinces me that the artisan knew of this pattern, and possibly, to accord individuality to one

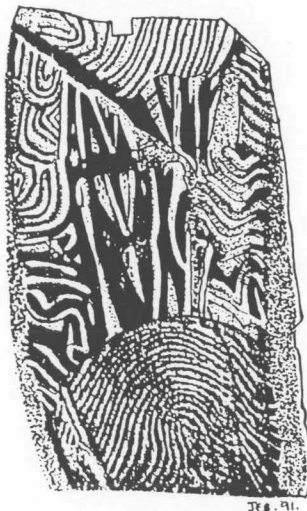


FIGURE 1.5
Standing Stone, Goat Island. Redrawn by
John Berry, from *The Megalithic Builders of
West Europe*, Glyn Daniel (1963).

of his designs, he incorporated one of his digit patterns, perhaps carved from a mud impression purposely made. The tent pattern is "squared-off" at the base. The sweat pores are pronounced, equally spaced on the ridges, and I regard this as being a most significant pointer. This carving of a tent pattern was not a coincidence: it was carved from direct observation.

I unhesitatingly align myself with, and fully support, the Stockis theory.

Mummies

As I have stated, the examination and recording of ridge detail on the hands and feet of mummies has been reported. I have visited museums in several countries, always specifically seeking out the Egyptian sections, and although many of the mummies were wrapped, I have been able to scrutinize ridge detail on the hands and feet of embalmed bodies on display and confirm the presence of fingerprint patterns similar to those shown in Figure 2.1.

In 1977, the mummy Asru, from the Temple of Karnak, was fingerprinted by experts in Manchester under the direction of Detective Chief Inspector Thomas Fletcher, head of the Fingerprint Bureau of the Greater Manchester Police. He kindly sent me a report and illustrations that were subsequently published in *Fingerprint Whorl*. Mr. Fletcher utilized the technique I have already described when the Hertfordshire personnel fingerprinted primates: the application of layers of acrylic paint on the digits. (This technique was invented by Roger Ball and was revealed for the first time in *Fingerprint Whorl*, January 1976.)

Mr. Fletcher used his experience as a detective to discover the occupation of Asru in the Temple of Karnak; she was either a dancer or a chantress:

Three thousand years ago Egyptian temple dancers performed their ritual dances barefoot, the foot being used as part of the body's expression. The sole was in constant contact with the ground and even on the smoothest of flooring there would be friction and consequent wearing of the ridges on the underside of the toes and balls of the feet. Asru's feet did not show any traces of this constant contact with the floor, the depth of the furrows and the clarity of the characteristics were not consistent with her having been a dancer, and the alternative of her being a chantress was much more acceptable.

Finger Imprints on Artifacts in Antiquity, circa 3,000 B.C.

In *Fingerprint Whorl*, October 1976, I published my research on this subject under the rather facetious title "Potter Throws Light on Prints." I consider that I covered the subject quite fully, and wrote:

Research into finger imprints in antiquity is a fascinating subject, because references occur of fingerprints on pottery and figurines in many parts of the world, even in pre-history. The scope for detailed research by the fingerprint expert is considerable, because my initial source material (quoted later) reveals authorities finding fingerprints on Neolithic vases, Bronze Age cooking pots, Assyrian clay tablets, ancient Mexican pottery and Aztec clay figures. Obviously, many of these instances occurred in the manufacture of articles where the manipulation of the basic clay into utensils indirectly left fingerprints. I write here detailing examples which suggest that the fingerprints were purposely indented into the clay. The earliest trace of finger imprints being purposely impressed occurred in Mesopotamia and dates from circa 3,000 B.C. where an authority asserts that a "digital impression" was placed on each brick used in the construction of the king's storehouse. This method of making identifying marks is also found on bricks used in the construction of the "royal buildings" in Ancient Egypt. It is pertinent to note that in these two examples the buildings were for kings or pharaohs, suggesting the importance placed in the craftsmanship which was confirmed by the finger impressions of the masons.

William Frederick Bade, once director of the Palestine Institute of Archaeology, conducted excavations at various sites in Palestine and at one place found finger imprints on many pieces of broken pottery. The chaotic state of this scene caused initial difficulty in dating artifacts, but it transpired that a study of the imprints on the numerous shards indicated that one potter made most of them. These "identifications" permitted the confused debris to be dated accurately; in fact, this particular excavation was dated to the fourth century A.D. Commenting on this case, *Fingerprint Magazine* (1937) stated that "these impressions were obviously intentional, and, no doubt, represented the workman's individual trade mark."

