CHAPTER

HISTORY

Jeffery G. Barnes

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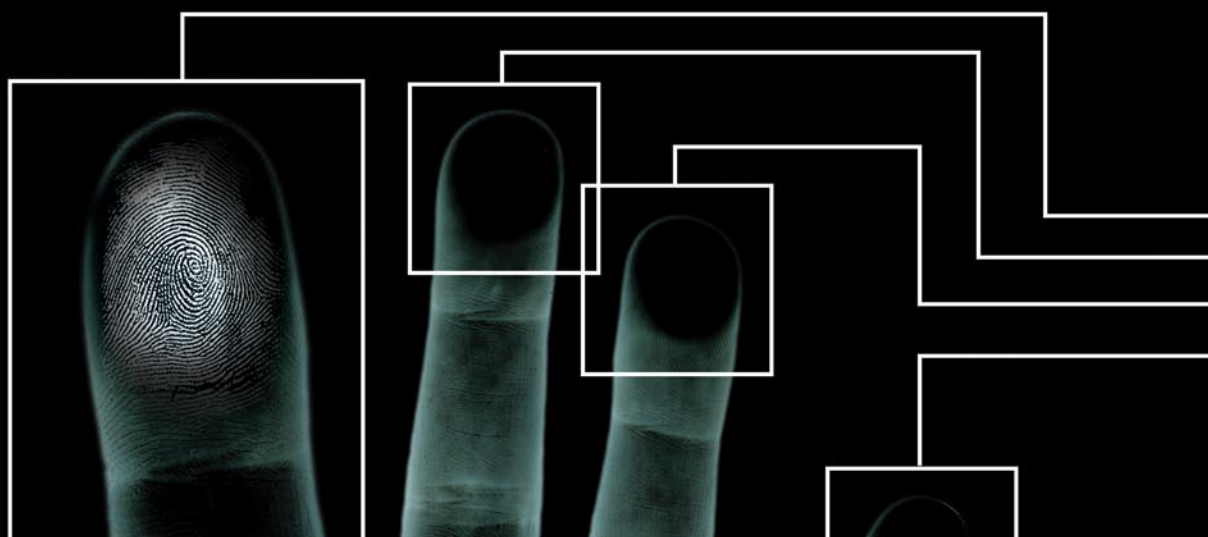
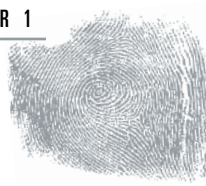




CHAPTER 1

HISTORY

JEFFERY G. BARNES

1.1 Introduction

The long story of that inescapable mark of identity has been told and retold for many years and in many ways. On the palm side of each person's hands and on the soles of each person's feet are prominent skin features that single him or her out from everyone else in the world. These features are present in friction ridge skin which leaves behind impressions of its shapes when it comes into contact with an object. The impressions from the last finger joints are known as fingerprints. Using fingerprints to identify individuals has become commonplace, and that identification role is an invaluable tool worldwide.

What some people do not know is that the use of friction ridge skin impressions as a means of identification has been around for thousands of years and has been used in several cultures. **Friction ridge skin impressions were used as proof of a person's identity in China perhaps as early as 300 B.C., in Japan as early as A.D. 702, and in the United States since 1902.**

1.2 Ancient History

Earthenware estimated to be 6000 years old was discovered at an archaeological site in northwest China and found to bear clearly discernible friction ridge impressions. **These prints are considered the oldest friction ridge skin impressions found to date;** however, it is unknown whether they were deposited by accident or with specific intent, such as to create decorative patterns or symbols (Xiang-Xin and Chun-Ge, 1988, p 277). In this same Neolithic period, friction ridges were being left in other ancient materials by builders (Ashbaugh, 1999, pp 12–13). Just as someone today might leave impressions in cement, early builders left impressions in the clay used to make bricks (Berry and Stoney, 2001, pp 8–9).

Other ancient artifacts have been found that have ridge patterns on them that were clearly carved rather than left as accidental impressions. Examples of ancient artifacts displaying what might be considered friction ridge designs include megalithic artworks in the tomb of Gavr'inis on an island just off the west coast of France and in the tomb at Newgrange on the coast of Ireland (Figure 1–1).

1.3 221 B.C. to A.D. 1637

The Chinese were the first culture known to have used friction ridge impressions as a means of identification. The earliest example comes from a Chinese document entitled "The Volume of Crime Scene Investigation—Burglary", from the Qin Dynasty (221 to 206 B.C.). The document contains a description of how handprints were used as a type of evidence (Xiang-Xin and Chun-Ge, 1988, p 283).

During the Qin through Eastern Han dynasties (221 B.C. to 220 A.D.), the most prevalent example of individualization using friction ridges was the clay seal. Documents consisting of bamboo slips or pages were rolled with string bindings, and the strings were sealed with clay (Xiang-Xin and Chun-Ge, 1988, pp 277–278). On one side of the seal would be impressed the name of the author, usually in the form of a stamp, and on the other side would be impressed the fingerprint of the author. The seal was used to show authorship and to prevent tampering prior to the document reaching the intended reader. It is generally recognized that it was both the fingerprint and the name that gave the document authenticity.

The fingerprint impressed into the clay seal is a definite example of intentional friction ridge skin reproduction as a means of individualization. It is clear that the Chinese understood the value of friction ridge skin prior to the Christian era (Laufer, 1912, p 649).

After the invention of paper by the Chinese in A.D. 105, it became common to sign documents using friction ridge skin. It was standard practice in China to place an impression—either palmprints, phalangeal (lower finger joint) marks, or fingerprints—on all contract-type documents (Xiang-Xin and Chun-Ge, 1988, pp 282–284). In A.D. 650, the Chinese historian Kia Kung-Yen described a previously used means of identification, writing, "Wooden tablets were inscribed with the terms of the contract and notches were cut into the sides at the identical places so that the tablets could later be matched, thus proving them genuine; the significance of the notches was the same as that of the fingerprints of the present time" (Ashbaugh, 1999, p 17).

FIGURE 1–1

One of the stones of Newgrange (Courtesy of http://www.ancient-wisdom.co.uk.)

This statement tends to confirm that fingerprints were used for individualization in China.

The use of friction ridge skin impressions in China continued into the Tang Dynasty (A.D. 617–907), as seen on land contracts, wills, and army rosters. It can be postulated that with the Chinese using friction ridge skin for individualization and trading with other nations in Asia, these other nations might have adopted the practice. For example, in Japan, a "Domestic Law" enacted in A.D. 702 required the following: "In case a husband cannot write, let him hire another man to write the document and after the husband's name, sign with his own index finger" (Ashbaugh, 1999, p 17–18; Lambourne, 1984, p 24). This shows at least the possibility that the Japanese had some understanding of the value of friction ridge skin for individualization.

Additionally, in India, there are references to the nobility using friction ridge skin as signatures:

> In A.D. 1637, the joint forces of Shah Jahan and Adil Khan, under the command of Khan Zaman Bahadur, invaded the camp of Shahuji Bhosle, the ruler of Pona (in the present day Maharashtra). The joint army defeated Shahuji, who was compelled to accept the terms of peace:
>
> > Since the garrison (of Shahuji) was now reduced to great extremities ....[,] Shahuji wrote frequently to Khan Bahadur in the most humble strain, promising to pay allegiance to the crown. He at the same time solicited a written treaty ... stamped with the impression of his hand. (Sodhi and Kaur, 2003a, pp 126–136)

The above text is an example of the nobility's use of palmprints in India to demonstrate authenticity of authorship when writing an important document. **It is believed that the use of prints on important documents was adopted from the Chinese, where it was used generally, but in India it was mainly reserved for royalty** (Sodhi and Kaur, 2003a, pp 129–131). The use of friction ridge skin as a signature in China, Japan, India, and possibly other nations prior to European discovery is thus well documented.

FIGURE 1–2

Dr. Nehemiah Grew (1641–1712). (Courtesy of Smithsonian Institution Libraries.)

