BLOCK 3

Homo Erectus to Modern *Homo Sapiens*

ignou
THE PEOPLE'S
UNIVERSITY

UNIT 7 *HOMO ERECTUS* FROM AFRICA, ASIA, EUROPE*

Contents

Learning Objectives

After reading this unit, you will be able to:

- know the distribution of *Homo Erectus* in asia, europe, africa;
- learn about morphological features of *Homo Erectus*; and
- understand life history and Biology of *Homo Erectus.*

7.0 INTRODUCTION

The earliest members of the genus *Homo* are of particular significance as they mark the evolution of our own species. *Homo erectus* was a true human as he exhibited all the basic elements of the human bio-cultural adaptive pattern. He also used fire, made stone tools and other implements, used the clean skin of other animals and therefore may be taken to represent the beginning of true man. In 1961, L.S.B Leaky reported parts of the skull and jaw of juvenile Hominid from Bed I at Olduvai Gorge. This material came from a site lower in the deposit which yielded *Zinjanthropus* and hence it was named as Pre-*Zinjanthropus*. In 1963, Leaky recovered more fossil material from Bed I and II from Olduvai. In 1972, Richard Leaky, showed casts of fossils from deposits at Lake Turkana to which he assigned a third Hominid model. The cranial capacity of this skull works out to about 770 c.c., the brow ridges are less prominent than in *Homo erectus*, the face seems to be very large and reminiscent of *Australopithecus*. The palate is very large and horse shoe shaped. Numerous other specimens from Lake Turkana were earlier assigned to genus *Homo*. The evidence of a more advanced Hominid at Lake Turkana at a relatively early date was confirmed in 1975 with the discovery of a *Homo erectus* cranium from the upper Kooby Fora formation by Leaky in 1976 (Shukla and Rastogi,1991).

* Dr. Vijeta Choudhary, UGC-Post Doctoral Fellow, Department of Anthropology, University of Delhi, Delhi.

A transitional phase of the Australopithecines to *Homo* can be traced from the period 2 to 1.5 million years (B. P.). During this period, skull and jaws of the Robust *Australopithecus* have been found. The occurrence of these skeletal remains indicated that there is continuity in the evolutionary perspective. Different species were also found under *Homo erectus* which includes *Pithecanthropus erectus, Sinanthropus pekinensis* and *Atlanthropus mauritanicus*. The transitional period from *Homo erectus* to *Homo* sapiens lies between 1.5 to 125,000 years B.P.

Check Your Progress

1) From where did L.S.B. Leaky report parts of skull and jaw of juvenile Hominid in 1961?

.....

.....

.....

.....

2) Who assigned the fossil deposit of lake Turkana as third hominid model?

.....

.....

.....

.....

3) Write down the name of three different species of *Homo* erectus.

.....

.....

.....

.....

Early African *Homo erectus* fossils (sometimes called *Homo ergaster*) are the oldest known early humans to have possessed modern human-like body proportions with relatively elongated legs and shorter arms compared to the size of the torso. These features are considered adaptations to a life lived on the ground, indicating the loss of earlier tree-climbing adaptations, with the ability to walk and possibly run long distances. Compared with earlier fossil humans, note the expanded braincase relative to the size of the face. The most complete fossil individual of this species is known as the 'Turkana Boy' – a well-preserved skeleton (though minus almost all the hand and foot bones), dated around 1.6 million years old. Microscopic study of the teeth indicates that he grew up at a growth rate similar to that of a great ape (http://humanorigins.si.edu/evidence/human-fossils/species/homo-erectus).

7.1 DISTRIBUTION OF *HOMO ERECTUS*

The specific name *Homo erectus* derived from *Pithecanthropus erectus* was given to the finds from Indonesia in the 19th century and when they were sufficiently

distinct from human, they were given a separate generic name known as *Homo erectus*. *Homo erectus* fossils have been discovered in many parts of the world, including Java (now part of Indonesia), China, Europe and Africa. In North Africa, three complete lower jaws and a piece of skull cap similar to that of the fossils found in China were discovered (https://www.civilserviceindia.com/subject/Anthropology/notes/phylogenetic-status characteristics-and-geographical-distribution.html).

7.1.1 *Homo Erectus* From Java

Eugene Dubois, the discoverer of the Java Man, was confident that the skull, thigh bone, and five teeth found by his crew in Java in 1890 were those of the missing link between humans and apes. Eugene Dubois named it *Pithecanthropus erectus* because it was an upright ape man. This label was accepted until the 1950s, when Ernst Mayr, a systematist, did a taxonomic restudy of the *Pithecanthropus* specimen. Through his study, he convincingly demonstrated that the Javanese fossils, as well as those found in China, belonged to a single genus *Homo erectus*. In time, the term was accepted by other paleontologists, with the addition of such sub-labels as Javanensis and Pekinensis, in order to indicate the place where they were recovered. Today most scientists refer to the *Homo erectus* groups as the Pithecanthropines. The Java man was found in the valley of the Solo River near Trinil in Central Java. The brain capacity of the Java man is placed approximately between 775-975 cc. Incidentally, the brain capacity of modern human is 1500 cc for the male and 1450 cc for the female. These figures, however, do not indicate that men are more intelligent than women; they only demonstrate that men's brains are larger because their bodies are bulkier (Panopio and Santico-Rolda, 2007).

There was no stone or bone artifacts recovered in direct association with the remains of Java Man. A stone-flake industry called Patjitan is known to exist on the upper portions of the Trinil beds in Java. Thus, if ever implements were used, they must have been crude and must have consisted of heavy scrapers of chopping tools with U-shaped edges such as those which characterized adzes. In addition, there were no indications that they were good hunters. Though they lived in the open, they had not mastered the use of fire (Panopio and Santico-Rolda, 2007).

In 1889-90 Dr. Dubois discovered two fossil crania at Wadjak, 60 miles south-east of Trinil in Java. He, however, announced his discovery in the year 1920. The Wadjak skull I is of a female. The cranial capacity of it is 1550 c.c. while that of the Wadjak II is 1650 c.c. The second one is the skull of male. The skulls are dolichocranial, the forehead is receding; the supraorbital ridges are prominent. The orbits are low and broad. The nasal root is depressed below the prominent glabellar region. The nasal aperture is wide; the nasal bones are small, flat and narrow. The alveolar portion projects forward (Das, 2011).

Other materials also discovered from 1936 to 1970s. The Java *Homo erectus* thus consists of parts of more than dozen skulls, five femurs and a number of facial fragments, five mandibles, teeth and an endo-cranial cast found in 1975 (Shukla & Rastogi,1991).

7.1.2 *Homo Erectus* from China

The *Sinanthropus pekinensis* was discovered in 1926. Two fossil teeth were found at Choukoutein (Choukoutein (Zhoukoudian), 37 miles south-west of Peiping (Peking) in China. In 1921, J.G. Anderson, a Swedish Geologist working in North

China noticed chips of quartz (apparently not native to the place) in the lime stone filling of a Pleistocene cave in the town of Choukoutein (*Choukoutein,* Zhoukoudian), about 48 kilometers west of Beijing. Excavations at this place brought out a human tooth. Davidson Black (1927) felt that it was human and belonged to a distinct genus which he preferred to call *Sinanthropus pekinensis*. Subsequently, it was found to be a variant of *Homo erectus* (Shukla & Rastogi, 1991).

Check Your Progress

4) Who named Java man as *Pithecanthropus erectus*?

.....

.....

.....

.....

.....

5) Where did the fossils teeth of *Sinanthropus pekinensis* find?

.....

.....

.....

.....

.....

The Peking man dined on venison and had knowledge of fire. They probably were "fire stealers". Fire appeared to be very significant in the Pekinensis adaptation to the environment where they found. Though he had knowledge of fire, he had not utilized his knowledge to improve his tools and weapons. This theory was reinforced by the discovery of implements in Choukoutien cave which, according to authorities, did not reach the level of technical excellence that was attained by *Homo erectus* at the same time in Africa and Europe where the Chellean-Acheulian tradition was well underway. Most of the materials they used for implements must have been collected from the bed of a nearby stream full of crystals of quartz. It is also conjectured they used wooden weapons. Peking man was likewise believed to have practiced cannibalism. Anthropologists classify three kinds of cannibalism according to the dominant motivations. The first is ritualistic and incorporative. This does not necessarily involve ingestion. The second form of cannibalism is gustatory because the feaster believed that human flesh was delicious and good. The third and last form of cannibalism is motivated by the desire to survive. Evidently, in times of famine and starvation, the human flesh can help people survive when no other food is to be found. There is no way, however, by which it can be determined that what sort of cannibalism the Peking man resorted to, though it was evident that he ate human brains and marrow of the long bones. In addition, the foramen magnum at the base of the braincase had been artificially enlarged so that it would admit a fist (Panopio and Santico-Rolda, 2007). .

The skulls of *Homo erectus* from Beijing are fully human size and quite similar to the java skulls. The Beijing material is from the late 'Mindel' glaciations estimated to be 30,000 years B.P. The lower cave at Choukoutien was a "Kill" site and as such the boney material indicates cranial fractures and lengthwise split in long bones (Shukla and Rastogi, 1991).

Abundance of animal bones which includes deer bones charred by fire was found at Choukoutein (Choukoutein (Zhoukoudian)). It is apparent that this site depicted as a home base and evidence recovered in the form of the food remains, numerous stone tools and original interpretations of the cave site for the *Homo erectus*. Burned bone with stone tools are suggestive of use of the fire for cooking and as well as for warmth.

The morphological structure of Peking man appears to be quite different from that of the Java man. For instance, Peking man's cranial capacity was 850-1300 cc. In terms of cranial capacity Peking man surpassed the great apes and the *Australopithecus*. In addition to it, Peking man also developed highly peculiar osteological characteristics. One of these is the so-called Mongoloid shovel-shaped incisor, which is scoopy-shaped on the posterior surface. This produces a ridge across the back of the cutting edge and down the sides. This was absent from the Java man, though it was considered as a feature of modern members of the Mongoloid race, including many American Indians (Panopio and Santico-Rolda, 2007).

7.1.3 *Homo Erectus* From Africa

L.S.B. Leaky, while leading an expedition in 1960 discovered from Olduvai, near the top of Bed II, fossil material consisting of the larger part of a thick skull lacking the base and the face. It has some similarities with the Java skulls of *Homo erectus*. More recent discoveries are from the Lake Turkana area. In 1975, Richard Leakey's expedition discovered a well preserved and undistorted cranium from Kooby for a formation. It had a small cranial capacity. North-West Africa has yielded a number of *Homo erectus* fossils in 1933 in a sandstone quarry, south of Rabat, wherefrom a partial mandible and a broken maxilla had been reported as the first discovery of *Homo erectus* in Africa. In 1971, a partial *Homo erectus* skull was discovered at Sale, Morocco. North-Africa has also yielded considerably old *Homo erectus* at Ternifine, Algeria. This material yielded three extraordinary mandibles and side of the cranium associated with early middle Pleistocene fauna (Shukla & Rastogi, 1991).

7.1.4 *Homo Erectus* From Europe

The European fossil evidence of *Homo erectus* is rather scarce. In 1907 a mandible was recovered from a sand pit at Mauer, near Heidelberg, West Germany. In 1965, Hungarian site yielded human fossils with an early pebble tool industry similar to that of Choukoutein (Choukoutein (Zhoukoudian)). It included several fragments of deciduous teeth which are similar to those of Beijing *Homo erectus*. Between 1969 & 1971 numerous discoveries were made in Arago cave in the Eastern Pyreness in France. This material included human skeleton, two mandibles, and teeth, bones of several species of extinct rodents; wolf and horse, besides handaxes and points of worked stones of Tayacian Culture (lower Paleolithic).These are believed to represent a transitional stage between *Homo erectus* and *Homo sapiens neanderthalensis*. In 1969, a virtually completed skull

found in a cave near Petralona, Greece is of considerable antiquity and is believed to belong to *Homo erectus*. It is estimated to be about 300,000 years old (Shukla & Rastogi, 1991).

7.2 MORPHOLOGICAL FEATURES OF *HOMO ERECTUS*

Homo erectus skulls exhibit extreme platycephaly (flat headedness). This flatness is less extreme in Peking man owing to the more extended cranial vault and it has a distinct sagittal keel. The temporal muscle did not extend up to the keel. The frontal region has a large supraorbital torus, a continuous bar of bone. However, in Peking man there is a trend towards the separation of this torus into two large supraorbital ridges. The frontal region in Java man is low but Peking man exhibits the beginning of an expansion into a true vertical forehead. Posteriorly, the skull is marked by a massive occipital torus representing the limits of the nuchal musculature which seems to be necessary for holding heavy head with large prognathous jaws. The cranial bones are generally thick walled. The foramen magnum is like modern man and is centrally located in a position indicating that it was a habitually erect and bipedal Hominid (Shukla and Rastogi, 1991).

The face of the *Homo erectus* is broad and large, nasal aperture broad and the nasal bridge slightly depressed. Zygomatic bones are larger in relation to total facial dimensions. Java specimens occasionally present a diastema in front of a slightly projecting and pointed canine in the upper jaw. The canines reflect the carnivorous nature of *Homo erectus*. The molar teeth are more advanced in morphology over the *Australopithecus africanus*, however,they exhibit wrinkling or crenelations of the teeth enamel and taurodontism (large pulp cavities and fused roots in the molar teeth). The palate is huge and parabolic. No chin and no simian shelf is present (Shukla and Rastogi, 1991).

Table-1: Comparative Cranial Patterns of Early and Late *Homo erectus*

Trait	***Homo erectus erectus***	***Homo erectus pekinensis***
Cranial capacity range	775-975cc.	850-1,300 cc.
Average cranial capacity	875 cc.	1,075 cc.
Platycephaly	Extreme	Less pronounced
Sagittal keel	Extreme	Reduced
Supraorbital region into separate ridges	Huge torus	Reduced, beginning to divide
Occipital torus	Massive and well-defined	Less massive; occipital region more expanded
Mandible	Large	Reduced, more modern
Chin	Absent	Slight indication of beginning
Diastema	Occasional	Absent
Canine tooth	some Projecting	Non-projecting

Source: Shukla, B. R. K., and Rastogi, S. (1991). An Introduction to Physical Anthropology and Human Genetics.

