1.1 The Present Research Work

1.1.1 Forensic Anthropology

Forensic Anthropology, an applied discipline, is a branch of physical anthropology which interacts with other disciplines pertaining to the understanding of crime and its investigations. Examination of skeletal remains recovered from crime scene has often been used by the forensic anthropologists to extract relevant personal information about the victim. In such situations, they undertake estimation of stature from such skeletal remains. Forensic anthropology becomes important nowadays as the scientific techniques of foul play have been sophisticated.

The term ‘forensic’ is derived from the Latin adjective word ‘forensis’ which means open court, public or forum (Montelle, 2008). In ancient Rome, the forum was a market place where people gathered to conduct all kinds of
business including that of a public affair. The meaning of forensic later on came to be restricted to refer to the courts of law. Therefore, etymologically forensic anthropology is the application of scientific methods developed in physical anthropology that used in personal identification of deceased individuals whose remains are decomposed, burnt, mutilated or otherwise unknown to the court of law.

Forensic Anthropology, according to Snow (1973) is the application of physical anthropologists’ specialised knowledge of human sexual, racial, age and individual variation to problems of medical jurisprudence. Stewart (1979) again defined forensic anthropology as “that branch of physical anthropology which, for forensic purposes, deals with the identification of more or less skeletonised remains known to be or suspected of being human. Beyond the elimination of non-human elements, the identification process undertakes to provide opinions regarding sex, age, race, stature and such other characteristics of each individual involved as may lead to his or her recognition”.

Forensic anthropology is the application of anthropological research and techniques to the solution of medico-legal issues, drawing primarily from physical anthropology and archaeology. A forensic anthropologist can help law enforcing agencies to establish one of the profiles of the unidentified remains. The profiles include sex, age, ethnicity, stature, post-mortem interval and sometimes the evaluation of trauma seen on bones. In many cases, after
identification of an individual, the forensic anthropologist is called to testify in
court of law regarding the identity of the remains and trauma or wounds
present on the remains.

Anthropometric characteristics have direct relationship with sex,
shape and form of an individual and these factors are intimately linked with
each other and are the manifestations of the internal structure and tissue
components which in turn are influenced by environmental and genetic factors.
The use of anthropometry in the field of forensic investigation dates back to
1882 when Alphonse Bertillon, a French Police expert invented a system of
criminal identification (Krishan, 2007).

Personal identification is one of the most important tasks to be done
by forensic anthropologists. The individual may be of a living or dead body or
partly decomposed or mutilated body or skeletonised remain for recognition.
This identification may be a complete or partial identification. The absolute
fixation of the individuality of the person and the determination of the exact
place in the community, which is occupied by him is the complete
identification; on the other hand, partial identification deals with ascertaining
only some facts about identity while other remains are still unknown.
Sometimes, the identification becomes more complicated due to natural
putrefaction when decomposition set in the body. The problems relating to
personal identifications of the recently dead are identical with those of living.
Mant (1984) categorised the problems of human identification as under:
(i) Recent dead persons,
(ii) Decomposed or mutilated bodies,
(iii) Skeletal remains and
(iv) Fragmentary remains.

In the present scenario, personal identification of a living person has become a common problem and such problem has risen in the court of law in relation to various crimes such as rape, murder, child trafficking etc. Knowledge of fingerprints, handwriting, and physical descriptions are helpful clues for personal identification of the missing person.

Various exhibits required in Forensic Anthropology can be classified (Chattopadhyay, 2003) as under:

(i) Forensic Somatoscopy and Anthropometry including oestology, oestometry and odontology.
(ii) Forensic serology and Biochemical genetics.
(iii) Forensic Dactyloscope (Finger, Palm, Sole and Toe prints including sole and shoe impressions).
(iv) Miscellaneous Anthropology (Hair, Nail, Tatoo marks wearing apparels etc.).