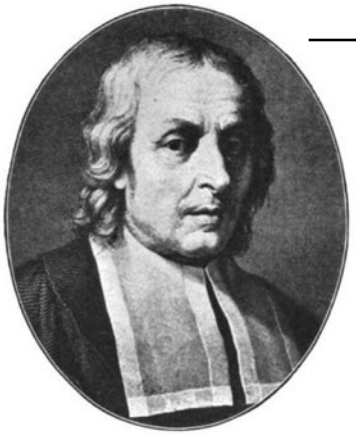


FIGURE 1–3

Dr. Marcello Malpighi (1628–1694). (Reprinted from Locy (1908). Image captured from Google Books.)

1.4 17th and 18th Centuries

In the late 17th century, European scientists began publishing their observations of human skin. **Friction ridge skin was first described in detail by Dr. Nehemiah Grew** (Figure 1–2) in the 1684 paper *Philosophical Transactions of the Royal Society of London.* Dr. Grew's description marked the beginning in the Western Hemisphere of friction ridge skin observations and characterizations (Ashbaugh, 1999, p 38; Lambourne, 1984, p 25). In 1685, Govard Bidloo, a Dutch anatomist, published *Anatomy of the Human Body,* which included details of the skin and the papillary ridges of the thumb but failed to address individualization or permanence (Ashbaugh, 1999, p 39; Felsher, 1962, pp 6–12). In 1687, the Italian physiologist Marcello Malpighi (Figure 1–3) published *Concerning the External Tactile Organs,* in which the function, form, and structure of friction ridge skin was discussed. **Malpighi is credited with being the first to use the newly invented microscope for medical studies.** In his treatise, Malpighi noted that ridged skin increases friction between an object and the skin's surface; friction ridge skin thus enhances traction for walking and

grasping (New Scotland Yard, 1990; Ashbaugh, 1999, p 40). In recognition of Malpighi's work, a layer of skin (stratum Malpighi) was named after him.

Although friction ridge skin had been studied for a number of years, it would be 1788 before the uniqueness of this skin was recognized in Europe. J. C. A. Mayer, a German doctor and anatomist, wrote a book entitled *Anatomical Copper-plates with Appropriate Explanations,* which contained detailed drawings of friction ridge skin patterns. Mayer wrote, "Although the arrangement of skin ridges is never duplicated in two persons, nevertheless the similarities are closer among some individuals. In others the differences are marked, yet in spite of their peculiarities of arrangement all have a certain likeness" (Cummins and Midlo, 1943, pp 12–13). **Mayer was the first to write that friction ridge skin is unique.**

1.5 19th Century

English wood engraver and ornithologist Thomas Bewick (1753–1828) published many books with wood engravings of birds and other animals. Three woodcuts (made in 1809, 1818, and 1826) included a fingermark, and the latter two had the legend "Thomas Bewick, his mark" (Herschel, 1916, 32–33). The woodcuts (Figure 1–4) were very detailed, but it is unknown whether Bewick understood the value of friction ridge skin for individualization (Galton, 1892, p 26; Lambourne, 1984, p 26).

In his 1823 thesis titled "Commentary on the Physiological Examination of the Organs of Vision and the Cutaneous System", Dr. Johannes E. Purkinje (1787–1869), professor at the University of Breslau in Germany, classified fingerprint patterns into nine categories and gave each a name (Figure 1–5) (Lambourne, 1984, p 26; Galton, 1892, pp 85–88). **Although Dr. Purkinje went no further than naming the patterns, his contribution is significant because his nine pattern types were the precursor to the Henry classification system** (Herschel, 1916, pp 34–35; Galton, 1892, pp 67, 119). (For more on Purkinje, see Chapter 5. For more on the Henry system, see p 10.)

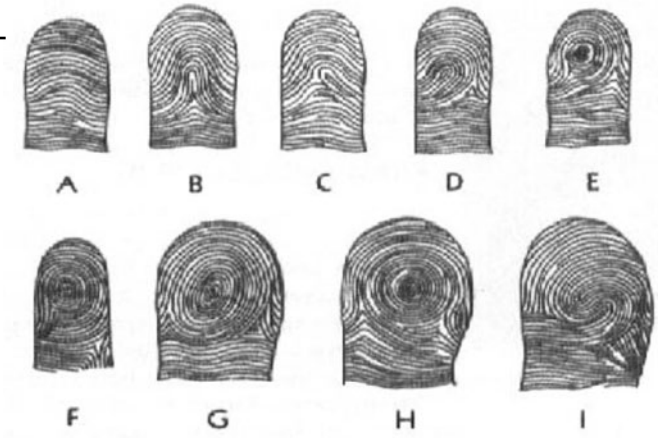
German anthropologist Hermann Welcker (1822–1898) of the University of Halle led the way in the study of friction ridge skin permanence. **Welcker began by printing his own right hand in 1856 and then again in 1897, thus gaining credit as the first person to start a permanence study.** However, in the paper Welcker published in

FIGURE 1–4

Bewick's published fingermarks. (Courtesy of the Natural History Society of Northumbria, Hancock Museum.)

FIGURE 1–5

Purkinje's nine types of finger patterns. (A: Transverse curves, B: Central longitudinal stria, C: Oblique stria, D: Oblique sinus, E: Almond, F: Spiral, G: Ellipse or elliptical whorl, H: Circle or circular whorl, and I: Double whorl). (Reprinted with permission from Cumming and Midlo (1943). Copyright 1943 Dover Publications Inc.)



1898, he sought no credit, but rather seemed only to offer assistance to prior claims of permanence in reference to friction ridge skin (Wilder and Wentworth, 1918, pp 339–340). Welcker is not cited often. **Generally, the credit for being the first person to study the persistence of friction ridge skin goes to Sir William James Herschel.**

Herschel (Figure 1–6) was born in England and moved in 1853, at age 20, to Bengal, India, to serve as a British Administrator for the East India Company. In 1858, he experimented with the idea of using a handprint as a signature by having a man named Rajyadhar Konai put a stamp of his right hand on the back of a contract for road binding materials. The contract was received and accepted as valid. **This spontaneous printing of Konai's hand thus led to the first official use of friction ridge skin by a European.** The success of this experiment led Herschel to begin a long exploration of friction ridge skin, and over the next year he went on to collect multiple fingerprints from family, friends, colleagues, and even himself. In 1860, he was promoted to magistrate and given charge of Nuddea, a rural subdivision in Bengal. While there, he recognized more identification possibilities for the use of friction ridge skin, especially in fighting and preventing fraud.

Upon his appointment as Magistrate and Collector at Hooghly, near Calcutta, in 1877, Herschel was able to institute the recording of friction ridge skin as a method of individualization on a widespread basis. Herschel was in charge of the criminal courts, the prisons, the registration of deeds, and the payment of government pensions, all of which he controlled with fingerprint identification. On August 15, 1877, Herschel wrote what is referred to as the "Hooghly Letter" to Bengal's Inspector of Jails and the Registrar General, describing his ideas and suggesting that the fingerprint system be expanded to other geographical areas. While proposing even further uses of this means of individualization, the Hooghly Letter also explained both the permanence and uniqueness of friction ridge skin (Herschel, 1916, pp 22–23).

Herschel continued his study of the permanence of friction ridge skin throughout his lifetime. He published prints of himself taken in 1859, 1877, and 1916 to demonstrate this permanence (Herschel, 1916, pp 22–31).

In 1877, Thomas Taylor (1820–1910), a microscopist for the U.S. Department of Agriculture, gave a lecture concerning prints and their possible applications concerning crime. Taylor proposed the idea of using bloody prints found at crime scenes as a means to identify suspects. The lecture was published in the July 1877 issue of *The American Journal of Microscopy and Popular Science* (Ashbaugh, 1999, p 26).

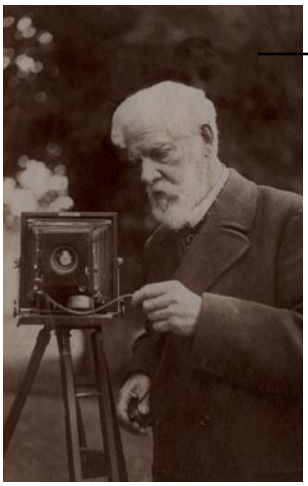


FIGURE 1–6

Sir William James Herschel (1833–1917). (Reprinted from private collection (1913). Courtesy of West Virginia University Libraries.)