7.3 PHYLOGENETIC STATUS AND LIFEWAYS OF *HOMO ERECTUS*

Homo erectus was the first perennial tool makers. Tool bearing sites spread from north-west Europe to south East Asia are much more numerous than the sites yielding fossils. The stone tool culture of mid-Pleistocene origin has been generally ascribed to Chellean and Acheulian traditions. Choppers and chopping tools found mainly in China are restricted in distribution up to central Asia, while hand axe is the most common tool in other parts of the world. *H. erectus*, in the absence of any defense organ used these tools for hunting. Handaxe was a multipurpose tool that could be used for cutting, chopping, scrapping, boring etc. and throwing at the animals. So essential was the use of stone tools that at Zhou-Kou-Dien stones for making tool were brought from a distance of more than 3 kilometers. The earliest evidence of fire by *erectus* is seen in China and much later at Vertess-zollos in hungry Terra Amata in France. Only fire could sustain erectus in colder regions like in northern china. In caves sites where fire has been located presence of charred bones indicates that (at least occasionally) fire was used to cook food. *Homo erectus* was a hunter gatherer. At Torralba in Spain, Howell has discovered a mud hole that was used to trap big animals. Here the bony remains of more than 40 elephants bear testimony to the hunting skills of middle Pleistocene hunters. *Home erectus* showed many characteristics similar to Modern Man and characteristics includes that cranial capacity overlaps the lower range of that in *H. sapiens* and the cranial vault is inflated. Increased flexion of face was found on the brain case (compared to *Australopithecus*) so that the anterior cranial fossa extends well over the orbits. Relative size of face reduced more than in *Australopithecus*. Foramen magnum positioned more anteriorly than in *Australopithecus* and conformation of tempero-mandibular joint as in *H. sapiens*. Dental arcade was found parabolic in shape. Dental morphology was more like *H. Sapiens* than *Australopithecus*. Limb bones were indistinguishable from those of H. sapiens in shape and size. (https://www.civilserviceindia.com/subject/Anthropology/notes/phylogenetic-status-characteristics-and-geograph-ical-distribution.html).

Check Your Progress

6) Where was the first evidence of use of fire by *Homo* erectus found?

.....

.....

.....

.....

.....

7) What is the range of cranial capacity of *Homo* erectus?

.....

.....

.....

.....

Home erectus also showed many characteristics similar to primates and characteristics are as follows-

Characteristics	***Homo erectus***
Bones of Cranial Vault	Very thick
Supra-orbital torus	strongly developed
Frontal bones	Receding
Occipital Ridge	Well developed
Mastoid process	Small
Nasal Bones	Broad
Alveolar Prognathism	Pronounced
Body of Mandible	Massive
Upper Incisors	Larger

Home erectus was the earliest bipedal found in a broad geographical zone as compared to earlier fossil records. Due to the maximum occurrence of its finding in ice ages, greater variation in terms of climate can be seen. The diverse area includes eastern, northern, and southern Africa, Spain, the Middle East, China and Indonesia. One of the important finding of *Homo erectus* has been found at Choukoutein (Zhoukoudian) site near Beijing in China. Human and animal remains along with artifacts have occurred from this site. Since 1920, 40 remains of *Homo erectus* and more than 100,000 artifacts have been recovered by the Anthropologists. The tools recovered from the site i.e. Choukoutein (Zhoukoudian) includes choppers, scrapers, points, and awls from stone. Deer antlers also have been used and it implies that they possibly used skull for drinking bowls. Detection of ash layers more than 18 feet deep is the sign of the use of fire. Hunting and butchering elephants and such remains recovered from the Spain points towards that *Homo erectus* lived by the hunting and gathering. The remains of deer and wild horses were also found from the Choukoutein (Zhoukoudian). Presence of the cut marks on the tools and bite marks on the bones suggest that *Homo erectus* was carnivorous. A wide variety of the wild fruits, vegetables along with tubers and eggs had recovered from the debris. The weather conditions were very cold during the period of existence of *Home erectus.* So, it can be said that this *Homo* species used clothing which was probably made from the animal skin to survive in the cold weather conditions. Evidence of needles among the bone tools at Choukoutein (Zhoukoudian) can be justified that *Homo erectus* used clothing. Large animal's remains also recovered which is suggestive of rapid consumption of meat by them and it implies that there were large social groups and due to which they had a complex mechanism for distribution of food and other good. Individual's remains without brain were also found at Choukoutein (Zhoukoudian). The reason of removal of brain may be a part of death rituals practices or possibility of cannibalism or another reason could be use of skull case as a drinking vessel.

Sex dimorphism, diet, and social implications: Based on the estimates of body size and correlative estimates of sex-based robusticity, the degree of sexual dimorphism in *H. erectus* can be estimated. *H. erectus* females appear to increase more in size relative to earlier *Australopithecus* (and possibly *Homo*) females than do males. Thus sexual dimorphism decreased in *H. erectus*, and energetic

demands for *H. erectus* females are also differentially increased. Differential female size increase may additionally be related to the differential energetic benefits accrued to females during walking when the lower limb is lengthened. These advantages are of course somewhat counter balanced by the increased energy requirements of large body size itself, and thus both indirectly support the previously discussed idea that *H. erectus* required a dietary shift to high-quality food items to maintain both large body and brain size. It is suggested that unlike other primates, assistance in childbirth is necessitated in *Homo* by an enlarged brain size and pelvic constraints of bipedality (Rosenberg and Trevathan, 1996), to scenarios entailing longer-term assistance throughout childrearing. These latter scenarios envision cultural changes that provide for the survival of greater numbers of infants per *H. erectus* female by the enlistment of a set of helpers. These scenarios include the "grandmothering" hypothesis, which implicates a relatively long postmenopausal role of female caregiving in *H. erectus* society (O'Connell et al., 1999) and the shortening of interbirth intervals, and the assistance of both male and female helpers, including provisioning and cooperative care (Antón, 2003).

***Homo erectus* as *Homo* sapiens:** In one view, *H. erectus* and *H. sapiens* represent a single evolving lineage that originated via a cladogenetic event some 2 million years ago. This view argues that *H. erectus* can be defined relative to *H. sapiens* only on the basis of plesiomorphic characters, and as such, that all fossil *Homo* from about 1.8 Ma to present should be considered *Homo sapiens*. Furthermore, "transitional" populations of Middle Pleistocene *Homo* throughout the Old World support the idea of Pleistocene *Homo* as a single evolving lineage, as would evidence of gradual rather than punctuated increases in brain size. Although this does not recognize any (cladogenic) speciation events within the lineage, it does recognize a number of morphological grades that in many (but not all) ways correspond to distinctions that others make between *H. erectus*, its subspecies, and *H. sapiens*. That is, this view recognizes regional morphs that others might choose to split into species. However, these distinctions are not viewed as being the result of autapomorphic characters in *H. erectus*, and thus are not considered indicative of a separate species designation (Antón, 2003).

7.4 OVERVIEW OF LIFE HISTORY AND BIOLOGY OF *HOMO ERECTUS*

H. erectus was a large-bodied, large-brained, moderately sexually dimorphic hominin whose ranging patterns were significantly enlarged over those of earlier hominins. The energetic costs of maintaining enlarged body and brain size suggest the occurrence of a shift to a higher-quality diet, some part of which likely included increased emphasis on meat and marrow acquisition. Maternal costs must have been differentially larger due to both carrying and birthing large-brained neonates. Data from extant dispersals and models of fossil dispersals suggest that increasing body size, greater reliance on animal food resources, and increased range size were part of an ecomorphological web of factors that facilitated the initial hominin dispersal from Africa. Developmental rates appear to have been somewhat faster in *H. erectus* than are those of modern humans, but an adolescent growth spurt cannot be rejected. Changes in growth between *H. erectus* and *H. sapiens sapiens* include heterochronic shifts in cranial vault growth. The data support the idea that the *H. sapiens* vault is neotenic relative to *H. erectus*, and suggest either that size increase led to changes in shape, due to the increased efficiency of the shape

of a sphere over more angular forms, or that behavioral flexibility and juvenilization of the brain are linked phenomena in the evolution of human skull form (Antón, 2003).

7.5 SUMMARY

To summarize, it can be said that evidences of emergence of *Homo erectus* have been found from the different parts of the world. In this section, appearance and dispersion have been briefly explained with reference to *Homo erectus* from Africa, Asia and Europe. It can be said that that *Homo erectus* can be considered ancestor of modern man. The emergence of the *Homo erectus* is not restricted to one place and indicative of dispersion with migration even in extreme weather conditions. It reviews that this hominid played a significant role in expansion of *Homo erectus* to *Homo* sapiens.

7.6 REFERENCES

Anton, S.C. (2003). *Natural history of Homo erectus. American Journal of Physical Anthropology: The Official Publication of the American Association of Physical Antropologists*, 122 (S37), 126-170.

Das, B.M. (2011). *Outlines of Physical Anthropology*. KitabMahal Agencies, Allahabad.

Groeneveld, E. (2017). *Homo erectus*. Retrieved from: https://www.ancient.eu/Homo Erectus/

Homo erectus- Upright Man: http://eol.org/pages/4454110/details.

Panopio, I.S. & Rolda, R.S. (2007). *Society and Culture: Introduction to Sociology and Anthropology*. Philippines: Katha Publishing Co., INC.

http://humanorigins.si.edu/evidence/human-fossils/species/homo-erectus

https://www.eivilserviceindia.com/subject/Anthropology/notes/phylogenetic-status-characteristics-and-georgraphical-distribution.html

http;//www.athenapub.com/AR/13intro-he-htm. Introduction: The long journey of an ancient human ancestor. Athena Review, Vol. (4), pp 16-24.

Nanda/Warms: Human Evolution, Cultural Anthropology 1 1e. https://www.cengage.com/resource_uploads/downloads/1133591469_374029.pdf

Shukla, B.R.K., & Rastogi, S. (1991). *An Introduction to Physical Anthropology and Human Genetics*. Palaka Prakashan. Delhi.

7.7 ANSWERS TO CHECK YOUR PROGRESS

1) L.S.B Leaky reported parts of the skull and jaw of juvenile Hominid from Bed I at Olduvai Gorge in 1961.
2) In 1972, Richard Leaky, showed casts of fossils from deposits at Lake Turkana to which he assigned a third Hominid model.
3) Name of three different species of *Homo erectus* are *Pithecanthropus erectus, Sinanthropus pekinensis and Atlanthropus mauritanicus.*
4) Eugene Dubois named Java man as *Pithecanthropus erectus* because it was an upright ape man.
5) Two fossil teeth of *Sinanthropus pekinensis* were found at Choukoutein (Choukoutein (Zhoukoudian), 37 miles south-west of Peiping (Peking) in China.
6) The earliest evidence of use of fire by erectus was reported in China.
7) The cranial capacity range of *Homo erectus* lies between 775-975 cc.

UNIT 8 *NEANDERTHALS**

Contents

Learning Objectives

After reading this unit, you will be able to :

- learn about fossil evidences and distribution of *Neanderthal*;
- understand its craniofacial features and phylogenetic status; and
- know the culture and tool-typologies used by *Neanderthal*.

8.0 INTRODUCTION

Neanderthal appeared between 200,000 & 250,000 years ago as a species of *homo*. *Neanderthals* have been considered closely related to the modern human beings. In Eurasia, their remains were recovered such as bones and stone tools along with the skulls having the advance and primitive characteristics. William King gave the name *Homo neanderthalensis* in 1864. After some years, it was named as *Homo sapiens neanderthalensis*, a subspecies of *Homo sapiens* by looking on the characteristics recovered from the different parts. It has been known that between the period of existence of *homo*, the climate fluctuated. The fossil records received for the *Neanderthal* showed the physical characteristics

* Dr. Vijeta Choudhary, UGC-Post Doctoral Fellow, Department of Anthropology, University of Delhi, Delhi.

which were well acclimatized with the cold climate. These characteristics included the barrelled chests and the stocky limbs where heat can be stored in a better way. However, ecological changes took placed due to fluctuations in weather conditions. Further, these changes brought the change in newer species of plants and animals such as grassland appeared. All these change could not adopted by the *Neanderthals*. The period of survival of *Neanderthal* was between 41,000 and 39,000 years ago. Thus, the extinction of *Neanderthals* in Europe coincides with the appearance of very cold period.

The modern humans are believed to live in co-existence with *Neanderthals* around 35,000 years ago. It is also assumed that *Neanderthals* inhabited the European continent for a longer period before the arrival of modern humans. In some recent studies, it has been argued that *H. sapiens* was reason behind the extinction of *Neanderthals* as *H. sapiens* introduced the diseases.

8.1 FOSSIL EVIDENCES AND DISTRIBUTION OF *NEANDERTHALS*

The first human fossil of *Neanderthal* was discovered by the lime workers in 1856 in the Feldhofer cave of the Neander Valley which is located near Düsseldorf in Germany. The fossil remains included the robust cranial vault, massive brow ridge, facial skeleton and several limb bones. The built was robust having strong limb bones with large articular surfaces on the ends. The size of the remains of extinct mammals and crude stone tools was found to be contemporary to the size of human fossils. After first time examination, the fossils were thought to be the oldest known human beings who lived in Europe.

