UNIT 8 APPLIED ANTHROPOLOGY AND FORENSIC ANTHROPOLOGY*

Contents

Learning Outcomes:

After reading this unit the students will learn to:

- Define and understand the discipline of forensic anthropology;
- Describe the roles and functions of a forensic anthropologist;
- Identify the methods used by forensic anthropologists; and
- Grasp the profile of forensic anthropology in India.

8.0 INTRODUCTION

Since the inception of the anthropology as a discipline, it has had an applied aspect wherein the researchers and practitioners employed their anthropological approaches to solve practical problems. This aspect of anthropology was consequently termed as applied anthropology. Applied anthropology is defined as the application of anthropological theories, methods and knowledge to address the social, economic and health issues of a society and community. The scope of applied anthropology is divergent and interdisciplinary in nature and is mainly integrated within the four major branches of anthropology i.e. socio-cultural, physical/biological, archaeological and linguistic anthropology.

Anthropological practitioners employ their skills in a variety of settings or domains as policy researcher, ethnographer, health practitioner, project evaluator and as an expert witness to solve legal cases. Forensic anthropology is one such applied field of anthropology that employs the principles of anthropology to analyse legal problems involving human osteological remains. Experts in this field, because of their understanding of skeletal

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biology and associated subjects, examine human bones with the goal of extracting as much information as possible about persons represented by skeletal remains and about the circumstances surrounding their deaths (Byers, 2016).

This unit discusses the application of applied anthropology in the field of forensics and explores the establishment of forensic anthropology as an important subfield of anthropology. The unit also describes the historical background, roles and methods of forensic anthropology. Status and development of forensic anthropology in India has also been delineated in this unit.

8.1 FORENSIC ANTHROPOLOGY

Forensic anthropology is an applied sub-discipline of physical or biological anthropology. Forensic anthropologists use their knowledge of modern human skeletal variation to help law enforcement identify unknown decedents and, if possible, provide information about the circumstances surrounding that person's death. The American Board of Forensic Anthropology defines forensic anthropology as "the application of the science of physical or biological anthropology to the legal process," adding that "physical or biological anthropologists who specialise in forensics primarily focus their studies on the human skeleton". Forensic anthropology is a relatively young field within biological anthropology. The development of forensic anthropology is divided into three periods that are divided by events that arguably changed the path of the field: the formative period (early 1800-1938), the consolidation period (1939-1971), and the modern period (1972-present) (Tersigni-Tarrant and Shirley, 2012).

Check Your Progress

1) What is forensic anthropology?

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8.1.1 Historical Background

The history of forensic anthropology can be categorised into three periods that are marked by the particular events or sequential development of the discipline. These three periods are: the formative period (early 1800 to 1938), the consolidation period (1939 to 1971) and the modern period (1972 to present). During the initial days, the practice of forensic anthropology was confined to anatomists, physicians, and some physical anthropologists who worked primarily as University professors or museum curators. There was lack of formal methods or instructions in the forensic aspects of physical

anthropology and practitioners were occasionally consulted on the cases of skeletonised remains for law enforcement.

Formative Period: The origin of the science of forensic anthropology can be traced to the twisted murder of Dr. George Parkman in 1849. He was murdered by Harvard chemistry professor, John Webster who put parts of his body in the anatomy laboratory and burned the head in the furnace. Harvard anatomy professors Oliver Wendell Holmes and Jeffries Wyman investigated Dr. Parkman's death and suggested that the skeleton belonged to George Parkman. After matching the dentures found in the furnace with a mold of Parkman's teeth,Webster was eventually convicted of the murder.

During formative period, Thomas Dwight (1843-1911), a professor of anatomy from Harvard, extensively published on the topic of human skeletal identification, which laid the foundation of the discipline of forensic anthropology. In 1878, he was also credited as the "Father of Forensic Anthropology in the United States" for his pioneering essay, *The Identification of the Human Skeleton: A Medico-legal Study* and other publications concerning the estimation of sex, age and stature from the skeleton. His articles and essays were the first of their kind that applied knowledge of the human skeleton to forensic situations.