FIGURE 1–7

Henry Faulds (1843–1930). (Reprinted from Faulds (1922). Courtesy of West Virginia University Libraries.)

Henry Faulds (Figure 1–7) became interested in friction ridge skin after seeing ridge detail on pottery found on a Japanese beach (Faulds, 1880). He was born at Beith, in Ayrshire, in 1843, and entered Anderson's College in Glasgow, graduating as a Licentiate of the Royal Faculty of Physicians and Surgeons in 1871. Faulds, as a medical missionary, opened a hospital in Tsukiji, Japan, working there from 1873 until 1885 (Lambourne, 1984, p 33). During that time, Faulds conducted independent research by collecting prints of both monkeys and people. In a letter dated February 16, 1880, to the famed naturalist Charles Darwin, Faulds wrote that friction ridges were unique and classifiable, and alluded to their permanence (Lambourne, 1984, pp 34–35). In October 1880, Faulds submitted an article for publication to the journal *Nature* in order to inform other researchers of his findings (Faulds, 1880, p 605). In that article, Faulds proposed using friction ridge individualization at crime scenes and gave two practical examples.

In one example, a greasy print on a drinking glass revealed who had been drinking some distilled spirits. In the other, sooty fingermarks on a white wall exonerated an accused individual (Faulds, 1880, p 605). **Faulds was the first person to publish in a journal the value of friction ridge skin for individualization, especially its use as evidence.** (For more on Faulds, see Chapter 5.)

While Herschel and Faulds were studying friction ridge skin, another scientist was devising an alternate identification method. Alphonse Bertillon (Figure 1–8) was a clerk in the Prefecture of Police in Paris, France. In 1879, Bertillon began studying the body measurements of various individuals and devised anthropometry, which was first put to use in 1882. Anthropometry is the study of body measurements for identification purposes. Bertillon's anthropometric method measured height, reach (middle finger to middle finger of outstretched arms), trunk, length of head, width of head, length of right ear, width of right ear, length of left foot, length of left middle finger, length of left little finger, and length of left forearm. With the success of anthropometry, Bertillon was made the Chief of the Department of Judicial Identity in 1888 (Rhodes, 1956, p 103). (For more on Bertillon, see Chapter 5.)

Anthropometry is a scientific and biometric way to individualize and was used on criminals throughout most of the world from its inception in 1882 until 1914. As friction ridge skin identification became more prevalent after experimentation proved its usefulness, fingerprints were added to anthropometric records. Thus, a complete anthropometric record would include the 11 body measurements, 2 photographs (front face and right side), and a set of all 10 fingerprints. Even though not officially adopted as a sole means of identification in France or elsewhere in Europe, the concept of using friction ridge skin for individualization was gaining momentum.

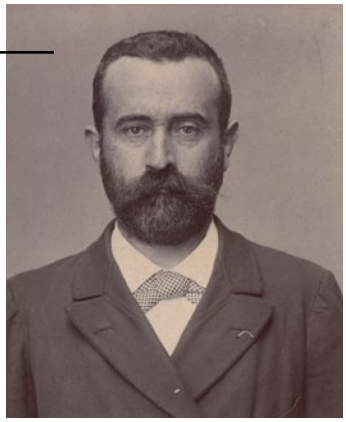


FIGURE 1–8

Alphonse Bertillon (1853–1913). (Reprinted from McClaughry (1922). Courtesy of West Virginia University Libraries.)

In the United States, geologist Gilbert Thompson guarded his checks against forgery by signing across an impression of his finger. Thompson did this while working on a project in New Mexico in 1882 (Galton, 1892, p 27).

In 1883, another American, Samuel Langhorne Clemens (1835–1910), better known as Mark Twain, wrote the story of his life in the book *Life on the Mississippi* and included a passage about the permanence and uniqueness of the print of the ball of the thumb (Twain, 1883, pp 160–161). In 1884, Clemens wrote the novel *The Tragedy of Pudd'nhead Wilson*. In it, he tells the story of a lawyer who spends his time collecting prints from the local townsfolk and then uses them to solve a murder. Not only does Clemens explain the permanence and uniqueness of friction ridge skin, the book also features several courtroom demonstrations: the first shows how each person's prints are different on each finger, the second shows that even identical twins have different prints from one another, the third shows how the prints made from the fingers can be individualized, and the last catches the murderer. The story is told using critical knowledge of friction ridge skin (Twain, 1884, pp 128–137). Although anthropometry was the current method of identification in the early 1880s, Clemens's writings illustrate that the value of friction ridge skin to uniquely identify an individual was becoming increasingly well known.

A publication in 1883 by Dr. Arthur Kollmann of Hamburg, Germany, *The Tactile Apparatus of the Hand of the Human Races and Apes in Its Development and Structure,* added to the research being conducted on friction ridge skin. Kollmann studied the embryological development of friction ridge skin, proposing that ridges are formed by lateral pressure between nascent ridges and that ridges are discernible in the fourth month of fetal life and are fully formed in the sixth (Galton, 1892, p 58). **Kollman was the first to identify the presence and locations of the volar pads on the hands and feet** (Hale, 1952, p 162; Ashbaugh, 1999, p 41). (For an explanation of volar pads, see chapter 3.) The studies of Kollmann were followed in

1888 with the publication in Germany of *On the Morphology of the Tactile Pads of Mammals* by Hermann Klaatsch. Klaatsch studied the walking surfaces of mammals other than humans, which led to his theory that the orderly arrangement of sweat glands into rows was an evolutionary change (Galton, 1892, p 60).

The scientific study of friction ridge skin was also taken up by a prominent scientist of the time, Sir Francis Galton (Figure 1–9). Galton was born February 16, 1822, in Sparkbrook, England, and was a cousin of Charles Darwin. Most of Galton's research focused on hereditary matters, which led him to the study of anthropometry and, later, fingerprints. Galton was looking to understand the hereditary nature of the physical body and what, if anything, it could tell about an individual (Caplan and Torpey, 2001, p 274). Visitors to his anthropometric laboratory were voluntarily measured seventeen different ways. These measurements were recorded on a card that was copied and given to the visitors as a souvenir (ca. 1885). From this data, he realized that forearm length correlated with height and derived the first example of what statisticians now call a correlation coefficient (a numerical value identifying the strength of the relationship between variables). Galton continued to take anthropometric measurements, and he added the printing of the thumbs and then the printing of all 10 fingers. **As the author of the first book on fingerprints (*Finger Prints,* 1892), Galton established that friction ridge skin was unique and persistent.** He also concluded that there was no link between friction ridge skin and the character of the individual with that skin. Because Galton was the first to define and name specific print minutiae, the minutiae became known as Galton details (Figure 1–10). Galton's details consist of a uniting or dividing ridge (bifurcation), the end or beginning of a ridge (ending ridges), a short island (short ridge), and an enclosure (two bifurcations facing each other) (Galton, 1892, p 54). (For more on Galton, see Chapter 5.)

While Galton conducted research that would further advance the science of fingerprints, fingerprints were being used practically as well. In 1886, I. W. Taber, a photographer in San Francisco, proposed using thumbprints to identify Chinese immigrants (Lambourne, 1984, pp 46–47). In 1889, the Director-General of the Post Offices in India was collecting thumbprints from employees to prevent individuals who had been fired from being rehired. Using thumbprints for identity worked well to prevent fraudulent practices (Henry, 1934, pp 8–9). The French medical/legal scientist René Forgeot published a thesis in 1891 in which he

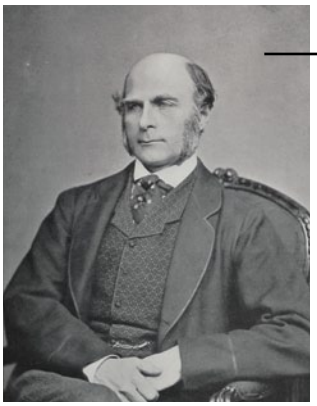


FIGURE 1–9

Sir Francis Galton (1822–1911). (Reprinted from Pearson (1914). Courtesy of West Virginia University Libraries.)