Additional fossils that resembled the *Neanderthals* from the Feldhofer and Spy caves were discovered during the latter part of the 19th century and the early 20th century. Along with that, other sites also discovered such as now in Belgium (Naulette), Croatia (Krapina), France (Le Moustier, La Quina, La Chapelle-aux-Saints and Pech de L'Aze), Italy (Guattari and Archi), Hungary (Subalyuk), Israel (Tabûn), the Czech Republic (Ochoz, Kùlna, and Sipka), the Crimea (Mezmaiskaya), Uzbekistan (Teshik-Tash), and Iraq (Shanidar). More recently, *Neanderthals* were discovered in the Netherlands (North Sea coast), Greece (Lakonis and Kalamakia), Syria (Dederiyeh), Spain (El Sidrón), and Russian Siberia (Okladnikov) and at additional sites in France (Saint Césaire, L'Hortus, and Roc de Marsal, near Les Eyzies-de-Tayac), Israel (Amud and Kebara), and Belgium (Scladina and Walou)(https://www.britannica.com/topic/Neanderthal). These sites were occupied with approximately 200 individuals including over 70 juveniles.

It is apparent that there are two distinct types of *Neanderthal* man: Conservative types and Progressive types. These two can be differentiated on the basis of morphology. Several fossils have been discovered from different parts of the world that represent these two types of *Neanderthal* man. For example *La Chapelle-aux-Saints*, *La Moustier*, *La Quina* and *La Ferrassie* are regarded as conservative *Neanderthal* whereas *Krapina*, *Ehringsdorf* and *Steinheim* are considered as the active members of Progressive type.

Check Your Progress

1) The fossil remains (including skull and long bones) of *Neanderthals* were discovered in the year?

.....

.....

.....

.....

.....

2) From which part of the world the remains of *Neanderthal* were obtained?

.....

.....

.....

.....

.....

The description of some of them has been given as follows:

8.1.1 *La-Chapelle-Aux-Saints*

In 1908, the skeleton materials were discovered in a small cave in the Correze district, France. The materials recovered included a skull with lower jaw, a clavicle, two almost complete humeri, two incomplete radii, some bones of hand, fragments of ilia, two incomplete femora, parts of tibiae, several bones of foot and good numbers of vertebrae and ribs. The associated findings include dressed flints, scrapers and points, skeletal remains of wooly rhinoceros, reindeer, extinct bison and cave hyena etc. The implements belong to the Mousterian culture (Das, 1993).

The important characteristics of *La-Chapelle-aux-Saints* are as follows: Its cranial capacity was measured as 1600 c.c.Its skull was big and heavy. Its head length and breadth were 208 mm and 155 mm respectively. The average cephalic index was 74.5. It varied individually from 70 to 76. Face was more developed in comparison to head. Frontal part of head was comparatively big. Vault height was low. Its head was less developed. Occipital region was found elevated and depressed. Temporal fossa was found big. It has continuous and big supra orbital ridge. Eye cortex was found to be very big. The position of maxillary was strong and heavy. Nose was platyrrhines type. Nasal root was found depressed like Australians. Nasal aperture was long. Palate was found. Mastoid process was very small. Glenoid cavity was big and post-glenoid epiphysis was more developed. Lower jaw was big and strong. Chin was less developed. Diastema was absent in teeth. Humerus was strong and small. Hands were smaller than feet. Femur was strong and heavy. Linea aspera like apes was less developed in femur. Tibia was small and strong. The length of its entire body was 5 feet. But its height was observed between 5’1’’ to 5’5’’. Its palm resembles more with apes(Pandey, 2010).

8.1.2 *La Ferrassie* 1

A skull was found from the *La Ferrassie*, France. In 1909, male and female adults were discovered. The age appears to be 70,000 years old. Large occipital bun, low-vaulted cranium and heavily worn teeth were its distinct characteristics.

8.1.3 *Le Moustier*

At the archaeological site in Peyzac-le-Moustier, Dordogne, France, a fossilized skull was discovered in 1909. The age of the skull is estimated to be less than 45,000 years old. The characteristics include a large nasal cavity and a somewhat less developed brow ridge and occipital bun. Otto Hauser discovered the first *Neanderthal's* 'Burial site'.

8.1.4 *Shanidar 1*

It was found in the Zagros Mountains in Iraqi Kurdistan. It was believed that a total of nine skeletons to have lived in the Middle Paleolithic by Ralph Solecki. Right arm was missing from its right arm of one of the skeleton. It can be theorized that either it had been broken off or amputated due to the use of stone tools. Flowers were found with one of the burial which signified that some type of burial ceremony may have occurred**.**

8.1.5 *Amud 1*

An adult *Neanderthal's* fossilized remains were found in a cave at Nahal Amud, Israel. From the fossils, it appeared that at least some of the fossilized remains may have been deliberately buried. The significant finding of *Amud* 1 was that it had higher cranial capacity (1740 cc) which is among the largest known cranial capacity found in any hominid either living or extinct. Francis Turville-Petre discovered these fossils in 1925.

8.1.6 *Tabun C1*

A palaeo-anthropological excavation conducted in a deep rock shelter located on the edge of Mount Carmel and facing the Mediterranean Sea in northern Israel and Dorothy Garrod discovered its fossils remains. It included a partial skeleton, a mandible, an isolated premolar teeth and fire isolated limb bones. So, the artifacts recovered in a long sequence of deposits at this site reflect the patterns of change in stone-tool manufacture during the Lower and Middle Paleolithic periods. Thus, in southwestern Asia, this record has converted into the reference scale for human technological evolution in between 300,000 and 50,000–100,000 years ago.

8.1.7 *Gibraltar*

It was found in Forbes' Quarry, Gibraltar. Captain Edmund Flint was the first to discover the Neanderthals of Gibraltar. It is also considered that this may have been among the last of their species. Occupants of the ten sites on the Gibraltar peninsula, reflects that it had one of the densest areas of Neanderthal settlement of anywhere in Europe. The skull showed typical *Neanderthal* features**.**

8.1.8 *Krapina*

Fragmentary skeletal remains about twenty individuals in association with some Mousterian industry were discoverd at Krapina, in Croatia, Yogoslavia in 1899.

The skeletal material show some typical *Neanderthal* character but at the same time in some other characters as type of forehead and round headedness the *Krapina* man approaches towards neanthropic type. The *Krapina* head was brachycephalic (Das, 1993).

8.1.9 *Swanscombe*

The first material was discovered by Alvin Marston in 1935. It is a gravel pit located near London along the Thames River. The findings included occipital bone, partial parietal bone and several stone tools. The skull bones were comparatively thick with the low brain case. The estimated cranial capacity was found about 1325 c.c.

8.1.10 *Steinheim*

The *Steinheim* skull without the lower jaw, in association with an Acheulian industry was discovered in 1993 from a deposit of the Middle Pleistocene Period at Steinhein-Murr in Germany. The skull was long and narrow. The cranial index was 70 and the cranial capacity 1070 cc. It was rather small for a Neanderthaloid though in the characters of supraorbital torus and certain other features, the *Steinheim* skulls resembles the conservative Neanderthal type. In some other characterslike facial and occipital parts it shows a marked tendency towards a neanthropic type (Das, 1993).

8.1.11 *Mount Carmel*

In 1931-32,the skeletons of *Mount Carmel* were discovered from two adjoining caves in Palestine.The cultural materials of the caves belonged to the Levalloiso-Mousterian industry. The *Mount Carmel* males possessed more height than females. Their head was heavy and height of vault was medium. Zygomatic process was like modern man. Canine fossa was absent. Eye orbit was flat. Cranial capacity varied between 1418 cc to 1857 cc in males while in females it varied between 1300 cc to 1350 cc (Pandey, 2010).

8.1.12 *Eringsdorf*

The materials were discovered at *Eringsdorf*, a village near Weimer, in Germany during the years 1914 and 1916. And in 1925 fragments of a shattered skull were discovered. The associated artifacts are pre- Mousterian, late Acheulian type. The material consists of fragmentary parts of skull and lower jaw. In the character of supra-orbital ridges, the temporal bone, the form of occiput, the jaw and the teeth, *Eringsdorf* man is a classic Neanderthal. But in other characters, it is like that of a Neanthropic man (Das, 1993).

Check Your Progress

3) What type of skeletal materials was discovered from a small cave of Correze district, France?

.....

.....

.....

.....

.....

4) Who discovered the first 'burial site' of *Neanderthal*?

.....

.....

.....

.....

.....

8.2 CRANIOFACIAL FEATURES OF *NEANDERTHALS*

Among the *Neanderthals*, the archaic human upper limbs were accompanied by evidence for extensive use of the anterior dentition as an aid to manipulation. In the broad transition from Middle Pleistocene archaic humans to the *Neanderthals* across Europe and western Asia, human populations maintained pronounced total facial prognathism and large anterior teeth, while their posterior teeth reduced in size and their masticatory muscle attachments (i.e. zygomatic bones and anterior mandibular ramus margins) migrated posteriorly. This produced the characteristic mid-facial prognathism of the *Neanderthals*, with a projecting midline, including the dentition, the nasal aperture and the mid- supraorbital torus, and a retreating zygomatic region. Associated facial features include large retromolar spaces, anterior zygomatic roots above M2-M3, mental foramina below P4-MI, absence of canine fossae and no inferolateral maxillary notches, pneumatization of the maxillae and middle half of the supraorbital torus, flattened zygomatic bones, and largely horizontal nasal bones. It appears that the retention of a Middle Pleistocene level of total facial prognathism was to facilitate the use of the anterior teeth as a vise, because biomechanical considerations of *Neanderthal* facial morphology show that they were habitually loading their anterior teeth. Furthermore, those large anterior teeth, containing shovel-shaped incisors, would wear down slowly and sustain high levels of bite force, especially labially directed force; they were thus adapted for extensive use. That they were so used is evident in their accelerated rate of wear relative to that on associated posterior teeth, the pronounced labial rounding evident on the incisors of older *Neanderthal* individuals and the high frequency of labiolingually oriented striae and marginal microchipping on their anterior teeth. The functional significance of the distinctive *Neanderthal* superior nuchal line morphology, with the absence of an external occipital protuberance and presence of suprainiac fossa is not apparent; it may be related to hypertrophy of the nuchal musculature. Certainly the consistently large, straight, and non-bifurcated spines of *Neanderthal* lower cervical are indicative of an enlargement of nuchal muscles, probably for cranial stabilization during anterior tooth use. With the advent of modem humans across the *Neanderthal* range, there was a loss of mid-facial prognathism produced by a posterior retreat of the dentition and associated nasal aperture, a decrease in absolute and relative anterior tooth, a loss of the greater rate of wear on the anterior dentition, the disappearance of the *Neanderthal* occipito-mastoid morphological complex, and a reduction in the dimensions of cervical vertebral spines (Trinkaus, 1986).

Neanderthals represented the distinct cranium and lower jaw features than the other homo genus. The features includes-

- Low vault Cranium
- Large orbital
- Large nasal openings
- Prominent arched brow ridges
- Pronounced occipital region
- Frontal teeth larger
- Molars and pre-molars small
- Cranial capacity similar or larger than the modern humans
- Robust lower jaw

Fig. 1: *Neanderthal* Man

Source: Bio-cultural Evolution (Pandey, 2010)

Fig. 2: *Neanderthal* Skull

Source: Bio-cultural Evolution (Pandey, 2010)

The features which added some distinction to *Neanderthals* included the lower jaw represented a receding chin. The mental foramen was placed farther back in *Neanderthals* than in recent humans, and a space between the last molar and the ascending edge of the lower jaw occurred in many individuals (https://www.britannica.com/topic/Neanderthal).

Paramasticatory use of the teeth was apparently no longer required for successful adaptation. In light of these considerations, it is interesting that in Africa and eastern Asia total facial prognathism decreased during the later Middle and early Upper Pleistocene as facial robusticity reduced. Evidently there was not sufficient selective pressure in those regions to maintain a long face. Furthermore, the distinctive *Neanderthal* complex of occipito-mastoid traits never appeared in Africa or eastern Asia. The only sufficiently intact specimen, Broken Hill 1, exhibits pronounced anterior dental wear and rounding similar to that of older *Neanderthals*, but its position at the beginning of this period means that it can only provide an indication that the ancestral, Middle Pleistocene African pattern was similar to that of the *Neanderthals* (Trinkaus, 1986).

8.3 COMPARISON BETWEEN *NEANDERTHAL* MAN AND *HOMO SAPIENS*

The physical structure of *Neanderthal* man resembles with *Homo sapiens*(True man or modern man). But one finds some differences in physical features, too. The stature of *Neanderthal* man was small. Its height varied between 5 ft to 5'5" ft. head was big, nose flat but pointed, shoulder flat and head sloping downwards. Fingers were not flexible like modern man. He could not stand keeping his neck erect. He could not walk continuously. Cranial capacity was more than modern man. But head belonged to lower category. His brain possessed weak power of seeing and touching. Probably he was able to speak but had not developed language. Although the scholars like Ashley and Montague have attempted to show that *Neanderthal* man resembled with modern man to a great extent, but some other scholars do not agree with this opinion. They believe that *Neanderthal* man possessed physical demerits and was not similar physically to man. Previous scholars held view that *Neanderthal* belonged to genus *Homo* but they were not true man or *Homo sapiens.* The believer of this view had isolated *Neanderthal* man from *Homo sapiens.* According to them *Neanderthal* was a semi human species. These semi human species were defeated by *Homo sapiens* of upper Palaeolithic period. The *Homo sapiens* of upper Palaeolithic period had defeated them and established their control over Europe. But recent discoveries made at Swansecombe, Steinheim and Fontechevade have revealed the remains of such human species who belonged undoubtedly to *Homo sapiens.* It seems probable that in the early period of glaciations such human species came to settle down in Europe who resembled *Homo erectus*. The evidence of Heidelberg man bears testimony in this regard. Those human species gave rise to *Homo sapiens* in lower Palaeolithic period. But when Europe met with fourth terrible glaciation in middle Palaeolithic period, a branch of *Homo sapiens* were left isolated.This branch of *Homo sapiens* represented *Neanderthal*. Due to isolation in glacial period, some changes in physical features of their body took place. They began to appear different from *Homo sapiens.* Thus, *Neanderthal* man was basically related to *Homo sapiens*(Pandey, 2010).