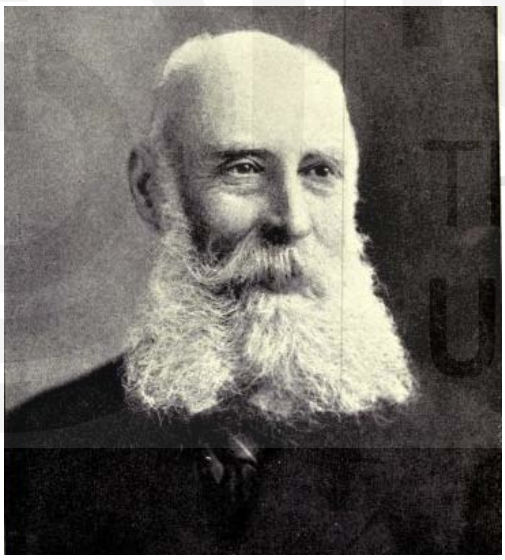

Fig. 8.1: Thomas Dwight, the father of American Forensic Anthropology
Source: https://upload.wikimedia.org/wikipedia/commons/c/c9/Dr._Thomas_Dwight.jpg

Check Your Progress

2) Who laid the foundation of forensic anthropology and in which year was he named the father of forensic anthropology?

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Other practitioners who made notable contribution to forensic anthropology were Harris H. Wilder (1864-1928), Paul Stevenson (1890-1971) and Ales Hrdlicka (1869-1943). Wilder was a European trained zoologist who worked on dermatoglyphics and facial reconstruction using skulls. Stevenson wrote two important articles on age determination based on epiphyseal union and stature estimation using long bones in a Chinese population. Ales Hrdlicka was a giant in the field of physical anthropology and W. M. Krogman in 1976 considered him as "founding father of American Physical Anthropology". Hrdlicka made two contributions for which he is often remembered:

Earnest A. Hooton (1887-1954) was another physical anthropologist whose work on human variation laid the foundations of biological and forensic anthropology. His research was mainly focused on human variation with respect to human origins and adaptations. During the latter part of the formative period, T. Wingate Todd (1885-1938), an anatomist, influenced the field of forensic anthropology. Todd was specifically interested in skeletal aging methods and growth and development. His contributions to anthropology are numerous which include documenting differences in limb proportions between American Blacks and Whites, establishing the usefulness of endo and ectocranial suture closure for age estimation, developing a method of age estimation based on age-related changes in the pubic symphysis, establishing principles of epiphyseal union, and extensively documenting various aspects of human postcranial and craniofacial growth, development, and maturation (Tersigni-Tarrant and Shirley, 2012).

Consolidation Period: Wilton Marion Krogman's (1903-1987) landmark publication *Guide to the Identification of Human Skeletal Material* is considered the end of formative period and beginning of the consolidation period. This noteworthy work, written as a pamphlet for the Federal Bureau of Investigation (FBI) in 1939 summarised all the knowledge about the skeletal remains that had been discovered up until that time. For the first time, this remarkable publication highlighted the forensic aspect of physical anthropology, as opposed to anatomy or the general discipline of physical anthropology.

Fig. 8.2: Wilton Marion Krogman

Source: https://alchetron.com/Wilton-M-Krogman

The extended version of Krogman's article was produced as first text book in forensic anthropology entitled *The Human Skeleton in Forensic Medicine.* This textbook focused on the practical application of human osteology to forensics. The overall emphasis of the book was on human variation which became the primary reference for physical anthropologists doing forensic anthropology at that time. Krogman mentioned that the methods presented in his book were only meant to be guidelines for assessing remains and should not be taken as hard and fast rules. Krogman's dedication to research helped to push forensic anthropology forward. He imparted a great deal of his wisdom upon his graduated students. One of these students, William M. Bass, had the greatest impact on the modern era of forensic anthropology (Tersigni-Tarrant and Shirley, 2012) which will be discussed in detail in the following section.

Modern Period: The founding of the Physical Anthropology Section of the American Academy of Forensic Sciences (AAFS) in 1972 is often regarded as the beginning of the modern period of forensic anthropology. This section was founded by Ellis R. Kerley (1924-1998) and Clyde Collins Snow (1928-2014), who had strong interest in expanding the practices of AAFS. After five years, the American Board of Forensic Anthropology was created in order to ensure the competence of practitioners who practice forensic anthropology in different areas of United States and Canada.