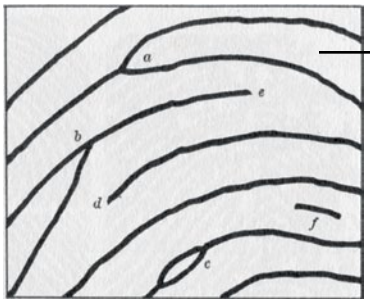


FIGURE 1–10

Minutiae diagram. (a and b: Bifurcations, c: Enclosure, d and e: Ending ridges, and f: Island). (Reprinted from Galton (1892).)

proposed using powders and chemicals to develop latent prints at crime scenes in order to individualize the person who had touched an object (Galton, 1892, p 46).

Another leading fingerprint researcher of this time period was Juan Vucetich. Vucetich was employed as a statistician with the Central Police Department in La Plata, Argentina, until his promotion to the head of the bureau of Anthropometric Identification. Vucetich, having studied Galton's research, began to experiment with fingerprints in 1891. He started recording the fingerprints of criminals and devised his own classification system (Lambourne, 1984, pp 58–59). **Vucetich's classification system and individualization of prisoners through the use of fingerprints were the first practical uses of the fingerprint science by law enforcement personnel.** Other countries soon looked into using a fingerprint system to identify prisoners. (For more on Vucetich, see Chapter 5.)

In 1892, in Buenos Aires, Argentina, a murder was solved using thumbprint evidence found at the crime scene. The two children of Francisca Rojas were found murdered. Rojas herself had a throat wound. She accused a man named Velasquez of the murder, stating that he was jealous because she refused to marry him since she was in love with another man. The local authorities brutally beat Velasquez hoping for a confession. When Velasquez did not confess, Inspector Eduardo Alvarez was brought in from La Plata to

conduct a thorough investigation. Inspector Alvarez began by examining the scene of the crime and found a bloody thumbprint on the door. Having been trained by Juan Vucetich to compare fingerprints, Alvarez removed the section of the door with the print and compared the bloody thumbprint with the thumbprints of Francisca Rojas. When confronted and shown that her own thumbprint matched the thumbprint on the door, she confessed to the murders (New Scotland Yard, 1990, pp 8–9; Beavan, 2001, pp 114–116). **The Rojas murder case is considered to be the first homicide solved by fingerprint evidence, and Argentina became the first country to rely solely on fingerprints as a method of individualization** (Lambourne, 1984, pp 58–59).

The Troup Committee, named for its chairman, Charles Edward Troup, was formed in 1893 to investigate current and possible future methods of identifying habitual criminals in England. After extensive research into previous methods of identification (such as photographs and the memories of police officers) as well as the new methods of anthropometry and fingermarks, the Troup Committee came to a compromise. The committee, like Sir Francis Galton, recognized weaknesses inherent in the filing and retrieving of fingermarks. Anthropometry and fingerprints were both considered to be effective methods of identification, but at the time, fingerprints did not have an adequate classification system. The committee thus felt compelled to use both systems and recommended that five major anthropometric measurements be taken and used for primary classification and that fingermarks be attached as an additional component of the classification system. The committee's recommendations were followed in England and in Bengal. By 1894, all newly arrested criminals were measured and fingerprinted in those two jurisdictions (Lambourne, 1984, pp 46–51).

In 1894, Sir Edward Richard Henry (Figure 1–11), Inspector General of Police for the Lower Provinces, Bengal, collaborated with Galton on a method of classification for fingerprints. With the help of Indian police officers Khan Bahadur Azizul Haque and Rai Bahaden Hem Chandra Bose, the Henry classification system was developed. Once the classification system was developed and proved to be effective, Henry wrote to the government of India asking for a comparative review of anthropometry and fingerprints. Charles Strahan, Surveyor General of India, and Alexander Pedler, a chemist, were sent to Bengal to meet with Henry to investigate the two methods of identification. Toward the end of March 1897, they sent a report to the government of India that stated, "In conclusion, we are of opinion that the method of identification by means of finger prints, as worked on the system of recording impressions and of classification used in Bengal, may be safely adopted as being superior to the anthropometrics method—(1) in simplicity of working; (2) in the cost of apparatus; (3) in the fact that all skilled work is transferred to a central or classification office; (4) in the rapidity with which the process can be worked; and (5) in the certainty of the results." (Henry, 1934, p 79) Thus in 1897, the government of India sanctioned the sole use of fingerprints as a means of identification for prisoners. (For more on Henry, see Chapter 5.)

Just as the use of friction ridge skin for individualization was becoming more prevalent, research to better understand its evolution and purpose was also proceeding. **David Hepburn of the University of Edinburgh, Scotland, is credited with being the first to recognize that friction ridges assist with grasping** by increasing the level of friction between the ridges and the grasped object. Hepburn's paper, "The Papillary Ridges on the Hands and Feet of Monkeys and Men", published in 1895 (Hepburn, 1895, pp 525–537), dealt with the evolution of the volar pads and named two of the volar pads found in the palm: the hypothenar and thenar. As research into the form and function of friction ridge skin increased, so did the study on how to use fingerprints effectively as a means of individualization.

Harris Hawthorne Wilder, Professor of Zoology at Smith College, was studying primates when he was struck by the resemblance of their volar friction ridges to those of humans. Wilder published his first paper in 1897, entitled "On

FIGURE 1–11

Sir Edward Richard Henry (1850–1931). (Reprinted from Finger Print Publishing Association (1919). Courtesy of West Virginia University Libraries.)

the Disposition of the Epidermic Folds Upon the Palms and Soles of Primates". During the next three decades, Wilder continued research in morphology (the biological study of the form and structure of living organisms), the methodology of plantar and palmar dermatoglyphics (the study of friction ridges) (Cummins and Midlo, 1943, p 22), genetics, and racial differences. **Wilder was the first to suggest that the centers of disturbance of primate friction ridge formations actually represented the locations of the volar pads.** He also developed the hypothesis of a relationship between primate friction ridge patterns and volar pads.

A criminal case in Bengal in 1898 is considered to be the first case in which fingerprint evidence was used to secure a conviction (Sodhi and Kaur, 2003b, pp 1–3):

> The manager of a tea garden situated in the district of Julpaiguri on the Bhutan frontier was found lying on his bed with his throat cut, his despatch box and safe having been rifled and several hundred rupees carried away. It was suggested that one of the coolies employed on the garden had committed the deed, as the deceased had the reputation of being a hard taskmaster, or that his cook, upon whose clothes were some blood spots, might be the culprit. There was suspicion also against the relatives of a woman with whom the murdered man had a liaison, also against a wandering gang of Kabulis of criminal propensities who had lately encamped in the neighbourhood. A representation was also made that the deceased had an enemy in an ex-servant whom he had caused to be imprisoned for theft. Inquiry, however, satisfied the police that there was no evidence to incriminate the coolies or the relatives of the woman or the Kabulis, and it was ascertained that the ex-servant had been released from jail some weeks before, and no one could say that he had since been seen in the district. The cook's statement that the marks on his clothes were stains from a pigeon's blood which he killed for his master's dinner was supported by the Chemical Analyst's report. Fortunately amongst the papers in the despatch box was found a calendar in book form, printed in the Bengali character, with an outside cover of light-blue paper on which were noticed two faint brown smudges. Under a magnifying glass one smudge was decipherable as a portion of the impression of one of the digits of some person's right hand. In the Central Office of the Bengal Police, the finger impressions of all persons convicted of certain offences are classified and registered, and the impression on the calendar when compared there was found to correspond exactly with the right thumb impression of Kangali Charan, the ex-servant above referred to. He, in consequence, was arrested in Birbhum, a district some hundreds of miles away, and brought to Calcutta, where his right thumb impression was again taken, and the police in the meantime set about collecting corroborative evidence. The Chemical Examiner to Government certified that the brown marks on the calendar were mammalian blood, the inference being that the actual murderer or some associate had knocked his blood-stained thumb against the calendar when rummaging amongst the papers in the despatch box for the key of the safe. The accused was committed to stand his trial before a judge and assessors, charged with murder and theft, and finally was convicted of having stolen the missing property of the deceased, the assessors holding that it would be unsafe to convict him of murder as no one had seen the deed committed, but recording their opinion that the charge of theft had been conclusively established against him. This conviction was upheld by the judges of the Supreme Court, to which the case was taken on appeal (Henry, 1934, pp 57–60).