During the examination of skeletal remains in a crime scene, the following key questions that are usually required to be answered are (Nath, 1987; Chattopadhyay, 2003)
(i) Are the materials bones?
(ii) Whether the bones are human or non-human?
(iii) If bones are human bones, which bones are they, and to which side they belong?
(iv) Whether they belong to one or more individuals?
(v) What would be the sex?
(vi) What is the age?
(vii) What is the ethnic group of the individual?
(viii) How tall the person would be?
(ix) What is the cause of death?
(x) What is the time of death?
(xi) What are the distinguishing characteristics in the skeletal remains that may lead to personal identification?

1.1.2 Biological Profile of Forensic Anthropology

The foundation from which forensic anthropology has developed includes age, sex, race (ancestry) and stature (Krogman and Iscan, 1986). The biological profile of forensic anthropology is also known as ‘Big Four’ which helps in personal identification.

a. Age Determination

The chronological age of the deceased can be determined by forensic anthropologists with the help of forensic odontologists. With the knowledge of the odontogenesis, eruption, attrition and other associated features are used by
forensic odontologists to determine the dental age of the deceased. The forensic anthropologists, on the other hand, study the appearance and union of ossification centre, symphyseal metamorphosis cranial suture closure, histological remodelling of cortical bone and, in older individuals, age progressive pathological changes in the bones and joints to determine skeletal age. Accuracy and certainty of age from skeletal remains decreases with increasing age of an individual’s living or death (Nath, 1989).

b. Sex Determination

Sex determination for the purpose of personal identification is not so difficult if a complete skeleton is available. In case of incomplete skeleton, sex determination is challenging and success rates depend upon the parts of the skeleton, which are available for analysis.

According to Basu (2003), sex determination rates from individual skeleton are as follows:

<table>
<thead>
<tr>
<th>Part of Skeleton</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire skeleton</td>
<td>100 %</td>
</tr>
<tr>
<td>Pelvis alone</td>
<td>95 %</td>
</tr>
<tr>
<td>Skull alone</td>
<td>92 %</td>
</tr>
<tr>
<td>Pelvis + skull</td>
<td>98 %</td>
</tr>
<tr>
<td>Long bone alone</td>
<td>80 %</td>
</tr>
<tr>
<td>Long Bone + pelvis</td>
<td>98 %</td>
</tr>
</tbody>
</table>
Discriminant function analysis of crown morphology has been used to determine sex in the absence of bone (skeleton) evidences (Ditch and Rose, 1972). The mandibular canine as displaying the greatest sexual dimorphism in human dentitions and using a combination of teeth can give 86 per cent success rate in correctly determining sex (Garn et al., 1977). Sexual dimorphism of the canine takes the form of an approximate 6 per cent difference in size (Keiser, 1990).

c. Determination of Race (Ancestry)

Determination of race is considered to be an important aspect of forensic anthropology in search of an identity. The three main world ethnic groups are Caucasoid, Mongoloid and Negroid. All other groups are subdivisions of these three main groups.

Knight (1990) further studied that in profile, the skulls of the three main races vary somewhat, though there are chances of variations from person to person. Among the Negroid, the most prominent part is the jaw area. On the other hand, the profile of the nose is the most prominent feature among the Caucasoid. In case of the Mongoloid, the cheek bone is prominent. All these attributes are concerned with skulls though naturally the soft tissues also follow the general patterns.
d. Stature Estimation

Stature is anatomically a complex personal attribute expressed by a total cumulative length dimensions of legs, pelvis, vertebral column and skull. Various body dimensions can be used in estimating stature. Moreover, a good number of studies have clearly pointed out that there is positive correlation between stature and each different body part. It is a measure for personal identification in forensic examination, especially, in unknown, highly decomposed, fragmentary and mutilated human remains. It helps in narrowing down the investigation process and thus provides useful clues to the investigating agency.