8.4 *NEANDERTHAL* CULTURE AND TOOL TYPES

The period of *Neanderthal* culture begins from end part of third inter-glaciation period and continues till middle of fourth glaciation period. In the last part of third inter-glaciation period, the environment of Europe was hot. That is why the life of *Neanderthal* of that period shows similarity with Acheulian. But during

fourth glaciation period, the life of *Neanderthal* man shows complete change. The middle Palaeolithic represented a single cultural tradition called as Mousterian. It was defined as culture associated with *Neanderthal* man (*Homo neanderthalensis*) (Pandey, 2010).

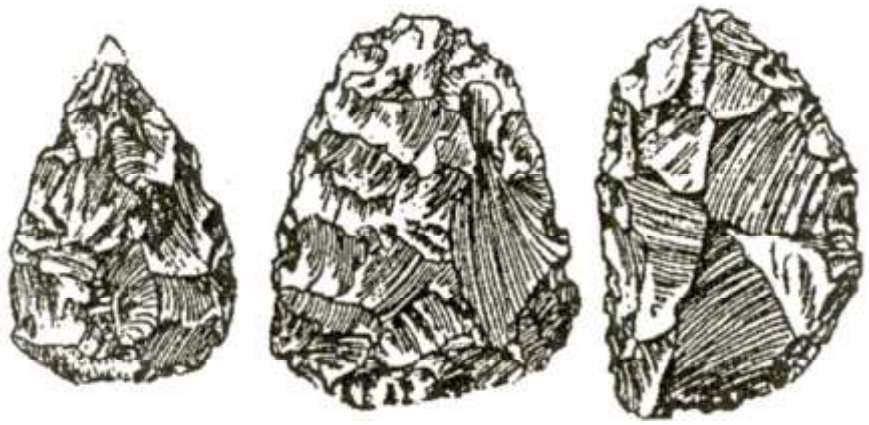


Fig. 3: Mousterian Tools

Source: Bio-cultural Evolution (Pandey, 2010)

In order to protect from cold environment of fourth glaciation period, *Neanderthal* man chose to live in caves. The period of *Neanderthal* is also known as early cave dwelling age and the period of upper Palaeolithic is also known as cave dwelling age. *Neanderthal* man knew the use of fire. This was also a useful means of protection from cold. *Neanderthal* man had contributed a lot to civilization by establishing control over fire. They were completely dependent on nature for food. Their general food consisted of wild fruits, wild roots, shoot, leaves, flower, seeds, honey, egg, earthworm, insects and frogs. They used to collect seaweeds and shells from sea to use as food. They also used to hunt small birds probably. *Neanderthal* man had only flake tools. Therefore, they were not able to hunt big animals without encircling them collectively. They used to eat the body of the hunted animals at the site where hunting was done (Pandey, 2010).

Social Life:*Neanderthals* used to hunt big animals. Hunting of big animals required collective effort and some kind of organization. This reveals that they were living in group. Each group had a head. Women and children were more in number than males in the group. Those members who did not obey the head were ousted from the group. They had division of labour in the group based on age and sex. Men of the group used to collect food items in day time and gather at a particular place during night. They lived in group to protect themselves from the attack of wild animals. Women and children used to collect stone fragments in order to shape tools. During night the head and other men of the group used to prepare tools from the stone fragments collected by woman and children. The children used to learn the art of tool making from the head and other men of the group. When some *boy* became quite young, he wanted to become the head of the group. He had to fight with head of the group for this purpose. If he defeated the head, he occupied the post of headship. Now all women, children and men remained under his control. But when he was defeated by the head, he had to leave the group as punishment. Sometimes he was killed by the group leader (Pandey, 2010).

8.5 PHYLOGENTIC RELATIONSHIP

Ever since the discovery of *Neanderthal* man in the year 1856, his precise evolutionary position has been a source of intense controversy. This has allowed for the analysis of their morphological variability and geographical distribution with a level of detail unparalleled in other hominins. The close phylogenetic relationship between *Neanderthals* and *Homo sapiens* also makes this group particularly interesting as understanding its status undoubtedly sheds light on the definition of our own species. As a matter of fact, anatomical descriptions of *Neanderthal* remains have most often focused on comparisons with extant or recent humans (Hublin, 2009).

The most significant points are their supposed sudden disappearance from the fossil record, their origins and their relationship to modern man. As regard, the phylogenetic implications and the significance of the so called neanthropic traits in these *Neanderthal* human fossils, there are two clear cut opinions:

1) These Progressive *Neanderthaloids* represent the Conservative types in the process of the evolving into *Homo sapiens*.
2) That the Palestinians are hybrids between *Neanderthal* man and some variety of the *Homo sapiens*.

These opinions indicate that *Neanderthal* man is our direct ancestor. However, there are two principle objections to this view-

i) *Neanderthal* man shows specialized traits which indicate an early and wide divergence from the main line of human evolution that leads to modern man.
ii) Completely evolved modern type of fossil men contemporary of *Neanderthal* man in Western Europe and hence they cannot be descendants.

Recent discoveries of a whole series of human fossil finds exhibit in their teeth and skeletal characters the piecemeal of replacement of *Neanderthaloid* specialization by modern morphology. As regards the hyberdity of the ancient Mount Carmelites, it has been argued that such a complete range of human evolution from Conservative type of *Homo sapiens* would not have been possible in such a short series and brief time space. Hooton feels that *Neanderthal* man should have changed into modern man by radical race mixture. The skeletal series from the cave of Skuhl and Tabun in Palestine demonstrate this to some extent.In his estimation some individuals, particularly the females, tend to reproduce almost in the conservative parental type, while males usually vary towards the Progressive parental stock.

Spencer (1984) has recently given the history of the *Neanderthals* and their evolutionary position. In general the phylogeny of *Neanderthal* man may be summarized in three ways using three hypotheses:

1) *Neanderthal* phase of man hypothesis.
2) The *Pre-Neanderthal* hypothesis.
3) *Pre-sapiens* hypothesis.

The first two views are widely considered valid but third view is less well supported.

In the absence of diagnostic upper limb remains for these non-*Neanderthal* archaic humans, it is impossible to determine whether their manipulative behaviors were more similar to those of *Neanderthals* or modern humans. There is little in the archeological remains associated with these non- *Neanderthal* archaic humans to indicate much of a contrast with those from Europe and western Asia (Trinkaus, 1986).

Check Your Progress

5) What are the distinctive features of *Neanderthal* cranium?

.....

.....

.....

.....

.....

6) Write a short note on *Neanderthal* diet.

.....

.....

.....

.....

.....

8.6 END OF *NEANDERTHALS*

Neanderthal species met their end nearly 40,000 to 35,000 years before today. They met with end by *Homo sapiens* or true man. *Homo sapiens* had emerged in Europe during lower Palaeolithic period and *Neanderthal* man basically was a branch of *Homo sapiens.* Before this view, a number of scholars believed that *Homo sapiens* and *Neanderthal* man were so different physically and mentally that they would not have come in contact with each other. Therefore, blood contact between early *Homo sapiens* and *Neanderthal* man was not possible. But in recent decades human remains of such species have been discovered from Palestine and Middle Asia that none could deny accepting them in between *Neanderthal* man and *Homo sapiens.*Skull remains found from a cave situated nearby Gallillo sea in Palestine and skeletons from caves of Carmel mountain reveal that they were not *Neanderthals*, rather they were *Neanderthaloid*. In 1938, remains of *Neanderthaloid* child were discovered from Uzbekistan in Russia. The remains of this child shows a mixture of *Neanderthals* and *Homo sapiens*. This shows that the blood contact between *Neanderthal* and *Homo sapiens* would have taken place (Pandey, 2010).

8.7 SUMMARY

The appearance of *Neanderthal* as a species of *Homo* has been marked between 200,000 & 250,000 years ago. Their remains inclusive of skull, bone and stone tools were recovered from different part of the Europe and Asia.The interpretations

of fossil records revealed that *Neanderthals* were well adapted for climatic conditions as implied by their physical characteristics. *Neanderthals* are majorly classified into two distinctive types on the basis of their morphology: Conservative types and Progressive types. *La Chapelle-aux-Saints*, *La Moustier, La Quina* and *La Ferrassie* are regarded as conservative *Neanderthals* whereas *Krapina, Ehringsdorf* and *Steinheim* are considered as the active members of Progressive *Neanderthals*.The unit provides a brief description of these fossils. The cultural interpretations of *Neanderthal* fossils tell scientists that they used to do specific seasonal hunting of eating animals and used tools for activities like hunting and sewing. There are differences of opinions regarding the fate of *Neanderthals*. Many researchers opine that *Neanderthals* were exterminated by the more progressive new-comers such as Cro-Magnon and *Homo sapiens* while others believe that their extinction was an outcome of harsh climatic conditions.

8.8 REFERENCES

Broom, R. (1950). *Finding the missing link*. Watts.

Constable, G. (1973). *The Neanderthals*. Time Life Medical.

Das, B. M. (1993). *Outlines of Physical Anthropology*. Kitab Mahal, Allahabad.

Ember, C. R. & Ember, M. (1994). *Anthropology: A Brief Introduction*. 2nd edition, Pearson Education, USA.

Hublin, J. J. (2009). The origin of Neandertals. *Proceedings of the National Academy of Sciences*, *106*(38), 16022-16027.

Mondal, G.C. (2016). *Neanderthal*. ePG Pathshala: A Gateway to all Post-graduate Courses. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgpcontent/anthropology/01.physical/biological anthropology/19.neanderthals/et/7213_et_et_19.pdf

Neanderthal. Encyclopedia Britannica. Encyclopedia Britannica Online. Encyclopedia Britannica Inc. Retrieved From: https://www.britannica.com/topic/Neanderthal

Pandey, G. (2010). *Bio-Cultural Evolution.*Concept Publishing Company Pvt. Ltd., New Delhi.

Shukla, B. R. K., & Rastogi, S. (1991). *An Introduction to Physical Anthropology and Human Genetics*. Palaka Prakashan, Delhi.

Tattersall, I. (1999). *The last Neanderthal: The rise, success, and mysterious extinction of our closest human relatives*. Basic Books.

Trinkaus, E. (1986). The Neandertals and modern human origins. *Annual Review of Anthropology*, *15*(1), 193-218.

https://australianmuseum.net.au/homo-neanderthalensis

http://humanorigins.si.edu/evidence/human-fossils/species/homo-neanderthalensis

8.9 ANSWERS TO CHECK YOUR PROGRESS

1) The fossil remains (including skull and long bones) of *Neanderthals* were discovered in the year 1856.

2) The remains of *Neanderthals* including bone and stone tools, were found from Eurasia, Western Europe, Central and Northern Asia.

3) In 1908, La-Chapelle-aux-Saints's skeletal materials were recovered froma small cave of Correze district, France. For more details kindly refer section 8.1.1

4) The first *Neanderthal* 'Burial site' was discovered by Otto Hauser.

5) *Neanderthal* cranium represented following distinctive features other than the genus homo: Low vault Cranium, Large orbital, Large nasal openings, Prominent arched brow ridges, Pronounced occipital region, Frontal teeth larger, Molars and pre-molars small, Cranial capacity similar or larger than the modern humans and Robust lower jaw (https://www.britannica.com/topic/Neanderthal).For more details kindly refer section 8.2.

6) The average *Neanderthal's* diet consisted of a lot of meat. *Neanderthals* also used to eat plants as interpreted by the remains of starch grains. For more details kindly refer section 8.4.

UNIT 9 ARCHAIC *HOMO SAPIENS**

Contents

Learning Objectives

After reading this unit, you will have an understanding of:

- climatic conditions in the Middle Pleistocene period;
- distribution of fossils which are labelled as Archaic *H. sapiens*;
- how Archaic *H. sapiens* is different from both *H. erectus* and *H. sapiens* anatomically;
- the cultural behaviour such as tool technology, subsistence strategy and campsites of Archaic *H. sapiens*; and
- taxonomic and phylogeny issues concerning Archaic *H. sapiens*.

9.0 INTRODUCTION

Every living being on earth is related to every other living being. However, if we go back far in time we will find that we all had a common ancestor. This principle of evolution is applicable to the origin of human beings also. If we look back in time we will find that our ancestors resembled us and must have looked the way we look today. This is exactly we would expect in an evolutionary process. However, what we were in the earlier is recorded in the fossils which give us the glimpse of our evolutionary past. It is now well established that only one living species of humans exist i.e. *Homo sapiens* (*H. sapiens*) today but millions of years ago many species of homo genus were present as discovered from the fossil evidence One out of many was *Homo erectus* which is considered as the possible ancestor of all the later hominin species but its linkage with modern human is still sketchy as there are other intermediary forms that showed similarities both with the *H. erectus* on one hand and modern *H. sapiens* on the other. These species which represents the transition from *H. erectus* towards the line of *H. sapiens* are popularly labelled as Archaic *H. sapiens* or advanced *H.*

* Dr. Priyanka Khurana, Department of Anthropology, Utkal University, Bhubaneswar.

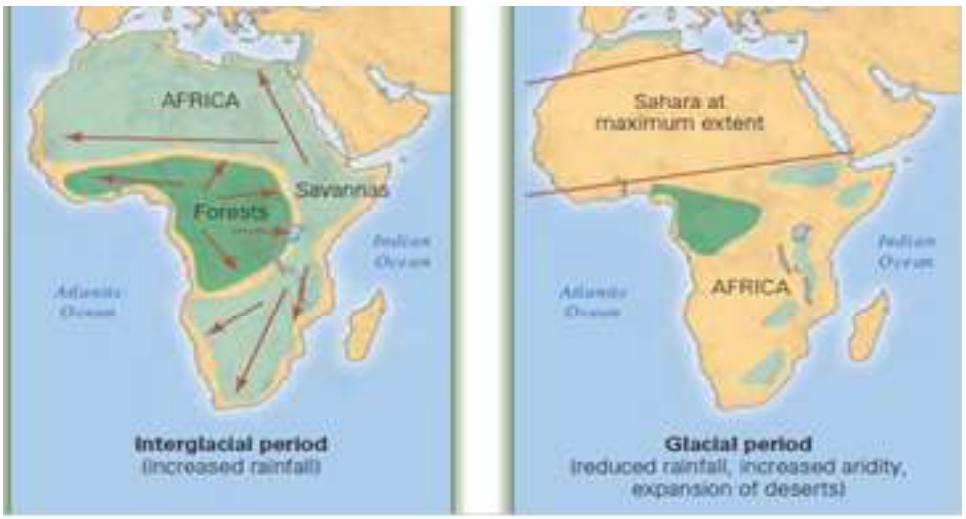
erectus or pre-modern humans. The distinct feature that places archaic *H. sapiens* close to modern *Homo sapiens* is their large brain size. However, their large and heavy facial skeletons place these hominin closer to *H. erectus*.