A Chinese clay seal, dated before the third century B.C., has been the focus of considerable research and speculation for many years. A left thumb imprint is deeply embedded in the seal, and on the reverse side is ancient Chinese script representing the name of the person who made the thumb imprint. The mark is so specific in pressure and placing that there can be no doubt that it was meant as an identifying mark. If this is so, there is the strong inference that the Chinese were aware of the individuality of fingerprints well over 5,000 years ago.

According to Mr. Laufer, a famous researcher who worked at the Field Museum of Natural History in the United States, before the first century B.C., clay seals were used extensively in sealing documents such as official letters and packages. Of the superb left thumb imprint mentioned above, he stated:

It is out of the question that this imprint is due to a mere accident caused by the handling of the clay piece. This impression is deep and sunk into the surface of the clay seal and beyond any doubt was effected with intentional energy and determination. In reasoning the case out logically, there is no other significance possible than that the thumb print belongs to the owner of the seal who has made his name on the reverse side. This case is therefore somewhat analogous to the modern practice of affixing on title deeds the thumb print to the signature, the one being verified by the other. This unique specimen is the oldest document so far on record relating to the history of the fingerprint system.

There is no evidence to conclude that the ancient Chinese were aware of the individuality of fingerprints on a universal basis. But the care taken to impress the clay seals suggests that the persons utilizing this form of signature (even should they only be symbolic tokens, as suggested) were aware that the design on their fingers or thumbs so applied constituted individuality. This must represent, even at its crudest level, the local recognition that the person who impressed a digit on a seal was permanently bound to the contents of the documents so certified.

A researcher who dedicated many years of work in this direction, although he was not a fingerprint expert, stated:

Fingerprint identification in our usage of the term appears to have been practiced in a simple form in times long past . . . but the history of fingerprint identification becomes shadowy as it is traced backwards.

I have examined Roman pottery and noted that finger imprints are sometimes present; one example in my possession shows three whorl types (twin loops) on the semismoothed underside. Yet when I was in Romania in 1985, I visited the ruins of a Greek settlement at Hystria, on the western coast of the Black Sea, and found shards of pottery completely devoid of finger imprints. I was extremely pleased to find the handle and part of the side of a Getic earthenware vessel among the rubble on the site. It was made during the first century B.C., and under examination with my fingerprint magnifying glass, I could see that the handle and side had been smoothed with fingers so finely that I believe every endeavor had been made to avoid leaving finger imprints on the finished product. I visited museums in Hystria, Constanta, and Bucharest, especially looking for finger imprints on pottery, and did not even find a lone example. Ergo, it is reasonable to assume that the potters in this area at least decided it was worthwhile removing offending imprints, *which they had noted*, in order to obtain an unsullied surface, a rather civilized artistic appreciation of subtlety of form.

Grauballe Man, A.D. 400

On Saturday, April 26, 1952, a body was discovered in the Nebelgard Fen near Grauballe, in Jutland, and carbon-14 dating revealed that the body had been in the bog between A.D. 1 and A.D. 400. The skin had been tanned like leather owing to the preservative qualities of the bog water. The cause of death was a deep incision across the throat, and it was presumed that the man had been ritually sacrificed to a fertility god to ensure the survival of his fellows. Two members of the staff of the police laboratory at Aarhus were entrusted with the examination of the Grauballe man's hands and feet. They found the ridge detail was excellent and were able to take impressions from the body. The right thumb was "a double curve whorl," a twin loop, and the right forefinger was an ulnar loop.