For the first time, Beddoe (1887) made an endeavour to estimate stature from femoral length of the older races of England using separate formulae for males and females. Later in 1888 that Rollet published his work in a tabular form to estimate stature from lengths of long bones. He measured stature and length of long bones of 50 males and females of French cadavers in the fresh state and later in the dry state and he observed that long bones lost in an average 2 mm of their length. Thus, he suggested that when stature is to be estimated from the dry bone length it has to add 2 mm to the measured length of each bone.

Pearson (1899) laid down certain basic rules for stature reconstruction, which is related to physical anthropology and forensic examination and also
established his regression equations formulae for estimation of living stature from cadaver long bone lengths. The basic rules of Pearson are as follows:

(i) The mean, standard deviation and correlations of any long bone in an extinct allied race should be secured as it is possible to measure.

(ii) When the correlations of long bones under consideration are high fifty to hundred individuals may be sufficient for the study.

### 1.1.3 Crime, Society and Forensic Science

Crimes and criminals are as old as the human society itself. In order to safeguard the interest and integrity members of the society, it has always been the endeavour in many societies to identify the criminals and isolate and punish them.

According to Tappan (1960), a lawyer-sociologist defined crime as “an intentional act or omission in violation of criminal law, committed without defence or justification and sanctioned by the state as a felony or misdemeanor”. Crime refers to the commission of behaviour that violates laws (Lawrence Miller, 1995). Crime is a short-term and circumscribed behaviour in which particular individuals use force or fraud to commit deviant or anti-social acts. Various writers have defined crime as an antisocial, immoral or sinful behaviour. However, according to the legal definition, crime is any form of conduct, which is to be socially harmful in a state and as such forbidden by law under pain of punishment.
Human customs vary from one society to another. This custom regulates human conduct during the course of human life. As the customs are learned by members of the society from the social unit i.e., family, as such customs are respected by the society as laws are regulated and respected by the state. Customs are considered as “long standing usage” – it is the basic source of law. Norms become laws in many simple societies when deviance becomes crime. A behaviour which is considered as deviant in one society may be considered approved behaviour in another society. Norms differ from society to society. When social change takes place in the course of time, the social norms also change. The society has always tried to check crimes through its command. And as such for detection of crime, identification of criminals and its effective punishment as per legal provisions is essential to prove and identify the real culprit beyond reasonable doubt that a particular person or group has committed the crime. For this purpose, adequate evidences in support of the crime need to be established.

Since time immemorial, such aspect of crime detection, with a view to punish the offender and to protect the innocent, have remained as fundamental requirement for maintaining peace and equilibrium in the society as well as for criminal justice administration. For most of the human problems, solution can produce with the knowledge of various scientists belonging to appropriate branch of science. The knowledge of forensic science thus can be used in serious criminal cases. With the advancement of science and technology nature
of criminal acts also changes as such forensic scientists have to constantly update and sharpen their tools, techniques and knowledge itself. Today, the forensic science provides the missing link in the chain of evidence, thereby enabling the criminal justice system to conduct and to convict the guilty criminal. It is a fact that until and unless justice is rendered, there will be no peace and harmony in the society.

The application of the knowledge of forensic science has become an indispensible part for solution to the crime investigation problem. Advanced techniques of forensic science can solve the problems of heinous crimes. Forensic anthropology that is considered as a distinct branch of forensic science has its role to play in the aspect of identification of stature of an individual who has involved in a crime. When the identification of the person has been proved through the estimation of stature using limb bones or any part, then an evidential report can be established for rendering effecting criminal justice.
1.2 Hypothesis

The regression equations formulated so far by various scientists are different because of inter-population and sex variations. Therefore, it is necessary to formulate separate regression equation for a particular population group for estimation of stature. One can use regression equations, which have been formulated from percutaneous bone measurements of living individuals to skeletal remains for the purpose of estimation of stature. Keeping this view in mind, the present study has been hypothesised as under:

(i) Regression equations and multiplication factors for estimation of stature of Maring males of Manipur will be different from those of other populations so far studied by various researchers.