Fig. 8.3:(a) Ellis R. Kerley
Source: https://anth.umd.edu/feature/dr.-ellis-kerleys-legacy

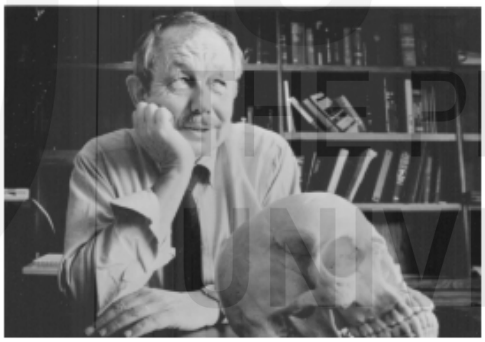

Fig. 8.4: (b) Clyde Collins Snow
Source: https://www.nmmi.edu/alumni/hall-of-fame-eminence/dr-clyde-collins-snow-1947-jc/

As mentioned earlier, William M. Bass had a significant impact on forensic anthropology. In the 1960s, Bass started a graduate program in physical anthropology at the University of Kanas and produced some of the leading forensic anthropologists such as Douglas Ubelaker, Walter Birkby, Linda Klepinger, and Richard Jantz (Tersigni-Tarrant and Shirley, 2012).

Two noteworthy events of modern period are the founding of the Forensic Anthropology Data Bank at the University of Tennessee, Knoxville, and the Scientific Working Group for Forensic Anthropology (SWGANTH). The Forensic Data Bank which started in 1986, is continuing today to gather information on documented forensic cases in order to update new standards for the determination of demographic and other characteristics from the human skeleton. SWGANTH was established in 2008 by the Federal Bureau of Investigation and Department of Defense Central Identification Lab (DOD

CIL) to recommend "best practices" in the discipline. The primary aim of this scientific group is to identify the existing standards, develop new standards and issue methodical guidelines for all the practicing forensic anthropologists (Byers, 2016).

8.1.2 Roles and Functions of Forensic Anthropologists

Forensic anthropology is considered as the applied sub-field of physical/biological anthropology wherein a forensic anthropologist applies anthropological theory and methods to the matters of legal concern. The five main functions of forensic anthropologists are:

- Forensic anthropologists try to determine the biological profile (race/ ethnicity, sex, age, stature) of a deceased person whose soft tissue has deteriorated to the extent that these bodily characteristics cannot be ascertained by visual inspection;
- In case of traumatic injury (e.g., bullet holes, stab wounds, fractures) to human bone, forensic anthropologists study the nature and causative agent(s) of trauma in order to identify the cause and manner of death;
- Forensic anthropologists can determine the postmortem interval (the amount of time that has passed since persons have died) as they have thoroughly studied the amount of deterioration that occurs in cadavers over time.
- Since forensic anthropologists have the knowledge of archaeological methods, they help in locating and recovering buried or surface remains relevant to the forensic investigation.
- Forensic anthropologists are also specialised in positive identification of a deceased person which is done through the unique identifying features present in virtually all skeletons.

Box 8.1

Forensic anthropological knowledge has been used in disaster victim identification (DVI) for over a century but it was not until 1970 that the American anthropologist Thomas Dale Stewart emphasised the value of including forensic anthropology in the identification process. Since this time, there have been a number of disaster events which have seen an increasing role for the forensic anthropologist in DVI. This increasing role has been augmented by feedback given after the 2004 Boxing Day Tsunami (Indian Ocean Earthquake and Tsunami 2004) in which it was recognised that the presence of a forensic anthropologist could have been useful in many occasions (de Boer, 2018)

In addition to the above-described work, forensic anthropologists fulfill a number of other roles in modern society. First, these specialists are consulted in the identification of victims of mass disasters. Airplane crashes, wars, acts of nature, or any phenomenon in which a large number of people perish and their remains are dismembered or disfigured are events that may need the

skills of forensic anthropologists. Another area in which forensic anthropologists work is the study of atrocities committed during warfare and civil unrest. Forensic anthropologists have also become involved in the study of persons of historical interest but of no medico legal significance (Byers, 2016).

7.1.3 Methods of Forensic Anthropology

Like any other sciences, methods of forensic anthropology can be divided into two types: (a) Data gathering methods and (b) Data analysis methods. Data gathering methods include all those techniques that are used to gather information from human skeleton remains and their surrounding circumstances. These techniques vary from simple visual examination of skeletal and soft tissue traits to complex methods, such as age determination from dental records. On the other hand, data analysis methods involve techniques used to analyse the data which was collected to solve a forensic problem. For example: To determine the living height of a person from a skeleton, first data are gathered and then stature estimation methods are employed. Each of these two methods consists of a set of methods which are regularly used by the forensic anthropologists.