In December 1900, the Belper Committee in England, chaired by Lord Belper, recommended that all criminal identification records be classified by the fingerprint system (Lambourne, 1984, p 64). **With this recommendation, the Henry Classification System and the individualization of criminals by means of fingerprints became standard practice in England and would eventually be adopted in most English-speaking countries.** During this transition, other events taking place would also demonstrate the advantage of recording friction ridge skin.

1.6 20th Century

The first trial in England that relied on fingerprint evidence involved Inspector Charles Stockley Collins of Scotland Yard. Collins testified to an individualization made in a burglary case. **That 1902 trial and subsequent conviction marked the beginning of fingerprint evidence in the courts of England** (Lambourne, 1984, pp 67–68).

In October 1902, Alphonse Bertillon, made an individualization in Paris, France, with fingerprints:

> On October 17, 1902, he [Bertillon] was called to aid the investigation of the murder of Joseph Reibel. A glass panel from a nearby cabinet had been broken, and

some bloody fingerprints were discovered on one of the broken pieces. These were dutifully photographed and preserved. After determining that they did not match the victim's prints, Bertillon began a search of his anthropometric cards, upon which, by that late date, he had added fingerprint impressions as a routine matter in addition to his measurements. Eventually he found a card which contained fingerprint impressions that showed areas that matched the prints taken from the crime scene. The report of the case describes the isolation of three points of resemblance in the thumb-print, four in the index and middle finger, and six in the print from the ring finger. The murderer, Henri Leon Scheffer, was apprehended and brought to justice. (Kingston and Kirk, 1965, p 62)

As a result of the above case, Bertillon is given credit for solving the first murder in Europe with the use of only fingerprint evidence.

The first systematic use of fingerprints in the United States was in 1902 by Dr. Henry P. de Forest of the New York Civil Service Commission. De Forest established the practice of fingerprinting civil service applicants in order to prevent imposters from taking tests for otherwise unqualified people. Applicants were fingerprinted when they submitted their applications, when they turned in each test, and when they officially reported to duty (de Forest, 1938, pp 16–20).

In 1903, after several months of fingerprinting criminals upon their release, Captain James H. Parke of New York state developed the American Classification System. **The use of the American Classification System and subsequent fingerprinting of all criminals in the state of New York was the first systematic use of fingerprinting for criminal record purposes in the United States** (McGinnis, 1963, pp 4–5). Although the American Classification System did not gain widespread acceptance throughout the United States, it did not take long before the science of fingerprints spread nationwide.

Within fingerprint history, there is a famous story about an incident that signaled the downfall of the use of anthropometric measurements in favor of fingerprinting. A man was arrested in 1903 and brought to the Leavenworth prison in Kansas. The man claimed that his name was Will West and that he had never been previously arrested. Prison personnel took the man's Bertillon measurements and his photograph to facilitate a prison records check. The records showed that a man named William West, with very similar anthropometric measurements and a striking resemblance to the new inmate, was already incarcerated in Leavenworth prison. Guards sent to check William West's cell may have suspected they were dealing with an escapee; instead, they found William West asleep in his bed. After comparing records of both men, prison personnel seemed unable to tell the men apart. Upon taking and comparing the fingerprints of both prisoners, it was clear that the fingerprint method of identification could distinguish between the two men. (Cole, 2001, pp 140–146; Chapel, 1941, pp 11–13).

The William and Will West story is somewhat sensationalized and omits prison record information, uncovered by later researchers, indicating that William and Will West both corresponded with the same family members and thus were probably related. Prison records also cite that Leavenworth inmate George Bean reported that he knew William and Will West in their home territory before prison, and that they were twin brothers (Nickell, 1980, pp 3–9). Their exact relationship is still unknown. What is factual is that the two West men were not unusual; many people have similar anthropometric measurements. It is generally accepted that identical twins will have the same or almost the same anthropometric measurements, yet easily differentiated fingerprints. The superiority of fingerprints over anthropometry is thus clear.

At the 1904 World's Fair in Saint Louis, there were three booths demonstrating identification methods. One booth displayed the anthropometric method and was run by Emerson E. Davis from New York. Captain James J. Parke, from New York, and Inspector John Kenneth Ferrier, of New Scotland Yard, each set up a booth displaying the fingerprint method of identification. Inspector Ferrier discussed the fingerprint method with many individuals at the fair, several of whom were in charge of their own police departments throughout the United States. He also showed visitors an instance where the anthropometric measurements of two men varied by only a millimeter and how the fingerprints were different (Myers, 1938, p 19). After the fair, Ferrier remained in the United States to teach fingerprinting, including how to use powder to develop latent prints (Myers, 1938, pp 19–21). Ferrier's students went on to teach fingerprinting to law enforcement and military communities throughout the rest of America.

On October 19, 1904, Inspector Ferrier and Major M. W. McClaughry began fingerprinting all inmates at the Leavenworth, KS, federal prison. **These fingerprint**

records became the beginning of the U.S. Government's fingerprint collection (Myers 1938, pp 19–20).

In 1904, Inez Whipple published the paper, "The Ventral Surface of the Mammalian Chiridium". Whipple's survey into mammalian palm and sole configurations formed an important part of the modern scientific knowledge on the subject and is considered a landmark in the fields of genetics and ridgeology (Ashbaugh, 1999, p 43). Her treatise was on the evolution of friction ridge skin and its development as mankind evolved. Whipple theorized that mammals lost hair from scales on volar surfaces; volar scales fused into rows; and ridges evolved according to the need for friction to facilitate locomotion and grasping. She gave locations of the volar pads and explained possible forces that affect ridge growth. (Whipple, 1904, pp 261–368). Whipple, who became Inez Wilder after marriage, was undoubtedly influenced by her coworker and husband, Harris Hawthorne Wilder (see p 16).

In 1905, Inspector Charles S. Collins of Scotland Yard testified to the individualization of a suspect's fingerprint on a cash box. The case involved the murder of a man and his wife. Two brothers, Alfred and Albert Stratton, were the defendants. Collins explained to the jury the classification of fingerprints and how to effect an individualization. Then, he demonstrated the characteristics he had marked on a chart as matching Alfred Stratton's right thumb. Collins claimed that in all his years of experience, he had never found two prints to have more than three characteristics in common. In this case, there were 11 characteristics in common. Supplementing eyewitness statements, the individualization of Alfred Stratton's right thumb impression was the strongest piece of evidence in the case. Both brothers were found guilty of the murders and sentenced to death. This case is referred to as the Deptford Murder Trial, in reference to the address of the crime, and **it was the first murder trial in England in which fingerprints were used as evidence.**

Also in 1905, in the case of *Emperor* v *Abdul Hamid,* a court in India decided that no expert was required to testify to the individualization of prints, and an appellate court agreed. They believed that participants in the court could just as easily make a comparison as anyone else and that an expert was not necessary (Cole, 2001, p 170). Other courts would later disagree with the position that no expertise is required to individualize fingerprints.

Murder suspect Thomas Jennings was convicted in 1910 after testimony by four experts who individualized Jennings' fingerprints from a porch railing at the crime scene. The experts were Michael P. Evans, head of the Bureau of Identification of the Chicago Police Department; William M. Evans, previously of the Bureau of Identification of the Chicago Police Department; Edward Foster, an inspector with Dominion Police in Ottawa, Canada; and **Mary Holland, a trainer of Navy* personnel and the first American female instructor of fingerprinting.** All four witnesses testified that the fingerprints on the railing were made by Jennings. Other evidence also incriminated the defendant, such as Jennings's proximity to the murder scene 13 minutes after the murder while carrying a recently fired pistol containing cartridges similar to ones found at the murder scene.