(ii) The relationship of one variable to another in respect of various body dimensions of Maring males is likely to differ when compared with other populations.
1.3 Aim and Objectives

The aim and objectives of the present research work have been laid down as follows:

(i) To compute range, mean and standard deviation (SD) of thirteen (13) body dimensions among Maring males of Manipur.

(ii) To observe the frequency percentage distribution of thirteen (13) body dimensions in various ranges among Maring males of Manipur.

(iii) To compute multiplication factors for estimation of stature from various percutaneous body dimensions among Maring males of Manipur.

(iv) To formulate linear regression equations for estimation of stature from various percutaneous body dimensions among Maring males of Manipur.

(v) To observe the variations in multiplication factors, linear regression equations and co-efficient of correlation (r) of Maring males of Manipur.

(vi) To assess the validity of multiplication factor and regression equation and percentage error.
1.4 Land and People

Manipur, one of the states situated in the north eastern region of India, is an isolated hill-girt state stretching between $92^058'\ E$ longitude to $94^045'\ E$ longitude and $23^050'\ N$ latitude to $25^042'\ N$ latitude. The present area of Manipur has 8,629 sq. miles of which the valley constitutes 700 sq. miles covering 0.68% of the Indian union. This small state is surrounded by nine hill ranges on all sides with a small and oval shape valley at the centre of the state. The state has 352 km long international border with Burma (Myanmar) to the southeast and 502 km long border with the adjacent states of Nagaland on the north, Cachar district of Assam on the west, Mizoram on the south and the southwest. The hills of Manipur are mostly inhabited by scheduled tribes of Manipur.

On the basis of physical features, Manipur is divided geographically into three land forms viz., the Manipur hills (91per cent), the Manipur valley (81per cent) and the Barak basin (1per cent). The Manipur hills are divided into two i.e., the Manipur western hill ranges and Manipur eastern hill ranges (Vedaja, 1998) The Manipur eastern hill ranges form a continuous chain along the Indo-Myanmar frontier for about 200 km long attaining an average altitude of about 1,500 m above MSL. The Manipur western hill ranges run north to south about 180 km with a breadth of 50 km in the north and 70 km in the south. These hill ranges are located at varying altitudes i.e., 1,200 m above the
MSL for the southern hill ranges and 2,994 m above MSL for the northern hill ranges.

According to 2001 census, 92 per cent of the scheduled tribe population of Manipur is found in the hill districts while the remaining 8 per cent is found in the valley districts. Marings are one of the recognised 39 scheduled tribes of Manipur. They are mostly distributed in Manipur eastern hill ranges, which include Machi and Tengnoupal sub-divisions of Chandel district, Manipur. Marings share a common dialect known as Maring Lhou, which belongs to the Tibeto-Burman sub-family. The name Maring is said to have been derived from two words i.e., ‘Mei’ and ‘Ring’ which means ‘fire’ and ‘to produce’ respectively. Thus, literally, Maring means to produce fire. They expressed that Maring forefathers made fire from a traditional ways of striking dry wood of a particular tree serving as fire sticks (Khongmai-heeng) with bamboo strips as plaint thong and dry grasses as tinder. Marings themselves prefer the name “Meiring” or “Meiringba”. The neighbouring ethnos used to call them Maring instead. In the earlier records, the people have been referred to by the same name but different spellings. Brown (1873) referred to as Murring. Dun (1886) and Hodson (1908) referred to as Marrin.

Regarding the origin, migration and settlement, they gave their own explanation and legendary story. According to their legend, once they lived inside a cave (Khul/Nungmuisho) at a place called Khulvi Shong Shong somewhere in Burma (Myanmar). The mouth of the cave was blocked by a big
stone (Lungthung) for a long time. One day, a black male mithun having white spots (Shringpa Bungrang) opened the mouth of the cave. As soon as the mouth of the cave was opened, seven men and seven women came out of the cave. Thus, the present Maring people have been considered to be the descendants of these men and women.