Data Gathering Methods: In forensic anthropological cases, data are gathered both from field and the laboratory. In the field, data are generally obtained by observing and mapping the area around the human skeletal remains whereas laboratory methods involve gathering of skeletal data by specific techniques. These techniques can be divided into four major types: anthroposcopic, osteometric, chemical, and histologic. All of these techniques measure the data in one of the four scales i.e. nominal, ordinal, interval, and ratio.

Nominal scale measures the data into discrete or non-overlapping categories. Example: Sex (Male/Female), Ethnicity (White/Black/Hispanic) etc. Ordinal scale also measure discrete non-overlapping categories but unlike nominal scale, these categories can be ordered, such as low, medium and high. Interval scales are numeric scales and are comparatively rare. These levels of measurements are generally used for measuring time and temperature. These scales have fixed units of measurements; thus, the difference between 20 and 40 minutes is the same as between 60 and 80 minutes. A peculiar feature of interval scale is that there is no zero point; zero does not mean the absence of a measured trait. On the contrary, ratio level scales have an absolute zero value which means the absence of a measured trait. This true zero value provides multiple possibilities for statistical analysis. Classic examples of ratio variables include height and weight.

a) **Anthroposcopy** involves visual examination of human body with the help of a lens or x-rays. Since anthroposcopy does not require any special instrument, it is considered as the most accessible and common method of data gathering. For example, visual comparison of the human

skulls as presented in figure 5 would indicate that skull (a) is larger and heavier than skull (b). This examination helps to make an opinion that skull (a) is of male and skull (b) is of female, because female skulls, on average, are smaller and less heavily built than male skulls.

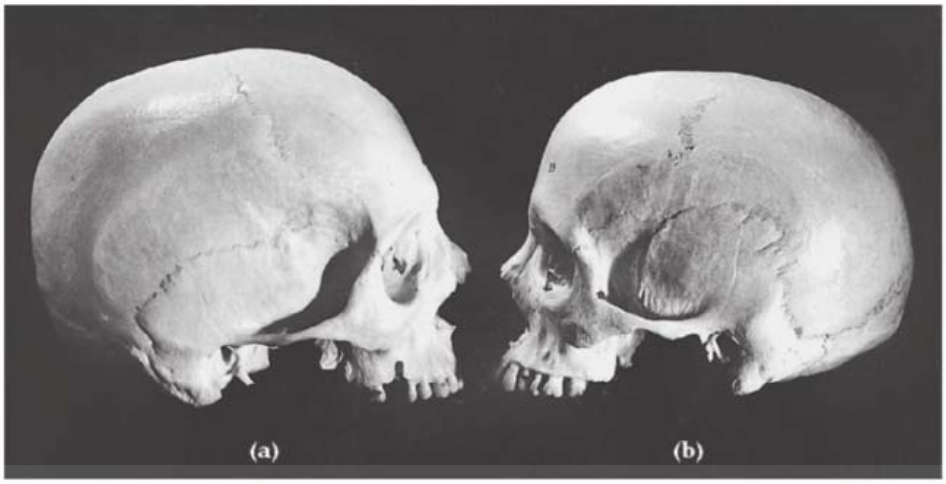

Fig. 8.5: Visual examination of human skulls

Source: Introduction to Forensic Anthropology (Byers, 2016)

b) Osteometryis the study and measurement of human bones using calipers and an osteometric board. Osteometric methods quantify many of the anthroposcopic characteristics in ratio scales to determine sex, age, ethnicity and stature from human skeleton.