Philosophical Transactions, 1684

The first person to study and describe ridges, furrows, and pores on the hand and foot surfaces was English plant morphologist Nehemiah Grew (Figure 1.6), born in Warwickshire in 1641. He was the first fingerprint pioneer; besides writing on the subject, he also published extremely accurate drawings of finger patterns and areas of the palm. In the 1684 publication he described, in the most beautiful phraseology, descriptions and functions of ridge detail:

For if any one will but take the pains, with an indifferent Glass, to survey the Palm of his Hand very well washed with a Ball; he may perceive (besides those great Lines to which some men have given Names, and those of middle size call'd the Grain of the skin) innumerable little Ridges, of equal bigness and distance, and everywhere running parallel with one another. And especially, upon the ends and first Joynts of the Fingers and Thumb, upon the top of the Ball, and near the root of the Thumb a little above the Wrist. In all which places they are regularly disposed into Spherical Triangles, and Ellipticks. Upon these Ridges and Pores, all in Even Rows, and of that magnitude, as to be visible to a very good Eye without a Glass. But being viewed with one, every pore looks like a little Fountain, and the sweat may be seen to stand therein, as clear as rock water, and as often as it is wiped off, to spring up within them again. That which Nature intends in the position of these Ridges is, That they may the better suit with the use and motion of the Hand: those of the lower side of every Triangle, to the bending in or clutching of the Fingers: and those of the other two sides, and one of the Ellipticks to the pressure of the Hand or Fingers ends against any body, requiring them to yield to the right and left. Upon these Ridges, the Pores are very providently placed, and not in the furrows which lie between them; that so their structure might be more sturdy, and less liable to be depraved by compres-



FIGURE 1.6
Nehemiah Grew. Drawn by John Berry.

sion; whereby only the Furrows are dilated or contracted, the Ridges constantly maintaining themselves and so the Pores unaltered. And for the same reason, the Pores are also very large, that they may be still better preserved, tho the skin be never so much compressed and condens'd by the constant use and labour of the Hand. And so those of the Feet, notwithstanding the compression of the skin by the weight of the whole body.

Grew died suddenly on March 25, 1712, and is buried at Cheshunt Parish Church, Hertfordshire.

De Externo Tactus Organo, 1686

Grew's contemporary, Marcello Malpighi (1628–94), also a plant morphologist, researched the functions of the human skin, and the "Malpighian layers" were named for him. He worked at the University of Bologna, Italy, and in his publication he mainly dealt with the skin, although he did briefly mention ridge detail. It is believed that Grew and Malpighi corresponded to a degree, but the differences in language were a frustration, strangely because Grew was more adept at Latin usage than the Italian.

William of Orange, 1690

I am sure that the reader will think this section is a hoax, but I report herewith one well-known historical fingerprint landmark, and the latest tremendous 1987 discovery, both having a direct connection with

the expatriate Dutch monarch William of Orange. The city of Londonderry (now in Northern Ireland) was under siege until relieved by forces under the command of William of Orange, and in 1691, 225 citizens of Londonderry, who had suffered damage and loss during the siege, made a representation to London for compensation. The claimants appended digit impressions on the document, adjacent to their signatures, obviously considering the individuality of their fingers as being inviolable. I have examined a photograph of the document (and have tried really hard but unsuccessfully to trace the original) and report that the impressions are unfortunately of poor quality, but it must be remembered that they were made 300 years ago.

An accidental fire occurred at the historic building Hampton Court, west of London, causing considerable damage; early in 1987, workmen removed some warped wooden panels in The Little Oak Room, Fountain Court, and found that the plaster underneath bore 17 complete handprints. I immediately visited the site with Martin Leadbetter and Nicholas Hall, a Hertfordshire Constabulary photographer, and we made a detailed examination, including measurements, photography, and an abortive attempt at lifting. Most of the handprints were excellent, revealing clear ridge detail; photograph A2 (Figure 1.7) shows the finest example. The plaster was made of lime, sand, and animal hairs. Archaeologists told us that The Little Oak Room had been redecorated in 1689–90 for King William III and his queen. The hands had been impressed in the plaster before it had hardened. We found that three different people had made the imprints. I do not believe that the plasterers would desecrate their handiwork; perchance the vagrant handprints were made by carpenters, soldiers, or servants who would be aware that large wooden panels of oak would speedily be placed atop the plaster. It was a fascinating experience to have the opportunity to examine the handprints on the wall, albeit the results of our examination were officially handed to the Hampton Court authorities as part of the records of the archaeological and other finds before refurbishment; also, our work was featured in an official Home Office film that is scheduled for television broadcast and publication in book form.

Thomas Bewick, 1753–1828

Thomas Bewick (Figure 1.8) is mentioned quite frequently in fingerprint publications simply because in a few books he used an engraving of his fingerprints as a signature. The importance of this fact is that he did this almost 200 years ago, and authorities such as Sir William Herschel have credited Bewick with stimulating their initial interest in the study of fingerprints.