The fossil records of archaic *H. sapiens* are found during Middle Pleistocene that lasted from 800,000 to 150,000 years ago. Their records have been unearthed from Africa, Europe and Asia which clearly exhibits their similarities with *H. sapiens* with respect to cranial capacity and distinction from *H. sapiens* in terms of cranial facial anatomical features. In this unit, we will be discussing them in detail.

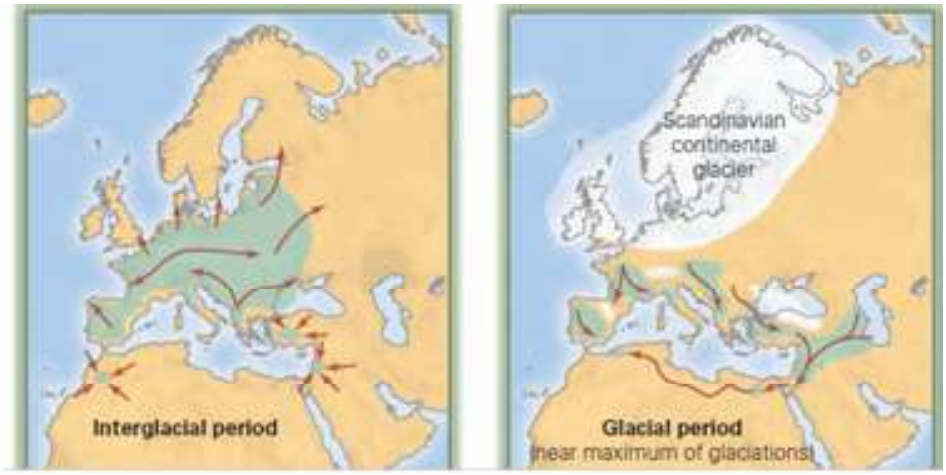
9.1 TIME AND TEMPERATURE IN MIDDLE PLEISTOCENE PERIOD

The fossils remain of Archaic *H. sapiens* are confined to the Pleistocene time especially during the middle and late part of Pleistocene epoch. The middle Pleistocene which began around 800,000 to 125,000 years ago and late Pleistocene, a period beginning 125,000 and ending approximately 10,000 years ago is marked by harsh climatic conditions and is popularly known as the ice age. This time period is marked by the frequent glaciations during which thick sheet of ice covered much of Europe, Asia, North America and Antarctica. The glaciations period was not continuous rather interpreted in between by warmer climatic condition and melting up of ice sheets known as an interglacial period. Corresponding to the glaciations period in the northern hemisphere, the south part of the world experienced a shift in rainfall patterns. The south during glaciations became a rider while during inter-glaciations rainfall increased. This fluctuation in rainfall patterns are termed as pluviation and inter pluviation.

Understanding of these periodic geo-climatic shifts is imported from the point of that these conditions affected the availability of the food as well as opening, creating and closing of migration routes. Overall it affected the dispersion of early hominin in the old world especially. For example, during the glacial period, much of Western Europe would have been cut off from the rest of Eurasia and reconnected during the interglacial period. Similarly, in Africa during glacial periods the Sahara Desert expanded, blocking migration in and out of sub-Saharan Africa (Lahr and Foley, 1998).



a. In Africa



b. In Eurasia

Fig. 1: Changing Middle Pleistocene environment a. In Africa b. In Eurasia. Distribution
Source: R. Jurmain, Essentials of Physical Anthropology, 2009

9.2 DISTRIBUTION OF FOSSILS

H. erectus was one of the first hominid species that moved out of Africa and migrated to Europe and Asia. These successors of *H. erectus* were also widely distributed and their fossils have been unearthed from Europe, Asia and Africa (Figure 2). Whereas in Africa and Asia these hominids either coexisted with or replaced the earlier forms, in Europe, they extended their geographical range and occupied new terrains. We will study the Archaic *H. Sapiens* remains from all the three continents.

Fig. 2: Location of Major H.heidelbergensis sites

Source: Relethford J, The Human Species: An Introduction to Biological Anthropology, 2010

9.2.1 European Archaic *H. sapiens*

The formal name *Homo heidelbergensis (H. heidelbergensis)* of archaic *H. sapiens* was derived from the discovery of a mandible in 1907 near the village Mauer , close to the Heidelberg, Germany. It was the first discovery of archaic *H. sapiens* and therefore surrounded by scepticism to place it under which taxon. The jaw was quite different from the established taxa from that time. It could not be placed under *H. sapiens* in being robust and lacking chin, feature very unlikely of modern man. Its classification under *H. erectus* was also debated due to two reasons. First, *H. erects* fossils itself were in its initial stages discovery and it was not a generally accepted taxon and secondly the mandible showed the difference with *H. erectus* mandible. Therefore, the Mauer mandible was given the status of new hominin species *H. heidelbergensis*. Even a decade later when *H. erectus* became an established taxon in the human evolutionary history it was seen that the feature of *H. heidelbergensis* were quite different from *H erectus*.

Fig. 3: The mandible from Mauer, Heidelberg, Germany

Source: Stein and Rowe, Physical Anthropology 1974

Apart from Heidelberg fossils, another interesting discovery of *H. heidelbergensis* comes from Atapuerca, Spain. The site which is about 500, 000 to 600,000 year old unearthed the fossils of approximately 28 individuals of different age groups (Arsuaga et al., 1997) from a cave site called as *Sima de los Huesos*, literally meaning "pit of bones". Rightmire (1998) has suggested that these fossils represent the earliest well-dated remains of *H heidelbergensis* from Europe. The postcranial remains from this sites and another site from Europe such as tibia bone from Boxgrove, England indicate that archaic *H. sapiens* were robust and heavily built with strong muscle marking, large joint surface area and broad pelvis. Another important feature of these fossils were their crania facial similarities with *Neanderthal* fossils such as double arched brow ridges and forward projection of the middle facial region, receding cheekbones which compels the experts to

Fig. 4: Skeletal remains from Atapureca, Spain

Source Stanford Craig et al, Biological Anthropology: The Natural History of Humankind, 2017

believe that in Europe archaic *H. sapiens* may be directly ancestral to late Pleistocene *Neanderthals*.

Many and more complete *H. heidelbergensis* fossils have been found throughout Europe such as finds from Petralona (Greece), Steinheim (Germany), Arago (France), Swanscombe and Boxgrove, (England) and other sites from Atapuerca (Spain).

9.2.2 African Archaic *H. sapiens*

Many African sites have yielded *H. heidelbergensis* fossils. However, two sites need important mention here. One is Kabwe, Zambia in broken hill limestone mines and other is Bodo, Ethiopia. Kabwe finds include a complete cranium and other cranial and postcranial remains. The site which is 600,000-125,000-year old yielded remains may be 300,000-year-old showing mixture of *H. erectus* and *H. sapiens* features. The Kawabe finds are also called as a Rhodesian man on the name of Rhodesia which is now called Zambia.

Unlike European forms the Kabwe cranium had massive brow-ridge, probably the thickest of any known Pleistocene hominin discovered so far. Similar to Kabwe cranium, eight other craniums from the sites of Lake Ndutu in Tanzania, Sale' from Morocco, Florisbad and Elandsfontein in South Africa, Laetoli in Tanzania, and Bodo in Ethiopia were discovered.

The cranium from Bodo is also of special interest. It represents one of the oldest specimens of *H. heidelbergensis* approximately 600,000-year-old from the African continent. Another interesting feature associated with the Bodo cranium is the presence of cut marks, similar to that seen in butchered animal bones. Researchers have hypothesized that the Bodo individual was probably defleshed by other hominids may be for ritual or cannibalism, the reason not clear. In any case, this is the earliest evidence of deliberate bone processing of hominin by hominin (White, 1986).

The African archaic *H. sapiens* from various sites share similar craniofacial features with many European forms except the one from *Sima de los Huesos*, Spain hominin which is believed to be in the line of *Neanderthal* lineage.

Fig. 5: The Kabwe skull with a thick supraorbital torus (left) and Bodo Cranium with cut marks (right).

Source: Stanford Craig et al., Biological Anthropology: The Natural History of Humankind, 2017

Check Your Progress

1) What are the major climatic shifts that occurred during the Middle Pleistocene? What is the role of these geo-climatic fluctuations in human evolution?

.....

.....

.....

.....

.....

2) Why archaic *H. sapiens* is designated as *H. heidelbergensis?*

.....

.....

.....

.....

.....

3) Why the discovery of archaic *H. sapiens* from Atapureca, Spain is considered significant?

.....

.....

.....

.....

.....

9.2.3 Asian Archaic *H. sapiens*

The best known *H. heidelbergenis* fossils from Asia are mainly from China. Like their European and African counterparts, the Chinese fossils display both modern and ancestral features. The 200,000 to 100,00 year-old cranium from Dali in Shaanxi province is considered as one of the best evidence of archaic *H. sapiens* in Asia. Similarly, the partial skeleton from Jinniushan in northeast China which has been estimated to be 200,000 years old is interpreted as a possible ancestor of earlier Chinese *H. sapiens* and most likely to be the variant of *H. heidelbergensis* in Asia (Rightmire, 2004). Other discoveries from China includes a cranium dated 280,000 and 240,000 from Lontandong Cave, Hexian County which was the first to be discovered in eastern or south-eastern China. Two fossil skulls, recovered in Yunxian, China, are considered to be 350,000 years old or younger based on the analysis of other fossil animals. From the Indian subcontinent, the remains of AHS come from Narmada valley. Earlier classified as *H. erectus,* the cranium is later classified as archaic *H. sapiens* based on a mosaic of features (Kenedy et al., 1991). The taxonomic placement and dating of the Asian archaic *H. sapiens* fossils are still contested.

Fig. 6: Archaic *H. sapiens* from Dali, China

Source: Stanford Craig et al., Biological Anthropology: The Natural History of Humankind, 2017) and from Jinniushan. (Jurmain, R et al. Essentials of Physical Anthropology, 2009)

Check Your Progress

4) List the major evidences of archaic *H. sapiens* from Old world?

.....

.....

.....

.....

.....

5) Explain the significance of Bodo cranium from Ethiopia.

.....

.....

.....

.....

.....

9.3 ANTOMICAL FEATURES OF ARCHAIC *H. SAPIENS*

Archaic *H. sapiens* show diversity of anatomical features just like the present-day human population, however, there are some common trends which can be seen among all the fossil remains discovered from Europe, Asia and Africa. The group differs consistently from its predecessor *H. erectus* and its successor *H. sapiens*. Unlike *H. erectus*, archaic *H sapiens* had large brain size with a cranial capacity between 1100-1400 cc, almost the cranial capacity of modern *H. sapiens*. Their cranium was parallel sided, dolichocephalic with the less angular back of the skull, that is occipital bone and overall relatively rounded braincase which means that maximum cranial breadth is higher up on the sides. The facial skeleton was also less prognathic with arching and separate brow ridges instead of straight

and continuous like *H. erectus*. Despite these features, the Archaic *H. sapiens* exhibits several *H. erectus* characteristics such as the low arching forehead, projected brow ridges, large and robust face with thick cranial vaults.

Compared to modern *H. sapiens,* Archaic *H. sapiens* retained robust skull with the heavy supraorbital ridge, wide nasal aperture and lower cranial vaults but not as low as seen in *H. erectus*. With a large face, they had large teeth. But their large brain size, relatively less prognathic face, the absence of sagittal keel shows more progressive changes in them. Overall the anatomy of Archaic *H. sapiens* displays mosaic in many features between *H. erectus* and *H. sapiens*.

Table 1. Comparisons between *H. erects*, *H. heidelbergensis* and *H. sapiens*

Sl. No.	Anatomical Features	*H. erects*	*H. heidelbergensis*/ Archaic *H. sapiens*	*H. sapiens*
1	Forehead	Low, flat	Arching	Vertical
2	Cranial Capacity (Average)	900cc	1200cc	1400 cc
3	Supraorbital ridges	Prominent as a bar and continuous	Prominent but separate	Slight and separate
4	Occipital	Angular	Less angular and relatively round	Round
5	Facial Skeletal	Large	Large	Small
6	Post orbital constriction	Pronounced	Less	Minor
7	Nasal aperture	Wide	Wide	Narrow
8	Occipital bone	Angular	Less angular and more round	Round
9	Teeth	Large	Large	Small
10	Sagittal keel	Present	Absent	Absent
11	Widest point in the cranium	Low on braincase	Relatively high on the braincase	High on braincase

Check Your Progress

6) From which region of India *H. heidelbergensis* was discovered. And why do researches debate over its status?

.....

.....

.....

7) Why *H. heidelbergensis* is considered a transitional stage between *H. erectus* and *H. sapiens?*

.....

.....

.....

9.4 PHYLOGENETIC RELATIONSHIP AND TAXONOMIC ISSUES OF ARCHAIC *H. SAPIENS*

Labelling Archaic *H. sapiens* as *H. heidelbergensis* for a group of hominins who lived about 800,000 -150,000 years ago to represent an intermediary stage between *H. erectus* and *H. sapiens* is debated on various grounds. The researcher while classifying a species follow two perspectives; a lumper's perspective who focus more on similarities and tries to club the species. This principle is also known as anagenesis or a splitter's perspective who tries to separate species on the basis of disparities of features. This principle is referred to as cladogenesis. In *H. heidelbergensis* case many scholars believe their features are not so profound enough to give them a status of separate species rather they view *H. heidelbergenis* as an evolutionary stage within a lineage towards *H. Sapiens*. In other words, it means to classify all the larger-brained species of the last half of Pleistocene as part of single evolving species and part of the continuous evolutionary process and designating all with informal terminology Archaic *H. sapiens*.