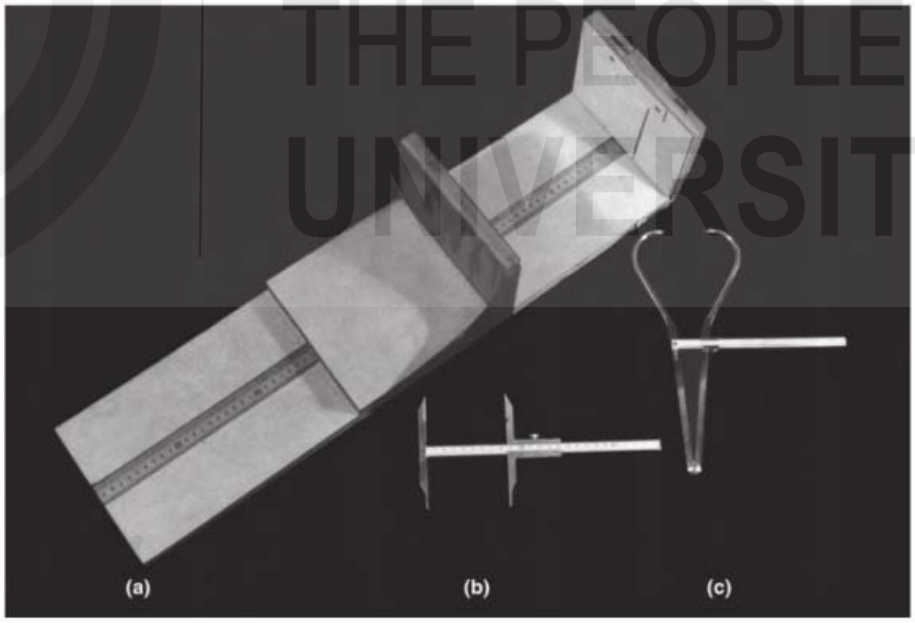

Fig. 8.6: (a) Osteometric Board (b) Sliding Caliper (c) Spreading Caliper

Source: Introduction to Forensic Anthropology (Byers, 2016)

For example, simple measurement of humerus with a caliper and multiplying the obtained length by five will give an estimate of the height of the living person from whom the humerus was attained.

c) **Chemical methods** analyse the chemical composition of human skeleton along with its associated structures (matter beneath a decomposing body).These methods try to identify and ascertain the nature of the sampling matter by applying special techniques.

d) **Histology** is the microscopic study of tissues. Forensic anthropologists mainly focus upon the tissues of bones and teeth to determine the demographic characteristics of a person. Generally, histological study involves viewing the thin stained slices of a tissue under a microscope. Since both the chemical and histological methods require special instrumentation, forensic anthropologists make more use of anthroposcopic and osteometric methods to gather data from human skeleton.

Check Your Progress

3) Write down the major functions of a forensic anthropologist.

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4) What are Anthroposcopy and Osteometry?

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Data Analysis Methods: In forensic anthropology five methods are most commonly employed to analyse the data derived from skeleton.These are: (a) Decision tables (b) Range charts (c) Indexes (d) Discriminant functions and (e) Regression equations. A brief description of each method is given below.

a) **Decision tables** assist forensic anthropologists to make a unified judgement on ambiguous data. For example, a skeleton may show both male and female characteristics. In this case, decision table helps the researcher to make a single determination about the sex of the skeleton. A decision table has a list of various decision options along with the characteristics that determines a particular feature. The researcher marks those characteristics in the table which are in alignment with the gathered remains; and the option which has maximum marks represents the decision.

Table 8.1: Decision table for determining a contemporary or non-contemporary skeleton

	Noncontemporary	Contempora
Color	Dark	Light
Texture	Rough	Smooth
Hydration	Dry	Wet
Weight	Light	Heavy
Condition	Broken	Solid
Fragility	Fragile	Tough
Soft tissue	Absent	Present

Source: Introduction to Forensic Anthropology (Byers, 2016)

b) Range charts help to determine the central tendency of multiple ranges of estimates through visual representations. They combine the information of various characteristics that have been derived from different skeletal structures to arrive at a single decision. For example, range charts are used to ascertain the age at death of a decomposed body from skeletal data. These charts provide the most probable estimate of a skeletal feature by depicting the maximum areas of overlap between various ranges.

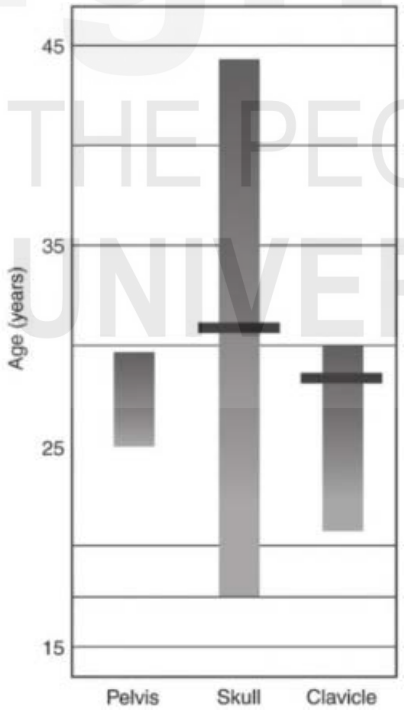

Fig. 8.7: Range chart for determining skeletal age

Source: Introduction to Forensic Anthropology (Byers, 2016)

c) Indexes are considered simple yet powerful estimates for measuring anthroposcopic characteristics. Indexes are obtained by dividing two measurements (measurement of two visually identifiable characteristics) and multiplying the result by 100. The value of indexes varies among different groups which help to determine the group membership of an

unrecognised skeleton. For example, nasal index is calculated by dividing the nasal width of a skull with the nasal height and multiplying by 100.