He was born in Ovingham, Northumberland, England, on August 12,



FIGURE 1.7. Right palm imprint in plaster, Hampton Court, London, 1689–90. Figure supplied by Nicholas John Hall, M.F.S., Hertfordshire.

1753, the son of a farmer. His early school career was marred by his absence from classes and disinterest in Latin, English grammar, and arithmetic, although he was eventually constrained to study them to a reasonable standard, as one contemporary writer put it:

By kindly words of persuasion a reformation was at length effected that severe discipline and punishment had failed to accomplish.



FIGURE 1.8
Thomas Bewick. Drawn by John Berry.

He used all the spaces in his school papers to draw murals, and when he used these up he continued his artistic progress by chalking designs on gravestones and the church porch. He became famous in the rural community as an artist, and he decorated the walls of their cottages "with an abundance of my rude productions at a very cheap rate."

While still a child, his head was scalded and thereafter his crown was berift of hair, necessitating, when he grew older, the application of a brown silk cap.

When he was 14 years old, he became an apprentice to an engraver in Newcastle, and after 5 years he completed his apprenticeship; the first book with a Bewick woodcut was published in 1774.

As the years progressed, Bewick became famous throughout England, and ultimately his fame became worldwide. Without doubt he was England's finest engraver. He invented the "white line" wood-engraving technique, "thus paying attention, not to what he left, but what he cut away from the block." Most of his famous wood engravings featured animals and birds. His *A General History of the Quadrupeds* ran to eight editions, as did his monumental *History of British Birds*. The finger imprint in Figure 1.9, showing the cottage and trees etched faintly in the background is from *History of British Birds 1797-1804*. His love of the countryside and nature must have caused him to note ridge detail on his hands. It has not been possible to find out how he concluded that ridge detail was unique, but it is obvious from his carved imprint superimposed with *Thomas Bewick his Mark* that he was utterly satisfied that his imprint denoted individuality. One of his

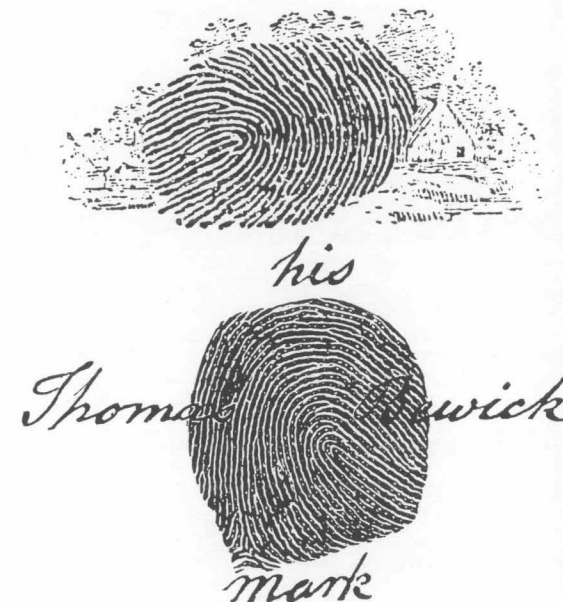


FIGURE 1.9. Trademarks of Thomas Bewick. From the publications of Thomas Bewick.

contemporaries observed that "Bewick's signature is sometimes written, a genuine autograph, but generally printed; the quaint conceit of his thumb print is amusing."

Bewick died on November 8, 1828, at Gateshead, and he was buried in Ovingham churchyard, in the parish where he was born.

Concerning the External Physiological Examination of the Integumentary System, 1823

Joannes Evanelista Purkinje was a Bohemian, and part of his thesis published on December 22, 1823, dealt in considerable detail with the functions of ridges, furrows, and pores; additionally, he illustrated and described nine fingerprint patterns: one arch, one tent, two loops, and five types of whorl. In 1985 my Hertfordshire colleague Martin Leadbetter optimistically wrote to the Burser of Wroclaw University, Poland, asking for photographs and part of the original thesis dealing with fingerprints. In two months, to our considerable surprise, a 35 mm film arrived with negatives of all the pertinent pages in Latin (Martin has entrusted the film to me to retain in my capacity as Historian of The Fingerprint Society). Professor Harold Cummins and Rebecca Wright Kennedy, of the United States, translated the thesis in 1940,