There are altogether twenty seven (27) Maring villages in Manipur. Maximum numbers of fourteen (14) Maring inhabited villages are in Machi sub-division of Chandel district, which contribute the largest number of cluster population group of all. Next, it is followed by Tengnoupal sub-division of Chandel district which has seven (7) Maring villages. There are only two (2) Maring villages in the Chandel sub-division of Chandel district, Manipur. Another four (4) Maring villages are situated within the jurisdiction of Sadar Hill East sub-division of Senapati district, Manipur. Thus, the distribution patterns have revealed that majority of Maring villages are distributed in various sub-divisions of Chandel district of Manipur.

The Maring Villages in Manipur

Machi sub-division (Chandel District):

1. Kangoi Khullen
2. Khangshang
3. Karongthel
4. Khunbi
5. Tuinem
6. Kojiam khunou
7. Konaitong
8. Laiching
9. Lamlong
10. Langol Khunjao
11. Machi
12. Tuishimi
13. Samanphai

_Tengnoupal Sub-division (Chandel District):_

1. Kampang Khullen
2. Kharou khunou
3. Langkhong Ching
4. Leibi
5. Narum
6. Saibom

7. Satang.

**Chandel sub-division (Chandel District):**

1. Khudei Khunou

2. Phunan Sambum (Kakching Phunan).

**Sadar Hill East sub-division (Senapati District):**

1. Yaipharok (Laipharok)

2. Kamu Maring

3. Kwarok Maring

4. Phunan Maring (Waithou Phunan).

Out of the total 27 villages, ten (10) Maring villages which represent various sub-divisions of Manipur have been considered as the sample for the present study. The villages are Yaipharok, Koijam Khunou, Phunan Sambum, Khangsang and Tuinem, Khunbi, Langol Khunjao, Phanchong, Machi and Kampang khullen. The former five villages i.e., Yaipharok, Koijam khunou, Phunan sambum, Khangsang, Tuinem are situated at the foothills of various sub-divisions of Manipur. The Yaipharok village is situated at the foothill of Ngariyan hill under Sadar Hill East sub-division of Senapati district, Manipur. Another Phunan sambum village is located at foothill of Phunan hill under
Chandel sub-division of Chandel district, Manipur. While the remaining three (3) of the former five (5) villages i.e., Koijam Khunou, Khangsang and Tuinem are situated at the foothill of Heirok hill ranges under the Machi sub-division of Chandel district, Manipur. The Yaipharok village has the shortest distance of only 9 km from the capital Imphal, while the remaining four (4) villages are located at varying distances ranging between 37 km to 55 km towards the south and south-eastern directions from Imphal. The altitudes of these five villages range from a minimum of 750 m to a maximum of 780 m above Mean Sea Level (MSL). The neighbouring villages are inhabited by the Meitei and Muslim communities of Manipur. These former five villages have plain characteristics in terms of altitudes and nature of habitats. Furthermore, they also expressed that their forefathers lived at high altitudes which is very interior and far away hilly places to protect themselves from enemies and then in course of time, they migrated from the very interior Maring villages in search of better communication system and started settling down at the foot hills of Ngariyan and Heirok hill ranges of Manipur.

The remaining other five (5) villages are Khunbi, Langol Khunjao, Phanchong, Machi and Kampang Khullen. In contrast with the former five (5) villages, these remaining five villages are situated at the hill slopes of comparatively higher altitude hilly areas of various sub-divisions of Manipur. The altitude of these villages ranges in between 1,100 m to 1,679 m above MSL. These villages are located towards the southeast direction from Imphal.
under the Machi and Tengnoupal sub-divisions of Chandel district, Manipur. The distance of the villages ranges from 62 km to 88 km from Imphal. The last Kampang Khullen village is under the jurisdiction of Tengnoupal sub-division of Chandel district, while the former four are under the Machi sub-division of Chandel district, Manipur.