Nasal Index = Nasal Width/Nasal Height X 100

d) Discriminant functions are advanced statistical form of indexes that uses more than two measurements to differentiate between different groups. The most famous application of this method in biological (and forensic) anthropology was by Eugene Giles and Orville Elliot (1962), who used a number of measurements of the skull to distinguish ancestral groups from each other. Discriminant functions figure prominently in forensic anthropology. From cranial measurements, these functions are used to distinguish males from females, as well as members from different ancestral groups (e.g., Whites, Blacks, Asians). Similarly, measurements of the lower jaw, as well as dimensions of the limb bones and other postcranial structures, can be entered into discriminant functions to determine both of these demographic categories. In short, this method is used whenever there are discrete categories that can be distinguished using metric measurements (Byers, 2016).

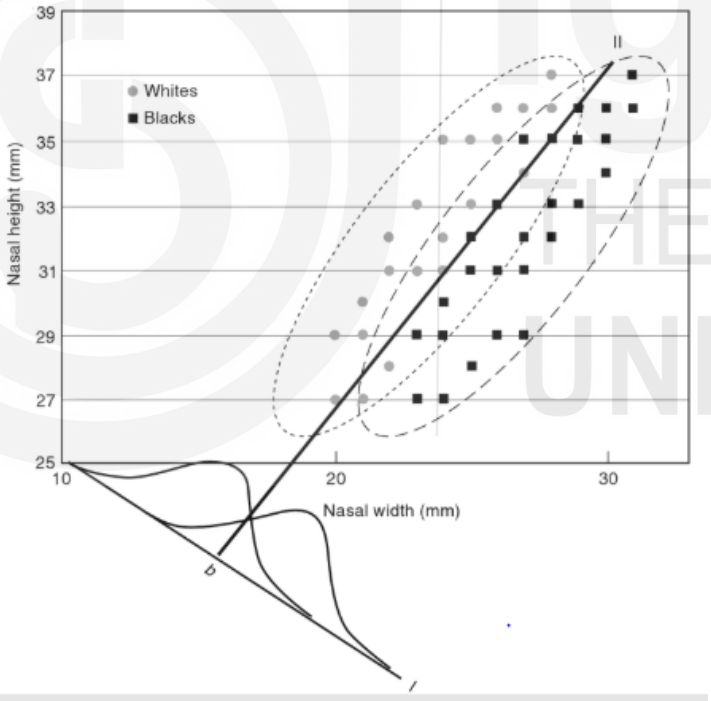

Fig. 8.8: Graphical representation of discriminant function (line l) for separating Whites from Blacks using nasal width and height. The point b is the sectioning point.

Source: Introduction to Forensic Anthropology (Byers, 2016)

e) Regression equations are used to predict one characteristic from other characteristics. Sir Thomas Galton first used regression method to study inheritance pattern. In this method, a line that best shows the association between two variables is computed through mathematical calculations. For example, regression equation can be used to determine the height of an individual from the length of his metatarsal.

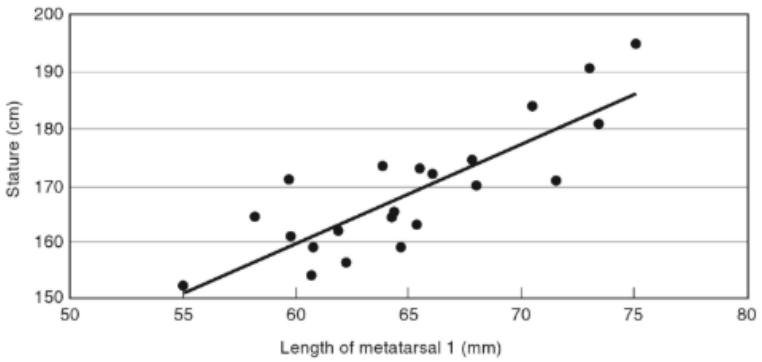

Fig. 8.9: Regression line for determining stature from the length of metatarsal

Source: Introduction to Forensic Anthropology (Byers, 2016)

8.2 FORENSIC ANTHROPOLOGY IN INDIA

The scope of forensic anthropology varies from the examination of human skeletal remains to the identification of living or deceased persons. In the last few decades, the discipline has made enormous progress in many contemporary areas including facial reconstruction, gait pattern analysis, photographic superimposition etc. Despite the multi-faceted relevance of forensic anthropology, its status and development in India is not recognised as a specialty of significance.