The cladogenic view, on the other hand, classifies *H. heidelbergensis* as distinct species from both *H. erectus* and *H. sapiens* based on the anatomical characteristics we discussed above. Interestingly in Europe, particularly Pertralona from Greece and *Sima de los Huesos* from Spain remains are seen as *Proto-Neanderthals*. Some have also suggested classifying Atapuerca Gran Dolina fossils from Spain as *H. antecessor* (Bermudez de Castro et al. 2004). None of the middle Pleistocene findings from Africa shows similarities with *Neanderthals* as in case of Europe hence in Africa, particularly Bodo and Kabwe are considered as an ancestral form of modern *H. sapiens*.

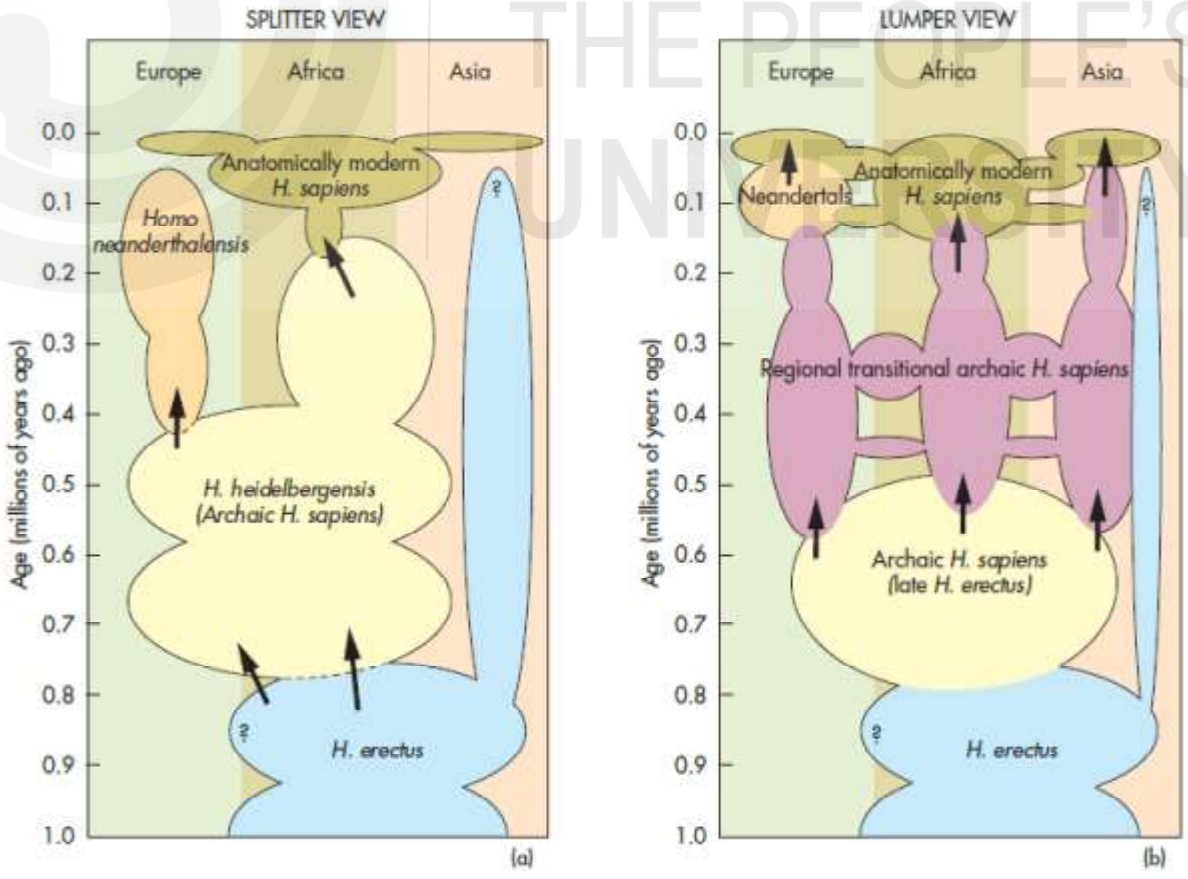


Fig. 7: The cladogenic (splitter) and anagenesis (lumper) view on the phylogenetic relationships between *H. heidelbergensis* aka Archaic *H. Sapiens*, *Neanderthals* and modern *H. sapiens*

Source: Stanford Craig et al., Biological Anthropology: The Natural History of Humankind, 2017

9.5 CULTURAL BEHAVIOR OF ARCHAIC *H. SAPIENS*

Middle Pleistocene period is not a conducive period for the preservation of fossils because of the fluctuations in climatic conditions as we discussed earlier in this unit. Thus, the tangible cultural remains associated with Archaic *H. sapiens* are scarce making reconstruction of their behaviour difficult. In addition, the relatively large brain size of Archaic *H. sapiens* develops a bias in judging the behaviour of Archaic *H. sapiens* similar to that of modern *H. sapiens*. Nonetheless, limited material cultural remain excavated at many sites gave us a glimpse of their tool technology and behaviour.

9.5.1 Stone tools

The Middle Palaeolithic stone tool industry is characterized by prepared core technology whereby the original core is modified by successive strikes for removing flakes till the flake of desired size and shape is attained. The main tool which is thus obtained is called a Mousterian point and technique is known as Levallois technique. In addition to prepared cores, the Middle Palaeolithic industry is also full of tools prepared by soft hammer technique using bone, antler, and soft stone to remove flakes. In addition, the Lower Paleolithic Oldowan and Acheulean industries still continue with sophistication.

The significance of Middle Palaeolithic culture is that it displays the increased cognitive ability and abstract thinking calibre of hominin in designing flakes with predictable size and shape. This acumen in designing tools may be the consequence of large brain size of *H. heidelbergensi*s. These tools were also efficient by having more cutting surface hence better utility in scraping.

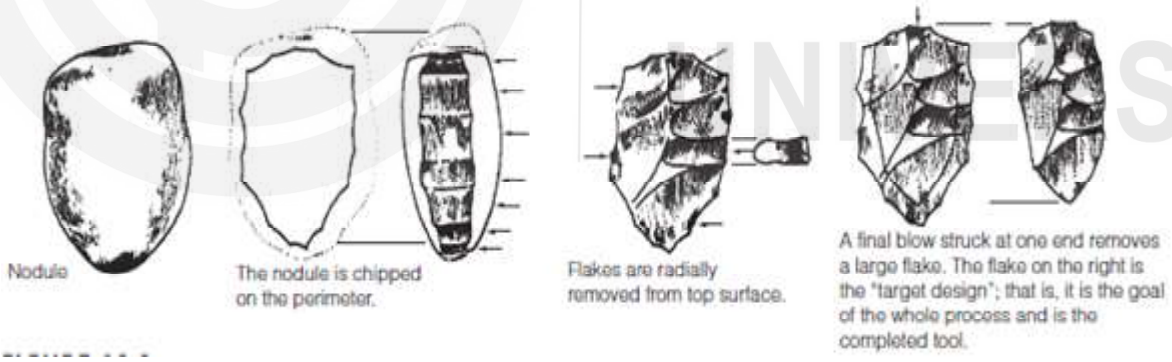


Fig. 8. The Levallois technique.
Source: Jurmain, R et al. Essentials of Physical Anthropology, 2009

Though no direct evidence of Archaic *H. sapiens* using bone or wooden tools or involvement in big game hunting has been found, but artifacts such as wooden spears and flake tools along with butchered remains of ten horses from Schoeningen, Germany may indicate the possibility of big game hunting by Middle Pleistocene hominin. Similar findings were found from Boxgrove, England where animal bones along with mostly hand axes were excavated. This evidence points out that Archaic *H. sapiens* were efficient tool makers and users who were also capable of bringing down a large game. This indirectly reflects their cooperative behaviour which is much needed for big game hunting as one of their subsistence strategies.

Indirect evidence of Archaic *H. Sapiens* using fire is also claimed based ash deposits and charred bones from a number of sites from France, Germany and Hungry (Klein, 1999). From Africa and Asia particularly China such claims are not convincing.

The evidence for Archaic *H. sapiens* campsite, home base, postholes which are used to reconstruct their lifestyle is also rare. However, the most detailed reconstruction of the life of Middle Pleistocene comes from the Tera Amata site in France (de Lumley and de Lumley, 1973). The site provides evidence for seasonal migration, small to big game hunting and exploiting marine life. However, this interpretation is not well accepted keeping in view the random scatter of bone and stone remains (Stinger and Gamble, 1993).

Check Your Progress

8) Do you agree the *H. heidelbergensis* should be referred to as separate *homo* speices?

.....

.....

.....

.....

.....

9) Which tool and technology is the hallmark of middle Palaeolithic stone culture?

.....

.....

.....

.....

.....

10) Do you agree that large brain size resulted in the development of sophisticated tool culture?

.....

.....

.....

.....

.....

9.6 SUMMARY

The middle Pleistocene time period is marked by harsh climatic conditions and is popularly known as an ice age in Northern hemisphere and fluctuations in rainfall pattern in Southern hemisphere. These oscillating climatic conditions

not only affected the availability of food but also lead to an opening, creating and closing of migration routes thus affected the dispersion of early hominin as recorded by their footprints in the form of fossils and associated material cultural remains from Asia, Africa and Europe.

The middle Pleistocene period also marks the evolution of intermediate species formally known as *H. heidelbergensis* and popularly Archaic *H. sapiens*. The species is designated as transitional form as it displays the mosaic of features of both *H. sapiens* and *H. erectus*. Their large brain size and changes in craniofacial anatomy are features in the line of modern *H. sapiens*. On the other hand, their large, robust and thick craniofacial anatomy reflects its link with the *H. erectus*.

Their behaviour as reconstructed from their cultural remains reflect *H. heidelbergensis* as the user of both middle stone age tools characterized by *the* Levallois technique as well as Lower Paleolithic Oldowan and Acheulean. Bone tools are also known from this time period and it is also a possibility that *H. heidelbergensis* was involved in big game hunting.

Taxonomic position of *H. heidelbergensis* fossils is also debated. Fossils from Africa and Europe resemble each other more than they do with the hominids from Asia. Some researchers view Chinese *H. heidelbergensis* as more modern than the contemporary fossils from either Europe or Africa and thus consider the *H. heidelbergensis* from China especially the Jinniushan remains as early members of *H. sapiens.* Other researchers (Rightmire, 1998) suggest that they represent regional variants of *H. heidelbergensis.*

In Africa, *H. heidelbergensis* is hypothesized to have evolved into modern *H. sapiens.* However, in Europe, it is believed that *H. heidelbergensis* evolved into *Neanderthals*. Meanwhile, the Chinese premodern populations may all have met with extinction.

9.7 REFERENCES

Arsuaga, J. L., Martýnez, I., Gracia, A., & Lorenzo, C. (1997). The Sima de los Huesos crania (Sierra de Atapuerca, Spain). A comparative study. *Journal of Human Evolution*, *33*(2-3), 219-281.

Bermúdez de Castro, J. M., Martinón Torres, M., Carbonell, E., Sarmiento, S., Rosas, A., Van der Made, J., & Lozano, M. (2004). The Atapuerca sites and their contribution to the knowledge of human evolution in Europe. *Evolutionary Anthropology: Issues, News, and Reviews: Issues, News, and Reviews*, *13*(1), 25-41.

de Lumley, H., & de Lumley, M. A. (1973). *Pre-Neanderthal* human remains from Arago cave in southeastern France. *Yearb Phys Anthropol*, *17*, 162-168.

Jurmain, R., Kilgore, L., & Trevathan, W. (2016). *Essentials of physical anthropology*. Wandsworth Cengage Learning.

Kennedy, K. A., Sonakia, A., Chiment, J., & Verma, K. K. (1991). Is the Narmada hominid an Indian Homo erectus?. *American Journal of Physical Anthropology*, *86*(4), 475-496.

Klein, R. G. (1999). *The human career: human biological and cultural origins* (second edition). Chicago: University of Chicago Press.

Mirazón Lahr, M., & Foley, R. A. (1998). Towards a theory of modern human origins: geography, demography, and diversity in recent human evolution. *American Journal of Physical Anthropology: The Official Publication of the American Association of Physical Anthropologists*, *107*(S27), 137-176.

Relethford, J. (2010). *The human species: An introduction to biological anthropology*. McGraw Hill Higher education publication.

Rightmire, G. P. (1998). Human evolution in the Middle Pleistocene: the role of Homo heidelbergensis. *Evolutionary Anthropology: Issues, News, and Reviews: Issues, News, and Reviews*, *6*(6), 218-227.

Rightmire, G. P. (2004). Affinities of the Middle Pleistocene Cranium from Dali and Jinniushan. *American Journal of Physical Anthropology*, Supplement 38:167 (Abstract).

Stanford, C., Allen, J. S., & Antón, S. C. (2017). *Biological anthropology: The Natural History Of Humankind*. Pearson Education.

Stein, P. L., & Rowe, B. M. (1974). *Physical Anthropology*. McGraw-Hill.

Stringer, C., & Gamble, C. (1993). *In search of the Neanderthals: solving the puzzle of human origins*. New YorK: Thames and Hudson.

White, T. D. (1986). Cut marks on the Bodo cranium: a case of prehistoric defleshing. *American Journal of Physical Anthropology*, *69*(4), 503-509.