The defense appealed the case, claiming the fingerprint evidence was improperly admitted and that it was not necessary to use a fingerprint examiner as an expert witness. The opinion delivered by the Illinois appellate court confirming the conviction including the following:

> We are disposed to hold from the evidence of the four witnesses who testified and from the writings we have referred to on this subject, that there is a scientific basis for the system of finger-print identification and that the courts are justified in admitting this class of evidence; that this method of identification is in such general and common use that the courts cannot refuse to take judicial cognizance of it.
>
> From the evidence in this record we are disposed to hold that the classification of finger-print impressions and their method of identification is a science requiring study. While some of the reasons which guide an expert to his conclusions are such as may be weighed by any intelligent person with good eyesight from such exhibits as we have here in the record, after being pointed out to him by one versed in the study of finger prints, the evidence in question does not come within the common experience of all men of common education in the ordinary walks of life, and therefore the court and jury were properly aided by witnesses of peculiar and special experience on this subject. [*People* v *Jennings* 1911, pp 9–10]

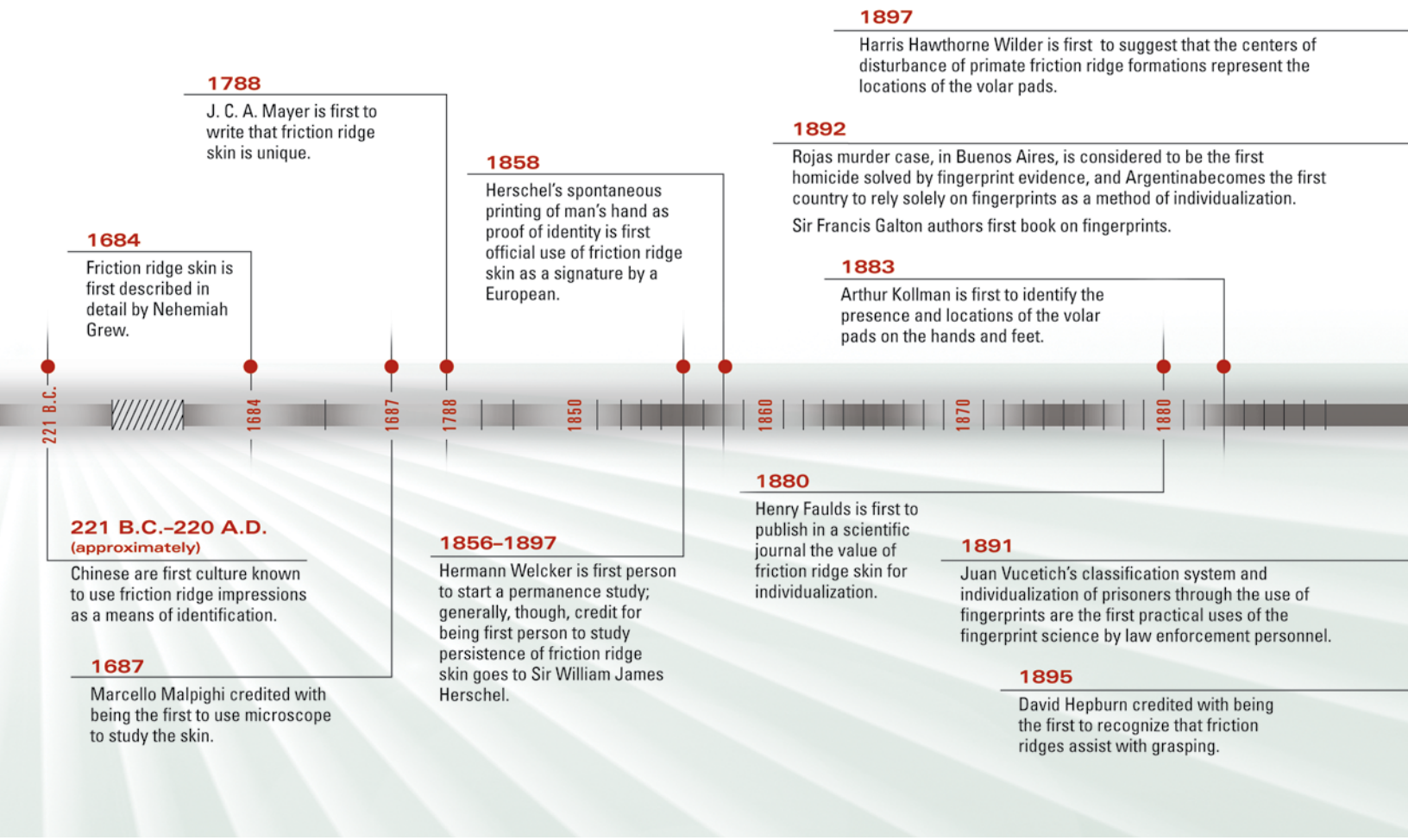
After being upheld on appeal, ***People* v *Jennings* became a landmark legal case because it was the first American**

*In 1907, the Navy adopted the practice of fingerprinting of applicants (Myers, 1938, p 15).

appellate case regarding the admissibility of fingerprint expert testimony. The appellate court concluded that fingerprint identification is a science and that expert testimony was appropriate to aid members of the court in understanding fingerprint evidence.

In 1911, Lieutenant Joseph Faurot, a New York Police Department fingerprint expert presented testimony in a burglary case. He individualized defendant Charles Crispi's fingerprint on a pane of glass removed from a door at the crime scene point of entry. In a dramatic courtroom demonstration, Faurot took the inked prints of the 12 jurors and other court personnel and then left the room. Faurot's assistant had a jury member place a print on a pane of glass to simulate the conditions of the burglary. Faurot returned to the courtroom, developed the print left on the glass, and identified the developed print to the proper juror. Next, Faurot gave each juror a set of charts showing marked characteristics in common between the known prints of Crispi and the print left on the piece of glass at the burglary scene. Each juror was then able to compare the prints along with Faurot. The demonstrations were so impressive that the defendant changed his plea to guilty. ***People* v *Crispi* (1911) is considered to be the first conviction obtained with fingerprint evidence alone in the United States** (despite the defendant's courtroom plea

