Key Concepts of Chapter 4:

**History of Fingerprint Identification**

- 100 years of practical application has established the permanence and uniqueness of fingerprints
- 650 A.D. China – Kia Kung-Yen
  - Historian
  - Earliest known use of fingerprints for identification
  - Prints placed on contracts to provide a positive means of identification
  - Unknown, but generally believed, that the Chinese understood the unique nature of fingerprints
- 1685 – Marcello Malphighi
  - Professor at the University of Bologna, Italy
  - Used a microscope for the first time to examine friction skin and observed as to its structure
- 1788 – Dr. J.C.A. Mayer
  - Medical book on human anatomical illustrations
  - One of earliest recordings supporting the uniqueness of fingerprints
  - Book included drawings of friction skin on fingers
  - “Although the arrangements 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 certain likeness”
- 1823 – Dr. J.E. Purkinje
  - Czech Physiologist and Professor of Anatomy at the University at Breslau
  - Classified fingerprint patterns into 9 groups
- 1856-1897 – Hermann Welcker
  - German anthropologist at the University of Halle
  - Conducted first study (34 years) into the permanence of the details of friction ridges
- Late 1800’s – Sir William Herschel of England
  - Observed fingerprints were unique and unchanging
  - Noted that recorded fingerprints could be used for personal identification
  - Used fingerprints for identification purposes as magistrate in India
  - Made longest study demonstrating the permanence of fingerprints
  - Noted prints taken 57 years apart did not show the slightest change in the detail
- 1880 – Dr. Henry Faulds
  - Medical doctor and scientific researcher of Scottish descent
  - Published letter in *Nature* stating fingerprints found at crime scenes, such as prints in blood, could be used to identify criminals
  - Made observations of the uniqueness and permanence of fingerprints
- 1883 – Alphonse Bertillon
  - Developed personal identification system of anthropometry
  - Used body measurements to show the differences between individuals
  - Nature never repeats was foundation of system (biological uniqueness)
Eventually phased out in favor of fingerprints

- **1890’s – Sir Francis Galton**
  - Noted scientist and anthropologist specializing in genetics, human heredity, and biological variation
  - Assigned names to major ridge characteristics: bifurcation, ridge ending, island and enclosure (“Galton Details”)
  - Statistical study stated chance of a duplicate fingerprint was 1:64 billion
  - Population of the earth today is estimated to be 5-6 billion
  - *Genetics* (1995) study still valid and provides conservative statistical assessment of chance of a duplicate fingerprint

- **1892 – Juan Vucetich**
  - Head of an identification bureau in Argentina
  - First to introduce bloody prints into evidence during a double murder trial
  - Resulted in a conviction
  - Developed fingerprint classification system used in most Spanish speaking countries

- **1897 – Sir Edward Henry**
  - Developed fingerprint classification system for the storage and retrieval of complete sets of fingerprints
  - System currently being used in most English speaking countries
  - Automated fingerprint identification systems (AFIS) are beginning to phase out manual classification systems

- **1904 – Izen Whipple**
  - Professor of biology
  - Published *The Ventral Surface of the Mammalian Chiridium – With Special Reference to the Conditions Found in Man*
  - Foundation of the modern scientific knowledge into the formation of friction skin

- **1904 – First fingerprint identification bureaus in U.S. were established**
  - Due to fingerprint identification exhibits at St. Louis World’s Fair and the annual meeting of the International Association of Chiefs of Police at the same location
  - Fingerprint identification was already well established in England and British possessions

- **1907 – U.S. Navy began using fingerprints to establish positive identification of service members**
  - Required placement of service member’s thumb print in an acid etching on the backside of their dog tags
  - Placing fingerprints on dog tags was phased out sometime near beginning of World War II

- **1918 – Dr. Harris Wilder and Bret Wentworth published the textbook, *Personal Identification***
  - Professor of Zoology
  - Discussed extensive research into uniqueness of friction skin (third level detail)
  - Reinforces principle of biological uniqueness
  - Statistical study revealed all areas of friction skin are unique
  - Concluded that the chance 2 different fingerprints would possess 9 characteristics in the same position and relationship would be 1: 1,953,125 quadrillion
1924 – **FBI established**
- 810,000 inked fingerprint cards
- Today automated filing contains over 40 million people

1943 – Harold Cummings, Ph.D. and Charles Midlo, M.D.
- Professors of Anatomy at Tulane University
- Authored *Fingerprints, Palms and Soles*
- Details medical research into structure of friction skin and current scientific basis establishing all areas of friction skin are unique and permanent

1952 – Alfred Hale, Ph.D.
- Published *Morphogenesis of Volar Skin in the Human Fetus*
- Scientific research into the formation of friction skin
- Explained differential growth and random formation of the ridges that show uniqueness