9.8 ANSWERS TO CHECK YOUR PROGRESS

1) Corresponding to the glaciations period in the northern hemisphere, the south part of the world experienced a shift in rainfall patterns. The south during glaciations became a rider while during inter-glaciations rainfall increased. This fluctuation in rainfall patterns affected the availability of the food as well as opening, creating and closing of migration routes. For further details refer to section 9.1

2) The name *H. heidelbergensis* is based on the first discovery of the archaic *H. sapiens* from the Village Mauer, near Heidelberg, Germany. Refer to section 9.2.1

3) The proto *Neanderthal* features of the remains from Atapuerca, Spain is the reason for the importance of the site. Refer to section 9.2.1

4) The fossils of archaic *H. sapiens* have been discovered from Europe, Africa and Asia. For further details refer to section 9.2

5) Bodo cranium represents one of the oldest specimens of *H. heidelbergensis* approximately 600,000-year-old from the African continent and it also represents the earliest evidence of deliberate bone processing of hominin by hominin. For further details refer to section 9.2.2

6) The remains of Archaic *H. sapiens* were recovered from come from Narmada valley. Earlier classified as *H. erectus* the cranium is later classified as archaic *H. sapiens* based on a mosaic of features. For further details refer to section 9.2.3

7) *H. heidelbergenis* is considered a transitional stage between *Homo erectus* and *Homo sapiens* because it shares various anatomical features with both of them. For further details refer to section 9.3

8) There are different views regarding the taxonomic position of *H. heidelbergensis*. One group of Scholars prefers to consider *H. heidelbergensis* as a part of common *Homo*. lineage because of its large brain size whereas others place it as separate hominin species. For further details refer to section 9.4

9) Mousterian points and Levallois technique is the hallmark of middle Palaeolithic stone culture. For further details refer to section 9.4

10) Yes. The increased cognitive ability and abstract thinking calibre of hominin significantly helped in designing flakes with predictable size and shape. For further details refer to section 9.5

UNIT 10 FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION*

Contents

Learning Objectives

After reading this unit, you will be able to:

- understand the origin and evolution of modern humans;
- learn the fossil evidences, distribution and characteristic features of early *Homo sapiens;* and
- comprehend the differentmodels of origin of modern humans.

10.0 INTRODUCTION

The origin of modern humans has always been a contentious issue. William Howells (Howells, 1976), the renowned paleoanthropologist stated, "That part of human history covering the emergence of modern man and his regional differentiation continues to be surprisingly obscure. Locations of some elements of agreement or controversy have long been clear, but the dimensions of the whole problem are far from obvious. The trees are familiar, but the forest is not." The main reason for the contention on human origin could be that there is no universal consensus on the characters that define humans. Neanderthals cranial capacity is slightly larger than humans on average and were of much greater geological age than formerly assumed and actually penecontemporaneous with the earliest modern humans, so the arguments for a large cranial capacity defining our species went by the wayside (Cartmill et al., 20019, Tattersall, 2015).

Culture was once assumed to be distinguishing feature of humans from all other life forms. But in the 1960s, Jane Goodall (1986) discovered that chimpanzees also made and used tools. This discovery raised questions about whether we could continue to use culture, a broad variable to define humans. There are few normally agreed-upon autapomorphies explicit to modern humans such as the presence of a mental eminence and a globular braincase. But, the absence of the latter characteristic among the recently reported early modern human fossils from Jebel Irhoud, Morocco (Stringer and Galway-Witham, 2017; Hublin et al., 2017), shows the probabilityof much more recent development, within the past 130,000 years (Bae et al., 2017).

* Dr. N. K. Mungreiphy, Amity Institute of Anthropology, Amity University, Noida.

Regardless of the general acceptance of the origin of *Homo sapiens* from Africa, the initial arrival and survival of modern humans in diverse areas of the globe continue to be disputed strongly. Asia has also been getting increasing attention in the discussions over the past several decades, particularly because Asia is considered the channel through which modern humans arrived in distant locations such as Australia, Western Europe, and finally the Americas. Asian continent is significantly bounded by the Indian, Pacific and Arctic Oceans on three sides and Europe to the west, includes a wide range of longitudinal, latitudinal and altitudinal disparity, which has major implications for human evolution (Bae et al., 2017a).

10.1 THE ORIGIN AND EVOLUTION OF *HOMO SAPIENS*

The origin of human species would be placed in the African late middle Pleistocene, based on fossils such as Herto 1 and 2, OmoKibish 1 and the Levantine material from Skhul and Qafzeh, if the use of *Homo sapiens* in fossil record is limited to specimens which share a substantial number of derived characteristics in the skeleton with extant *Homo sapiens*. But, genetic data suggest that *Homo neanderthalensis* and *Homo sapiens* shared a last common ancestor in the middle Pleistocene approximately 400-700 ka, which is at least 200000 years earlier than the species origin indicated from the fossils already mentioned. Thus, it is likely that the African fossil record will document early members of the *sapiens* lineage showing only some of the derived features of late members of the lineage. On that basis, human fossils such as those from Jebel Irhoud, Florisbad, Eliye Springs and OmoKibish 2 do represent early members of the species, but variation across the African later middle Pleistocene/early Middle Stone Age fossils shows that there was not a simple linear progression towards later *sapiens* morphology, and there was chronological overlap between different 'archaic' and 'modern' morphs. Even in the late Pleistocene within and outside Africa, *Homo sapiens* specimens are found which are clearly outside the range of Holocene members of the species, showing the complexity of recent human evolution (Stringer, 2016).

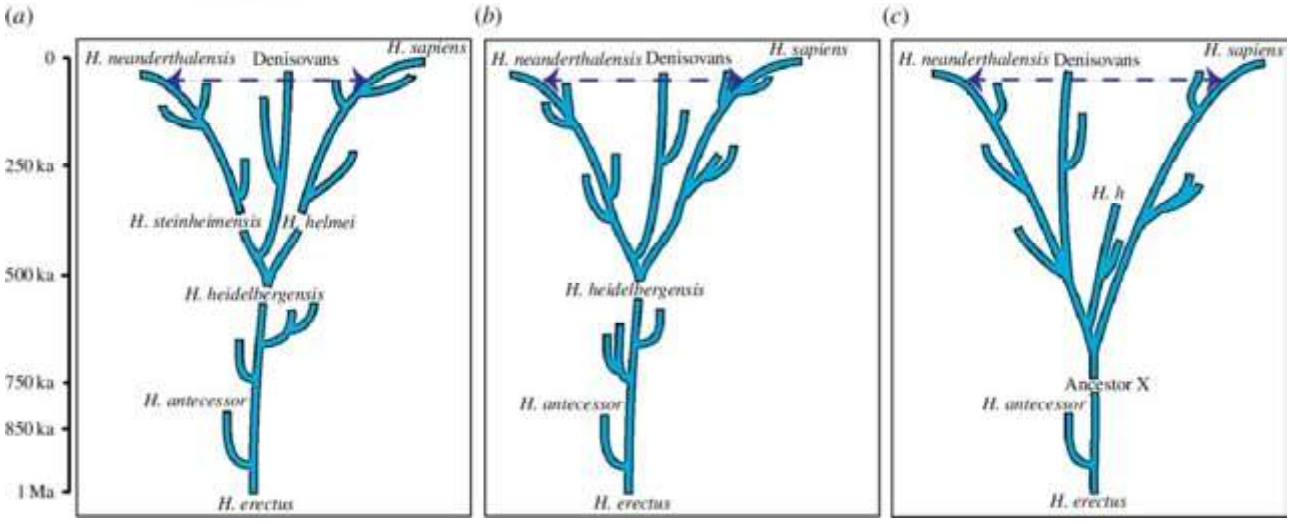


Fig. 1: Taxonomical position of Homo species

Source: Stringer C. 2016 The origin and evolution of *Homo sapiens*. Phil. Trans. R. Source. B371: 20150237.Pp 7. http://dx.doi.org/10.1098/rstb.2015.0237

Figure 1. (a) *H. sapiens* and *H. neanderthalensis* as species represented only as terminal taxa, with all the traits judged to be diagnostic. *H. helmei* and *H. steinheimensis* as intermediate species between each terminal species and LCA, here suggested to be *H. heidelbergensis*. (b) Looser diagnoses of *H. sapiens* and *H. neanderthalensis* including all populations after the split from the LCA. Both species encompass considerable morphological variation along their lineages and populations which go extinct without issue. The overall topography of both trees and the estimated divergence and LCA 'dates' are derived from a study of whole mtDNA genomic data (Stringer, 2012; Endicott et al, 2010). (c) A tree which uses the new date and Neanderthal-like morphology of the Sima sample, plus an inferred deeper divergence date based on new genomic mutation rate estimates (Meyer et al., 2016). Here, a hypothetical and older 'Ancestor X' replaces heidelbergensis as the LCA. The Denisovans are also shown on the diagram, as an early derivative of the Neanderthal clade. Their taxonomic status is still unclear (Stringer and Barnes, 2015). Late Pleistocene inter-lineage gene flow is indicated by the dashed arrows.

10.2 EARLY *HOMO SAPIENS*: FOSSIL EVIDENCES AND DISTRIBUTION

The wide morphological variation in fossil human crania associated with early MSA archaeology in Africa, ranging from material like Florisbad and Jebel Irhoud through to Ngaloba and Herto is illustrated in Figure 2. The figure also includes examples from Skhul and Qafzeh. This array of fossils shows differing combinations of archaic and derived (recent H. *sapiens*-like) traits and illustrates some of the variation displayed even at closely related sites. OmoKibish 1 and 2 contrast strongly in cranial shape. A transition between their morphologies would provide a different model of *H. sapiens* evolution from that suggested by Herto, and this is perhaps exemplified in the ER-3884 partial cranium from Guomde which shows features found in both the Kibish crania.

Fig. 2.The origin and evolution of *Homo sapiens*

Source: Stringer C. 2016.Phil. Trans. R. Soc. B371: 20150237.Pp 3. http://dx.doi.org/10.1098/rstb.2015.0237

Figure 2.Left lateral crania views of Israeli and African archaic, and early modern *Homo sapiens* (replicas unless otherwise stated). Bottom-Left to Right: Omo 1, Herto (original, reversed), Ngaloba, Singa, Skhul 5, Qafzeh 9. Top-Left to Right: Florisbad, Jebel Irhoud 1, Jebel Irhoud 2 (original), Eliye Springs, Guomde (reversed), Omo 2.

These potential variations already suggest that there is probably not a simple,linear relationship between an ancestral heidelbergensis-likemorphology and that of *H. sapiens*. Alternatively, as suggested by Stringer (2006, 2012), this variation might instead reflect the coexistence of morphologically distinct populations during the later middle Pleistocene in Africa. Evolution may at times have progressed independently in different areas, with morphological substructure leading on to the eventual coalescence of the full suite of H. *sapiens* characteristics, comparable with the pattern seen in the genetic data. Stringer (2016) called this an'African multiregionalism', with many potentially interfertile subdivisions of the evolving *sapiens* species across Africa. Others like Ackermann et al., (2015) have used the analogy of a braided stream for what they consider to be an open genetic network for different human lineages across the whole Old World,but the most appropriate application for this analogyis in the middle Pleistocene of Africa. The imperfect chronological control over the African middle Pleistocene record provides only very limited support for an ordered progression from 'archaic *sapiens*' to 'modern *sapiens*' through time. Instead we see morphologically varied fossils such as Broken Hill,Florisbad and OmoKibish 1 apparently juxtaposed in closetemporal proximity (Stringer, 2012).

The result of these processes was the composite we call modern *H. sapiens*, genetically, morphologically and behaviorally, but there was never a single center of origin, and despite later Homogenization (Howells, 1989), some ancient substructure could have persisted. Several relatively late Pleistocene African sites contain fossils that exhibit combinations of archaic and recent H. *sapiens* traits.

Stringer (2016) found that, despite its Late StoneAge associations and overall 'modern' shape, the Iwo Eleru fossil from Nigeria was idiosyncratic, since it also showed affinities to archaic fossils such as Ngandong, Saccopastore 1 and Omo 2 (Stringer, 1974;1978). Its dating was recently confirmed as late Pleistocene (approx. 14 ka) but also confirmed was its morphological distinctiveness from recent African crania. Despite its late date,it showed morphometric shape affinities to the much older Elandsfontein, Ngaloba, and Skhul and Qafzeh fossils (Harvati et al., 2011; 2013).A comparable though slightly earlier example of late Pleistocene distinctiveness (approx. 22 ka) is the Lukenya Hill partial calvaria from Kenya, which was restudied by Tryon et al. [98], showing a similar mix of more archaic and recent elements of cranial shape. These specimens emphasize how little we still know about late Pleistocene morphological variation across much of the African continent. These fossils may indicate deep Pleistocene population sub structural variation, possibly including hybridization between late *H. sapiens* and surviving archaic hominin lineages (Harvati et al., 2011; Stringer, 2012), variation which was subsequently lost.

10.3 CHARACTERISTIC FEATURES OF *HOMO SAPIENS*

Anatomically *Homo sapiens* is characterized by traits such as small flat face with coronal-oriented infraorbital plates, round skull, high forehead, suggesting a large encephalic volume, an average of 1350 cm^3, dentition characterized by decrease in size as compared to earlier species,presence of a chin, and a more graceful postcranial bones as compared to other species of its genus (Carbonell et al., 2017).

Palaeontological species *Homo sapiens* were considered a biological species for years. But, tests on the remains alerted the existence of hybrid characters in an infant. At the time of its discovery this information was however not accepted by many paleoanthropologists. Development of sequencing methods finally provided evidence that anatomically modern humans crossbred with some *Homo neanderthalensis* populations and displayed that small percentage of Neanderthal genes is present in contemporary Eurasians. Likewise, present humans in Oceania also retain a small percentage of archaic gene contribution, conforming in their case to Denisovans, an ancient populace discovered ina Siberian cave and described until now only through genetic analyses (Krause et al., 2010).

The possibility that these species represented only palaeontological, instead of biological species can be considered when part of their genome and genetic history are known. This would be biological variability, in the strict sense, so anatomically modern humans are not explicitly different even in this field. Beside have common ancestors with other species, humans also cross-bred with other palaeontological species that coexisted with humans during the 200000 years of our evolutionary history. Presently only *Homo sapiens* from the *Homo* genus inhabits our planet, nevertheless this has only been the case for the last thirty-thousand years. Human species is possibly a phylogenetic synthesis (Carbonell et al., 2017).