A TIMELINE OF FINGERPRINT FIRSTS

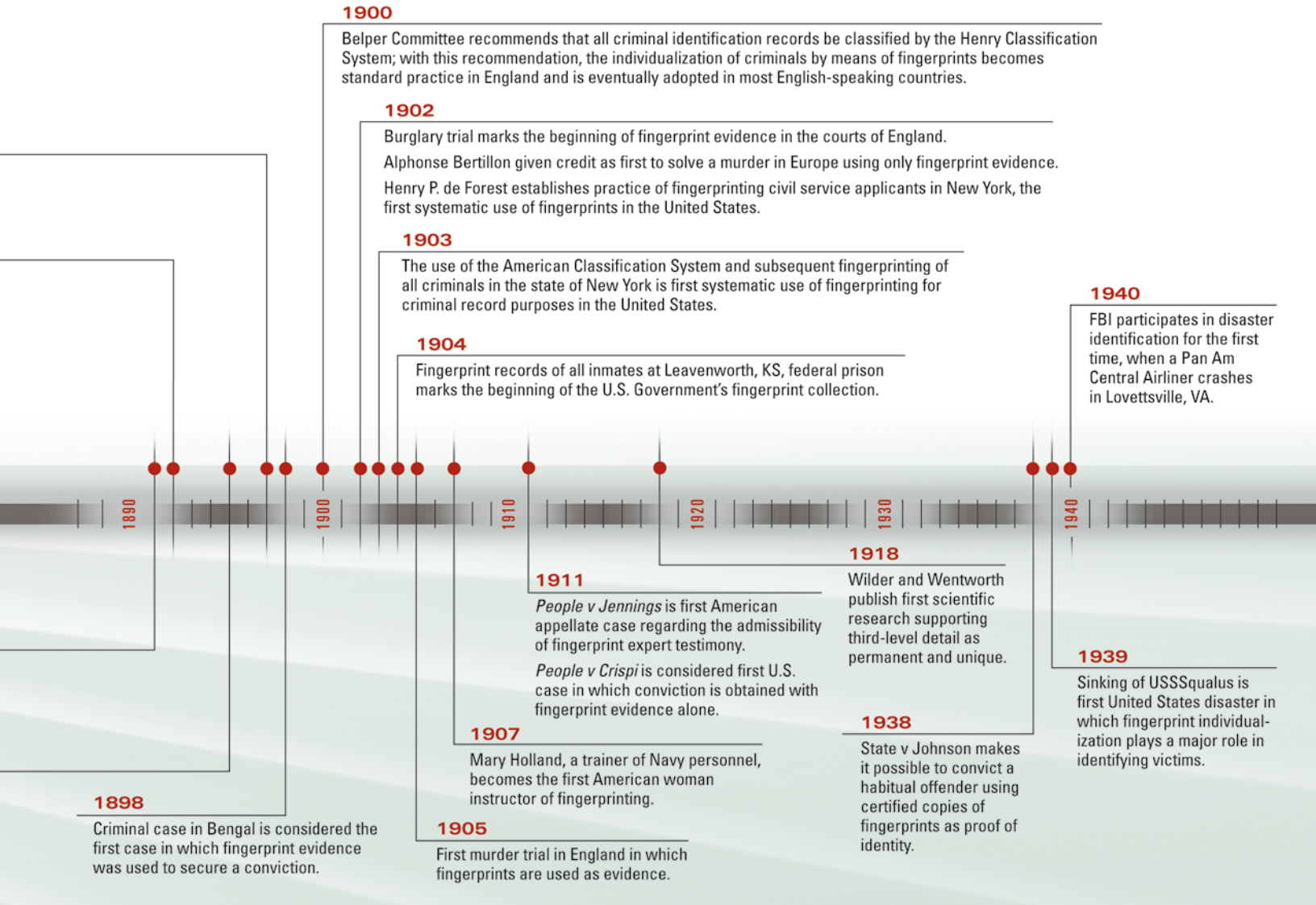


change) (Cole, 2001, pp 181–185; Wilder and Wentworth, 1918, pp 283–284).

In 1914, Dr. Edmond Locard published "The Legal Evidence by the Fingerprints". Locard was Director of the Laboratory of Police at Lyons, France, and was a student of Alphonse Bertillon. Locard's 1914 article, and others published soon afterwards, explained the theory of poroscopy and how the use of pores could supplement a fingerprint comparison by lending supporting data. Dr. Locard's study into the sweat pores of friction ridge skin is one more example of law enforcement personnel conducting research into fingerprint science (Locard, 1914, p 321).

In 1918, Harris Hawthorne Wilder and Bert Wentworth (Police Commissioner of Dover, NH) collaborated to publish *Personal Identification: Methods for the Identification of Individuals, Living or Dead,* exemplifying how, through joint effort, the fields of science and law enforcement could function together.

In their book, Wilder and Wentworth state, "The patterns of the friction skin are individual, and, taken together, impossible to duplicate in another individual. The separate ridges, too, show numerous details, which are also so individual that a small area of friction skin, taken even in the most featureless portion, cannot be matched by any other piece"



(Wilder and Wentworth, 1918, p 134). **This was the first scientific research supporting third level detail as permanent and unique.**

Because of the use of friction ridge skin as a means of identification, prisons throughout the United States acquired large fingerprint collections. The collections from Leavenworth and the files of the National Police Bureau of Criminal Identification were combined (810,188 records) on July 1, 1924, establishing the Identification Division in the U.S. Justice Department's Bureau of Investigation. The Identification Division was placed under the charge of a young assistant director of the Bureau named John Edgar Hoover (Cole, 2001, pp 238, 245; Myers, 1938, p 8). Eventually the Bureau of Investigation would become the Federal Bureau of Investigation (FBI), led by J. Edgar Hoover for many years.

In April 1939, the Supreme Court of Washington State upheld the decision of the Superior Court of King County on the conviction of a habitual offender. **This was a major step, because the case decision (*State* v *Johnson,* 1938) made it possible to convict a habitual offender using certified copies of fingerprints as proof of identity as opposed to requiring officials from other locations to testify to prior convictions to establish the individual as a habitual offender** (Myers, 1942, p 16).

Fingerprint individualization has also been used in noncriminal matters, such as the identification of disaster victims. **The first United States disaster in which fingerprint individualization played a major role was when the *USS Squalus* sank on May 23, 1939.** The submarine sank stern-first to the bottom of the ocean in 240 feet of water. James Herbert Taylor, Superintendent of the Identification Division, United States Navy, conducted the identification operation. All the bodies were identified through the use of fingerprints (Myers, 1942, p 18).

In 1940, a court in Hamilton, TX, declared the fingerprint method of identification to be valid. Newton Grice was convicted of burglary based on his fingerprint on a pane of glass removed from a door. Grice appealed the conviction on the grounds that the fingerprint evidence was insufficient to prove that he had been at the location and handled the item in question. The appellate judge, Thomas Beauchamp, proclaimed that since thousands of prints had been taken, classified, and filed in the United States, with none being the same as any other, there was more than enough proof that fingerprints are unique. The judge ruled that defense attorneys need to take the time to actually find prints that are in common in two different individuals rather than simply make the argument that it is possible. Judge Beauchamp upheld the conviction and stated that he felt that fingerprints are unique, and he placed the burden of proof on the defense to prove that fingerprints are not unique (Myers, 1942, pp 22–23).

Also in 1940, the FBI participated in disaster identification for the first time, when a Pan Am Central Airliner crashed in Lovettsville, VA, with an FBI agent and an FBI stenographer on board. The members of the FBI Identification Division's Single Fingerprint Section were dispatched to identify the bodies of the FBI employees. FBI fingerprint specialists helped identify the bodies of all 25 victims from the crash. This was the beginning of the FBI Disaster Squad, which still responds to disasters today.

Several years later, Dr. Harold Cummins (1893–1976) of Tulane University in New Orleans, LA, conducted a great deal of research on friction ridge skin. By examining fetuses in various stages of growth and health, Cummins made many contributions to the modern understanding of friction ridge skin. Cummins's book *Fingerprints, Palms, and Soles—An Introduction to Dermatoglyphics* (published in 1943 with his coauthor Charles Midlo) describes the formation and development of volar pads on the human fetus. Cummins notes that volar pad regression takes place almost concurrently with the beginning of friction ridge development; that the size, location, growth, and configuration of the volar pad affects the friction ridge patterns; and that disease or birth defects have an effect on the growth of volar pads (Cummins and Midlo, 1943, pp 178–186).

In 1952, Dr. Alfred R. Hale, also of Tulane University, published a thesis titled "Morphogenesis of the Volar Skin in the Human Fetus". By studying cross sections of fetal skin, Hale was able to describe the formation of friction ridges during fetal development and the differential growth of friction ridges, which is the major premise of friction ridge identification (Ashbaugh, 1999, p 53).

Salil Kumar Chatterjee (1905–1988) of Calcutta, India, published the book *Finger, Palm, and Sole Prints* in 1953, but Chatterjee is best known for his 1962 article "Edgeoscopy" (Chatterjee, 1962, pp 3–13), in which he described his theory of using specific ridge-edge shapes to supplement fingerprint individualization. He defined ridge shapes including

straight, convex, peak, table, pocket, concave, and angle. Chatterjee believed that these edge shapes could be used to assist in making individualizations (Ashbaugh, 1999, p 160). (For more on Chatterjee, see Chapter 5.)

In 1976, Dr. Michio Okajima of Japan published the paper "Dermal and Epidermal Structures of the Volar Skin". The main contribution from his work is the study of incipient ridges, which appear as smaller ridges in friction ridge impressions (Ashbaugh, 1999, p 58).