**The Maring Villages Under Study**

<table>
<thead>
<tr>
<th>Name</th>
<th>Distance from Imphal</th>
<th>Sub-divisions</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yaipharok</td>
<td>9 km</td>
<td>Sadar Hill East</td>
<td>Senapati</td>
</tr>
<tr>
<td>Koijam Khunou</td>
<td>37 km</td>
<td>Machi</td>
<td>Chandel</td>
</tr>
<tr>
<td>Phunan Shambu</td>
<td>47 km</td>
<td>Chandel</td>
<td>Chandel</td>
</tr>
<tr>
<td>Khangshang</td>
<td>49 km</td>
<td>Machi</td>
<td>Chandel</td>
</tr>
<tr>
<td>Tuinem</td>
<td>55 km</td>
<td>Machi</td>
<td>Chandel</td>
</tr>
<tr>
<td>Khunbi</td>
<td>62 km</td>
<td>Machi</td>
<td>Chandel</td>
</tr>
<tr>
<td>Langol Khunjao</td>
<td>63 km</td>
<td>Machi</td>
<td>Chandel</td>
</tr>
<tr>
<td>Phanchong</td>
<td>65 km</td>
<td>Machi</td>
<td>Chandel</td>
</tr>
<tr>
<td>Machi</td>
<td>68 km</td>
<td>Machi</td>
<td>Chandel</td>
</tr>
<tr>
<td>Kampang Khullen</td>
<td>88 km</td>
<td>Tengnoupal</td>
<td>Chandel</td>
</tr>
</tbody>
</table>
Map 3 Map of Chandel District
Amongst them, there are identifying marks which are characterised by the colour border of their traditional attires or dresses. They are red colour, black colour and red and black colour. They are expert in cane and bamboo works. Maring people who live on the higher altitudes practise shifting cultivation as a means of livelihood. While some sections of them depend on wet cultivation as well as terrace cultivation, especially, for those who live at the foothills. The Maring hill people face lots of struggle for livelihood. This is due to lack of sources of income and other modern facilities which they can not meet in their daily live. Though they live in different villages, they form themselves as distinct ethnic group and considered themselves as members of a same family. After the adoption of Christianity, they have accepted the outside culture and as such the indigenous culture has been disappearing day by day.

Brown (1873) was of the opinion that the Maring tribe show similar physical features to those of the Burmese, some of them have flat noses, while others have well-shaped noses. Their general expression is mild and intelligent. In stature, they are of medium height, muscular, active and with well developed lower limbs. As a tribe, men are short and of a muscular development, nearly Khongjai (Dun, 1886).

1.4.1 Demographic Profile

The demographic data for the present study is primarily based on the census report of 1961, 1971, 1981, 1991 and 2001 except for the Maring population of 1881, which is based on Dun’s Gazetteer of Manipur (1886).
The decade wise census reports have revealed that the Maring population is gradually increasing since 1881 till 2001. Thus, the total population was 17,361 (Census of India, 2001). They have contributed 2.43 per cent of the total population of Manipur.

As per decadal value, the highest rate with 31.57 per cent is found in between 1971 and 1981, and this is due to rapid population growth rate in 1981. It is followed by decadal rate (26.85 per cent) of the years 1961 and 1971.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Decadal value (p.c.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1881</td>
<td>484</td>
<td>---</td>
</tr>
<tr>
<td>1961</td>
<td>7745</td>
<td>---</td>
</tr>
<tr>
<td>1971</td>
<td>9825</td>
<td>26.85</td>
</tr>
<tr>
<td>1981</td>
<td>12,927</td>
<td>31.57</td>
</tr>
<tr>
<td>1991</td>
<td>15,698</td>
<td>21.44</td>
</tr>
<tr>
<td>2001</td>
<td>17,361</td>
<td>10.59</td>
</tr>
</tbody>
</table>