1970’s – First automated fingerprint identification systems (AFIS) developed
- By mid-1980’s, AFIS were well established in law enforcement agencies throughout the world
- In the last 30 years, millions of fingerprint files are in these computerized databases of filing, matching, and retrieval systems

**History of Fingerprint Identification**
- No two fingerprints have been found to be identical using these systems
  - Provides additional reinforcement for uniqueness of complete fingerprints and partial prints found at crime scenes
  - Most compelling statistical study supporting the uniqueness of friction skin

1976 – Dr. Michio Okajima
- Published *Dermal and Epidermal Structures of the Volar Skin*
- Provided additional confirmation on how friction skin is formed

1980 to present – **Dr. William Babler**
- Marquette University
- Studied and published on formation of friction skin
  - *Embryologic Development of Epidermal Ridges and Their Configurations*
  - *Quantitative Differences in Morphogenesis of Human Epidermal Ridge*
- Testified in 1999 at the first Daubert Hearing on fingerprints that all areas of friction skin, including individual ridge units, are unique

1999 – Lockheed-Martin and FBI
- Performed computerized statistical study checking 50,000 fingerprints with the same pattern against themselves
- Results showed that the chance of 4 like characteristics occupying the same positions and relationship in 2 different prints was beyond the population of the earth

**History of Fingerprint Identification**
- Since the 1600’s scientific and medical researchers have studied friction ridges found on the fingers, palms and feet
- Study relationship of fingerprints and their patterns to a person’s sex, race, heredity and various illnesses
Not used to create a super tool to identify criminals

- Theory that all areas of friction skin are unique and permanent has been verified
- Biological uniqueness of friction skin easily meets the standards of a “natural law”
- Referred to as a law by Wentworth and Wilder in *Personal Identification* (1918)
- Numerous articles from 1800s-1900s have been published in *Nature*
- Numerous articles within last 25 years have been published *Journal of Forensic Identification*

**Key Concepts of Chapter 7:**

**Tenets of Friction Skin Identification**

- **Unique**
  - All areas of friction skin are totally individual
  - Sufficient detail in a print allows for individualization
    - Only one person in the world could have a known print
- **Permanent**
  - Friction skin is formed during fetal life
  - Location, appearance, and relationships of features remain unchanged throughout lifetime
    - Permanent damage such as injuries that result in scars may change print
  - Individualization makes friction skin one of the best forms of personal identification available

**The Nature of Friction Skin**

- Friction skin
  - Corrugated skin structure located along undersides of fingers, palms, toes, and soles
  - Volar skin – term used by biologists
  - Fingerprint – term used by public
  - Made up of elevated areas (ridges) and depressions (furrows)
- Constructed of two main layers
  - Epidermis – outer layer of skin, made up of several smaller layers
    - Generating layer – innermost layer of epidermis that creates new cells
    - Outermost layer made up of mostly dead cells
  - Dermis – inner layer
    - Covered with double rows of peg-like formations called papillae
    - Each double row appears under 1 ridge
    - Injuries to the skin that go to the papillae or below will result in a scar
- Each friction ridge is made up of a series of ridge units joined together to form the ridge
  - Contains one sweat gland and one pore
  - Has a unique structure and appearance
- Pores along tops of ridges have random placement resulting in unique arrangements and appearance on the ridge
- General patterns on volar areas are influenced by heredity and follow a genetic master plan
  - Friction ridges are randomly formed due to biological variation
  - Biological variations are a result of environmental influences that occur during fetal development
    - Pressures, stresses, and other physical factors (i.e. disease and nutrition)
• No two areas of friction skin are the same
  o Identical twins may have similar friction skin patterns; however, individual ridge formations will not be the same
• Ridges become unique and permanent during the 4th month of fetal life
• All areas of friction skin are created in the same way and any area can be used equally well for identification

Anatomical Designations of the Hand
■ Terminology
  • Distal – refers to furthest distance to center of body; tip of longest finger
  • Proximal – refers to closest distance to center of body; area where hand connects to arm
  • Ulnar – refers to little finger/blade side of hand
  • Radial – refers to the thumb side of the hand
  • Phalange – finger
  • Volar pads – raised areas appearing on the palm
    o Interdigital area – pad below fingers
    o Hypothenar area – pad along ulnar side of palm
    o Thenar area – pad next to the thumb

Major Flexion Creases of the Hand
■ Permanent features that are somewhat consistent in their arrangements compared with other hands
■ Flexion creases are not wrinkles
■ Beginning of friction skin on the palm
■ Metacarpo-phalangeal crease separates palm from fingers (A)
■ 3 major flexion creases on the palm
  • Distal transverse crease (B)
  • Proximal transverse crease (C)
  • Radial longitudinal crease (D)
■ Bracelet creases separate hand from wrist (E)
■ Flexion creases occur at 2 joints on fingers:
  • Separates distal phalange from middle phalange
  • Separates middle phalange from proximal phalange

REFERENCE