In 1984, Brigitte Lacroix, Marie-Josephe Wolff-Quenot, and Katy Haffen of Strasbourg, France, published "Early Human Hand Morphology: An Estimation of Fetal Age". The paper discussed the three phases of the development of the hand (Ashbaugh, 1999, pp 58–59).

Dr. William Babler of Marquette University in Milwaukee, WI, published "Embryological Development of Epidermal Ridges and Their Configurations" in 1991. That paper reviewed prior work by other scientists and the research Babler performed relative to the "prenatal relationship between epidermal ridge dimension and bone dimension of the hand" (Babler, 1991, p 106).

1.7 Conclusion

Study, research, and experimentation have led to and supported fingerprints as a means of individualization and a forensic tool of incalculable value. The research and practical knowledge accumulated over the course of many centuries well supports the science.

As time moves forward and people continue to study any science, that science grows and becomes better understood. No one has said it better than Johann Wolfgang von Goethe: "The history of a science is the science itself" (Kline, 1980, p 7).

1.8 Reviewers

The reviewers critiquing this chapter were Debbie Benningfield, Mike Campbell, Christine L. Craig, Laura A. Hutchins, Ginger A. Kobliska, William F. Leo, Bridget Lewis, Charles Richardson, Michelle L. Snyder, and Juliet H. Wood.

1.9 References

Ashbaugh, D. R. *Quantitative-Qualitative Friction Ridge Analysis: An Introduction to Basic and Advanced Ridgeology;* CRC Press: Boca Raton, FL, 1999.

Babler, W. J. Embryologic Development of Epidermal Ridges and Their Configurations. In *Dermatoglyphics: Science in Transition;* Plato, C., Garruto, R. M., Schaumann, B. A., Eds.; Birth Defects: Original Article Series; March of Dimes: New York, 1991; pp 95–112.

Beavan, C. *Fingerprints: The Origins of Crime Detection and the Murder Case That Launched Forensic Science;* Hyperion: New York, 2001.

Berry, J.; Stoney, D. A. History and Development of Fingerprinting. In *Advances in Fingerprint Technology,* 2nd ed.; Lee, H. C., Gaensslen, R. E., Eds.; CRC Press: Boca Raton, FL, 2001; pp 1–40.

Caplan, J., Torpey, J. Eds. *Documenting Individual Identity: The Development of State Practices in the Modern World;* Princeton University Press: Princeton, NJ, 2001.

Chapel, C. E. *Fingerprinting: A Manual of Identification;* Coward McCann: New York, 1941.

Chatterjee, S. K. Edgeoscopy. *Finger Print and Ident. Mag.* 1962, *44* (3), 3–13.

Cole, S. A. *Suspect Identities: A History of Fingerprinting and Criminal Identification*; Harvard University Press: Cambridge, MA, 2001.

Cummins, H.; Midlo, C. *Finger Prints, Palms and Soles: An Introduction to Dermatoglyphics*; Dover: New York, 1943.

de Forest, H. P. The First Finger-Print File in the United States. *Finger Print and Ident. Mag.* 1938, 19, 16–20.

Faulds, H. On the Skin—Furrows of the Hand. *Nature* 1880, 22, 605.

Faulds, H. A Manual of Practical Dactylography. London: The "Police Review" Publishing Co., Ltd., 1922.

Felsher, I. M. A Quick Look at Dermatoglyphics. *Ident. News* 1962, *12* (7), 6–12.

Finger Print Publishing Association. *Finger Print Magazine* 1919, 1 (1), cover photo.

Galton, F. *Finger Prints;* MacMillan: New York, 1892.

Hale, A. Morphogenesis of Volar Skin in the Human Fetus. *Am. J. Anat.* 1952, *91* (1), 147–173.

Henry, E. R. *Classification and Uses of Fingerprints,* 7th ed.; H. M. Stationery Office: London, 1934.

Hepburn, D. The Papillary Ridges on the Hands and Feet of Monkeys and Men. *Scientific Transactions of the Royal Dublin Society* 1895, *5* (2), 525–537.

Herschel, W. J. *The Origin of Finger-Printing;* Oxford University Press: London, 1916.

Kingston, C. R.; Kirk, P. L. Historical Development and Evaluation of the "12 Point Rule" in Fingerprint Identification. *Int. Crim. Police Rev.* 1965, *20* (186), 62–69.

Kline, M. *Mathematics: The Loss of Certainty*; Oxford University Press: New York, 1980.

Lambourne, G. *The Fingerprint Story;* Harrap: London, 1984.

Laufer, B. *History of the Finger-Print System;* Smithsonian Institution: Washington, DC, 1912.

Locard, E. La Preuve Judiciaire par les Empreintes Digitales (The Legal Evidence by the Fingerprints). *De Médecine Légale et de Psychologie Normale et Pathologique (Of Forensic Medicine and of Normal and Pathological Psychology)* 1914, *29,* 321.

Locy, W. A. *Biology and its Makers;* Henry Holt and Co.: New York, 1908; p 204.

McClaughry, M. W. History of the Introduction of the Bertillon System Into the United States. *Finger Print Magazine* 1922, 3 (10), 4.

McGinnis, P. D. *American System of Fingerprint Classification;* New York State Department of Correction, Division of Identification: New York, 1963.

Myers, H. J. II. The First Complete and Authentic History of Identification in the United States. *Finger Print and Ident. Mag.* 1938, *20* (4), 3–31.

Myers, H. J. II. Supplemental History of Identification in the United States. *Finger Print and Ident. Mag.* 1942, *25* (6), 3–28.

New Scotland Yard. *Fingerprint History: A Synopsis of the Development of the System of Fingerprint Identification with Particular Reference to New Scotland Yard;* Metropolitan Police, New Scotland Yard: London, 1990.

Nickell, J. The Two Will Wests—A New Verdict. *J. Police Sci. and Admin.* 1980, *8* (4), 406–413.

Pearson, K. *The Life, Letters and Labours of Francis Galton, Volume I: Birth 1822 to Marriage 1853.* London: Cambridge University Press, 1914.

People v *Jennings* (*State of Illinois* v *Jennings*), 252 Ill. 534, 96 N.E. 1077 (1911).

Rhodes, H. *Alphonse Bertillon: Father of Scientific Detection;* Abelard-Schuman: London, 1956.

Sodhi, G. S.; Kaur, J. Indian Civilization and the Science of Fingerprinting. *Indian J. of Traditional Knowledge* 2003a, *2* (2), 126–136.

Sodhi, G. S.; Kaur, J. World's First Conviction on Fingerprint Identification. *National Crime Records Bureau Gazette* 2003b, *15* (2), 1–3.

State v *Johnson* (*State of Washington* v *Johnson*), 194 Wash. 438, 78 P. 2d 561 (1938).

Twain, M. *Life on the Mississippi;* James R. Osgood & Co.: Boston, 1883. (U.S. edition).

Twain, M. *The Tragedy of Pudd'nhead Wilson;* C.L. Webster: New York, 1884.

Whipple, I. L. The Ventral Surface of the Mammalian Chiridium. *Zeitschrift für Morphologie und Anthropologie (Journal of Morphology and Anthropology)* 1904, *7,* 261–368.

Wilder, H. H.; Wentworth, B. *Personal Identification*; The Gorham Press: Boston, 1918.

Xiang-Xin, Z.; Chun-Ge, L. The Historical Application of Hand Prints in Chinese Litigation. *J. Forensic Ident.* 1988, *38* (6), 277–284.

1.10 Additional Information

Åström, P.; Eriksson, S. A. Fingerprints and Archaeology. In *Studies in Mediterranean Archaeology;* Paul Åströms förlag: Göteborg, Sweden, 1980.

Cole, S. A. Grandfathering Evidence: Fingerprint Admissibility Rulings from Jennings to Llera Plaza and Back Again. *Am. Crim. L. Rev.* 2004, *41* (3), 1189–1276.

Kevles, D. J. *In the Name of Eugenics, Genetics and the Uses of Human Heredity;* Knopf: New York, 1985.