In India, medico-legal cases pertaining to forensic anthropology are mostly examined by the doctors of the Forensic Medicine department or the Forensic Science laboratory where such cases are referred. However, over the last few years, with growing awareness of the role and expertise of forensic anthropologist a need is felt to employ their services. India being a multiracial country, the need is greater as anthropologists have the training, skill and familiarity of subtle racial variation in human skeleton which a medical man lacks. Moreover unlike in the past when identification from skeletal parts was based on examination of morphological traits, with time this mode of assessment has given way to more precise and definite anthropometric measurements which when processed through modern statistical techniques (Discriminant function analysis) make identification more objective. An anthropologist, through years of training in anthropometry has an advantage over a medical person (Purkait, 2006).

A limited number of academic institutions in India teach forensic anthropology as a part of the anthropology degree and forensic science programs. However, with the increasing popularity and practical utility of the discipline, forensic anthropology has steadily recognised as a full-fledged discipline, separate from the parent subjects of anthropology and forensic science.

Check Your Progress

5) What are indexes? How are they calculated?

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6) Describe the status of the discipline of forensic anthropology in India.

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8.3 SUMMARY

Forensic anthropology is a sub-field of physical anthropology that uses the knowledge of human skeletal variation to analyse the medico-legally significant cases. Although the practice of forensic anthropology began in the United States in the early 1800 with the pioneering works of Thomas Dwight and others but it developed as a separate field in the mid-1900. A forensic anthropologist's functions ranges from determining the demographic characteristics (sex, age, stature and ethnicity) to the positive identification of a person. Estimation of time since death, determining the cause of death and recovering the buried or surface remains are another major provinces of a forensic anthropologist. Several methods and techniques are used by forensic anthropologists to collect and analyse the human skeletal data. Significant data gathering methods include anthroposcopy, osteometry, histoscopy and chemical methods whereas decision tables, range charts, indexes, discriminant functions and regression equations are used to analyse the collected data. Although with the development of technologies the discipline has made enormous progress in many contemporary areas but despite its practical utility the status and development of forensic anthropology in India is still in infancy stage.

8.4 REFERENCES

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8.5 ANSWERS TO CHECK YOUR PROGRESS

1) Forensic anthropology is an applied sub-field of physical or biological anthropology that uses the knowledge of modern human skeletal variation to help law enforcement identify unknown decedents. For more details refer section 8.1.

2) Thomas Dwight (1843-1911), a professor of anatomy from Harvard, laid the foundation of the discipline of forensic anthropology. In 1878, he was also credited as the "Father of Forensic Anthropology in the United States" for his pioneering essay, *The Identification of the Human Skeleton: A Medico-legal Study* and other publications concerning the estimation of sex, age and stature from the skeleton. For more details refer section 8.1.1.

3) The five main functions of a forensic anthropologist(s) are: (a) determination of the biological profile (race/ethnicity, sex, age, stature) of a deceased person; (b) identification of the cause and manner of death; (c) estimation of the postmortem interval (d) locating and recovering buried or surface remains relevant to the forensic investigation (e) positive identification of a deceased person. For more details refer section 8.1.2.

4) Anthroposcopy and osteometry are data gathering methods of forensic anthropology. Anthroposcopy involves visual examination of human body with the help of a lens or x-rays and Osteometry is the study and measurement of human bones using calipers and an osteometric board. For more details refer section 8.1.3.

5) Indexes are simple and powerful estimates for measuring anthroposcopic characteristics. Indexes are computed by dividing two measurements (measurement of two visually identifiable characteristics) and multiplying the result by 100. For more details refer section 8.1.3.

6) In India, medico-legal cases pertaining to forensic anthropology are mostly examined by the doctors of the Forensic Medicine department or the Forensic Science laboratory. Despite the multi-faceted relevance of forensic anthropology, its status and development in India is not recognised as a specialty of significance. For more details refer section 8.2.