Check Your Progress

1) Write a short note on the origin and evolution of *Homo sapiens*.

.....

.....

.....

.....

.....

2) Elaborate on the Fossil evidences and distribution of *Homo sapiens*.

.....

.....

.....

.....

.....

10.4 LIFEWAYS OF *HOMO SAPIENS SAPIENS*

Homo sapiens sapiens is estimated to have emerged from Africa between 200,000 and 130,000 years ago, thereby displacing other hominids in the rest of the world. Around approximately 60,000 years ago Africa remained home to modern humans, while other hominids, particularly *Homo erectus* and Neanderthals, were in Asia and Europe, respectively. Quite gradually, small groups migrated out of Africa to nearby continents suitable for human habitation after climate changes. Early human societies in sub-Saharan Africa relied on foraging for much of their subsistence, living off the available flora and fauna of the region.The adaptability

of these early societies allowed them to exploit different sources of food and develop different tool kits to allow them extract resources from the environment terms of hunting, food processing, and the manufacture of implements from stone and other raw materials. Some early human communities developed portions of the landscape to accommodate sedentary lifeways centered on agriculture. Through the use of fire as a way to clear brush and forests, thereby establishing dominion over the land, these early settlements developed farmland and grazing fields. Early art work found in the region depicts a variety of foraging and hunting activities, as these remained the primary mode of human sustenance. During the Neolithic, agricultural surpluses allowed for the establishment of craft specialization outside of agriculture, the development of political structures, and the creation of more complex belief systems. Through this process human domesticated both plants and animals, selecting both seeds and breeds that illustrated desirable characteristics and ensured survival and adaptability to human needs. The clearing of fields and forests continued along a more systematic course of landscape development as settlements increased in size and density. Livestock was maintained as an integral source of sustenance and was provided with food and protection from predators (Andrea & Neel, 2011).

The lifeways of prehistoric communities worldwide between 10,000 and 4000 BCE can be broadly classified into two groups: hunting-gathering and farming. This distinction places food acquisition as the major force in human activity, not least because it underpins most aspects of social activity as well as facilitates trade and structures the division of labour. Hunting and gathering were the most widespread means of food acquisition circa 10,000 BCE. Paleolithic people worldwide used wood and stone tools for hunting, but as the last ice age ended, tool kits altered. Innovations included increased tool diversity and the production of microliths (i.e., small scrapers, blades, and points that would have been hafted in wood). In some regions there was also an increase in tools made from antler and bone. In Europe such innovations appear to have been a response to a changing environment, notably a shift from relatively open habitats to early interglacial forests, and have led archaeologists to describe the culture as Mesolithic or Middle Stone Age, which lasted until circa 5000 BCE. In the Near East this stage is not represented, and the Paleolithic gave way to the Neolithic or New Stone Age, which is associated with the inception of agriculture. Mesolithic cultures comprise the Maglemosian in northern Europe, the Beuronian in central Europe, the Epigravettian in the Mediterranean zone, and the Sauveterrian in western Europe. Neolithic people were also hunter-gatherers who began to adopt a more sedentary lifeway as farming became established. Neolithic people also practiced rituals, as evidenced by human figurines and plastered skull found at some sites. The early farmers did not have pottery and belong to a period circa 8500 to 7500 BCE that is known as the pre-pottery Neolithic. It is distinguished from the earlier Natufian period by a more varied stone tool assemblage, including an increased range of pounding and grinding tools. Pottery making dates from 7500 BCE and marks the establishment of a new technology in the region. Settlements continued to grow and diversify as agriculture expanded. By 5000 BCE new technologies were developing, namely metal smelting, that initially involved the exploitation of copper ores, which gave rise to the Copper Age and the Bronze Ages, and later iron ores. Jewelry made from stone, clay, bone and shell and later from metals was also produced. Such technologies broadened the range of goods for trade and reflect the increasing sophistication of societies in which craft specialization occurred. Agriculture thus allowed a proportion of society to engage

in activities other than food acquisition. From the fertile Crescent agriculture spread into Europe, Asia and Africa where it became a major cause of environmental change and especially of deforestation. Neolithic Revolution brought marked change in lifeways from the stage of hunting and gathering to food production (i.e. plant cultivation and animal husbandry). The emergence of agriculture as sustained subsistence was neither accidental nor purely intentional. Instead, it resulted from the dynamic interplay of various factors, both external (i.e., relating to the conditions of environmental ecology) and internal (i.e., posing a challenge to human adaptive strategies). The earliest signs of a trend toward sedentism are found in the ancient Near East, in the context of ecological changes that affected human living conditions. In response to the ecological changes, humans retreated to areas where wild grass was still available. In the vegetational refugia, humans adapted to local ecology and exploited the food resources intensively. The chain reaction of events during that phase of a shift from mobility to sedentism illustrates that the impuls for that development was sparked by ecological changes that in turn induced responses of human intentionally to cope with those challenges (Andrea & Neel, 2011).

Check Your Progress

3) Write short note on the characteristic features of *Homo sapiens*.

.....

.....

.....

.....

.....

4) Explain the Lifeways of *Homo sapiens sapiens*.

.....

.....

.....

.....

.....

10.5 SUMMARY

The study of Modern human origin has always been a contentious matter. Irrespective of the general acceptance of the origin of *Homo sapiens* from Africa, the initial arrival and survival of modern humans in diverse areas of the globe has been disputed. Recent fossil finds and new information from the field of molecular genetics have led to a reassessment of the question of the origin of modern human beings.Advancement in paleoanthropology requires improvement in theory,not just additional fossils and new analytical methods. Modern human origin models deliberation illustrates this evidently. The amount of fossil evidence pertaining to modern human origins and the range of analytical techniques has increased considerably in the last twenty years. However, the level of disagreement has not declined substantially among specialists. All those in the deliberation

have claimed that new findings support their position. An imperative reason for this puzzling state of affairs on human origin, is that inadequate consideration has been paid to the theories of modern human origins, and specifically to what differentiates them from each other and what they foresee in relation to a given investigation. In this background, Collard and Demboanalyzed the four models of human origin that need to be taken into accountwhen discussing modern human origins and sought to describe them in sucha way that their differences are clear.

10.6 REFERENCES

Ackermann, R. R., Mackay, A., & Arnold, M. L. (2015).The hybrid origin of "modern" humans. *Evolutionary Biology*, *43*(1), 1-11.

Andrea, A. J., & Neel, C. (Eds.).(2011). *World History Encyclopedia* (Vol. 10).ABC-CLIO.

Bae, C. J., Douka, K., &Petraglia, M. D. (2017). On the origin of modern humans: Asian perspectives. *Science*, *358*(6368), eaai9067.

Bae, C. J, Douka, K &Petraglia, M. D. (2017a). Human colonization of Asia in the Late Pleistocene: Introduction to Supplement 17. *Current Anthropology* 58, S373–S382.

Carbonell, E., Bermudez De Castro, J. M., &Sala, R. (2017). *Homo sapiens*': who are we? Essential traits of our species.Monograph.Mètode Science Studies Journal.University of Valencia.

Cartmill, M., & Smith, F. H. (2009). *The Human Lineage*.John Wiley & Sons.

Caspari, R. &Wolpoff, M. H. (2013). The Process of Modern Human Origins: The Evolutionary and Demographic Changes Giving Rise to Modern Humans. In F. H. Smith & C. M. James (Eds.).*The Origins of Modern Humans: Biology Reconsidered*', (Second edition). John Wiley & Sons, Inc.

Collard, M. &Dembo, M. (2013).Modern Human Origins.In D. R. Begun (Ed.).*A Companion to Paleoanthropology*, (First Edition). Blackwell Publishing Company.

Endicott, P., Ho, S. Y., & Stringer, C. (2010).Using genetic evidence to evaluate four palaeoanthropological hypotheses for the timing of Neanderthal and modern human origins. *Journal of Human Evolution*, *59*(1), 87-95.

Goodall, J. (1986). The Chimpanzees of Gombe: Patterns of behavior. Belknap Press: Harvard University Press.

Harvati, K., Stringer, C., Grün, R., Aubert, M., Allsworth-Jones, P., &Folorunso, C. A. (2011). The Later Stone Age Calvaria from LwoEleru, Nigeria: Morphology and Chronology. *PLoS One*, *6*(9), e24024.

Harvati, K., Stringer, C., Grün, R., Aubert, M., Allsworth-Jones, P., &Folorunso, C. A. (2013). Correction: The Later Stone Age Calvaria from Iwo Eleru, Nigeria: morphology and chronology. *PloS one*, *8*(11).

Howells, W. W. (1976). Explaining modern man: evolutionists versus migrationists. *Journal of Human Evolution*, *5*(5), 477-495.

Howells, W. W. (1989). Skull shapes and the map: craniometric analyses in the dispersion of modern *Homo*. *Papers of the Peabody Museum of Archaeology and Ethnology*, *79*. Cambridge, MA: Harvard University Press.

Hublin, J. J., Ben-Ncer, A., Bailey, S. E., Freidline, S. E., Neubauer, S., Skinner, M. M., ...&Gunz, P. (2017). New fossils from Jebel Irhoud, Morocco and the pan-African origin of *Homo sapiens*. *Nature*, *546*(7657), 289-292.

Krause, J., Fu, Q., Good, J. M., Viola, B., Shunkov, M. V., Derevianko, A. P., &Pääbo, S. (2010). The complete mitochondrial DNA genome of an unknown hominin from southern Siberia. *Nature*, *464*(7290), 894-897.

Meyer, M., Arsuaga, J. L., de Filippo, C., Nagel, S., Aximu-Petri, A., Nickel, B.,..& Viola, B. (2016). Nuclear DNA sequences from the Middle Pleistocene Sima de los Huesoshominins. *Nature*, *531*(7595), 504-507.

Smith (Eds.). *Continuity or Replacement?Controversies in Homo sapiens Evolution*. (pp. 145 – 156). Rotterdam: Balkema.

Stringer, C., & Galway-Witham, J. (2017). Palaeoanthropology: On the origin of our species. *Nature*, *546*(7657), 212-214.

Stringer, C. B., & Barnes, I. (2015).Deciphering the Denisovans. *Proceedings of the National Academy of Sciences*, *112*(15), 542-543.

Stringer, C. B. (2006). The Origins of Modern Humans 1984-2004. In H. Soodyall (Ed.).*The Prehistory of Africa*. (pp. 10-20). Johannesburg, South Africa: Jonathan Ball.

Stringer, C. (2012). Evolution: What Makes a Modern Human. *Nature*, *485*(7396), 33-35.

Stringer, C. (2011). *The origin of our species*. London: Penguin.

Stringer, C. (2016).The origin and evolution of *Homo sapiens*. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1698).

Stringer, C. B. (1974). Population relationships of later Pleistocene hominids: a multivariate study of available crania. *Journal of Archaeological Science*, *1*(4), 317-342.

Stringer, C. B. (1978).Some problems in Middle and Upper Pleistocene hominid relationships. In D. Chivers& K. Joysey (Eds.).*Recent advances in primatology*. (*3*, pp. 395-418). UK: Academic Press.

Stringer, C. (2012).The status of *Homo* heidelbergensis (Schoetensack 1908). *Evolutionary Anthropology: Issues, News, and Reviews*, *21*(3), 101-107.

Tattersall, I. (2015). *The Strange Case of the Rickety Cossack: And Other Cautionary Tales from Human Evolution*. St. Martin's Press.

10.7 ANSWERS TO CHECK YOUR PROGRESS

1) The origin of human species would be placed in the African late middle Pleistocene, based on fossils such as Herto 1 and 2, OmoKibish 1 and the Levantine material from Skhul and Qafzeh. Human fossils represent early members of the species, but variation across the African later middle

Pleistocene/early Middle Stone Age fossils shows that there was not a simple linear progression towards later *sapiens* morphology, and there was chronological overlap between different 'archaic' and 'modern' morphs (Stringer, 2016).For details refer section 10.1

2) Several relatively late Pleistocene African sites contain fossils that exhibit combinations of archaic and recent *Homo sapiens* traits.These fossils may indicate deep Pleistocene population sub structural variation, possibly including hybridization between late *Homo sapiens* and surviving archaic hominin lineages (Harvati et al., 2011; Stringer, 2012), variation which was subsequently lost.For details refer section 10.2.

3) Anatomically *Homo sapiens* is characterized by traits such as small flat face with coronal-oriented infraorbital plates, round skull, high forehead, suggesting a large encephalic volume, an average of 1350 cm^3, dentition characterized by decrease in size as compared to earlier species, presence of a chin, and a more graceful postcranial bones as compared to other species of its genus. For details refer section 10.3.

4) The lifeways of prehistoric communities worldwide between 10,000 and 4000 BCE can be broadly classified into two groups: hunting-gathering and farming. Paleolithic people worldwide used wood and stone tools for hunting, but as the last ice age ended, tool kits altered. For details refer section 10.4.

ignou
THE PEOPLE'S
UNIVERSITY

PRACTICAL

ignou
THE PEOPLE'S
UNIVERSITY

PRACTICAL

Contents

Craniometry

Maximum Cranial Length

Maximum Cranial Breadth

Maximum Bizygomatic Breadth

Greatest Occipital Breadth

Upper Facial Height

Nasal Breadth

Nasal Index

Cranial Index

Osteometry

Measurements of long bones: lengths, minimum/least circumference and calibre index.

Learning Objectives

After reading this practical manual you will be able to:

- define craniometry and osteometery;
- know various craniometric and osteometric landmarks and measurements;
- get an idea of various tools and techniques used by Anthropologists for measurement of human cranium and long bones; and
- calculate various craniometric and osteometric indices.

CRANIOMETRY

Skull is the upper most part of our skeleton consisting of head and face. The lower part of the facial skeleton is constituted by a single loose bone, the mandible. The skeleton of a skull without mandible is called a cranium. The brain box, i.e. the neurocranium, is also designated as calvarium; and the top most part of the skull i.e. the skull cap is designated as Calotte.

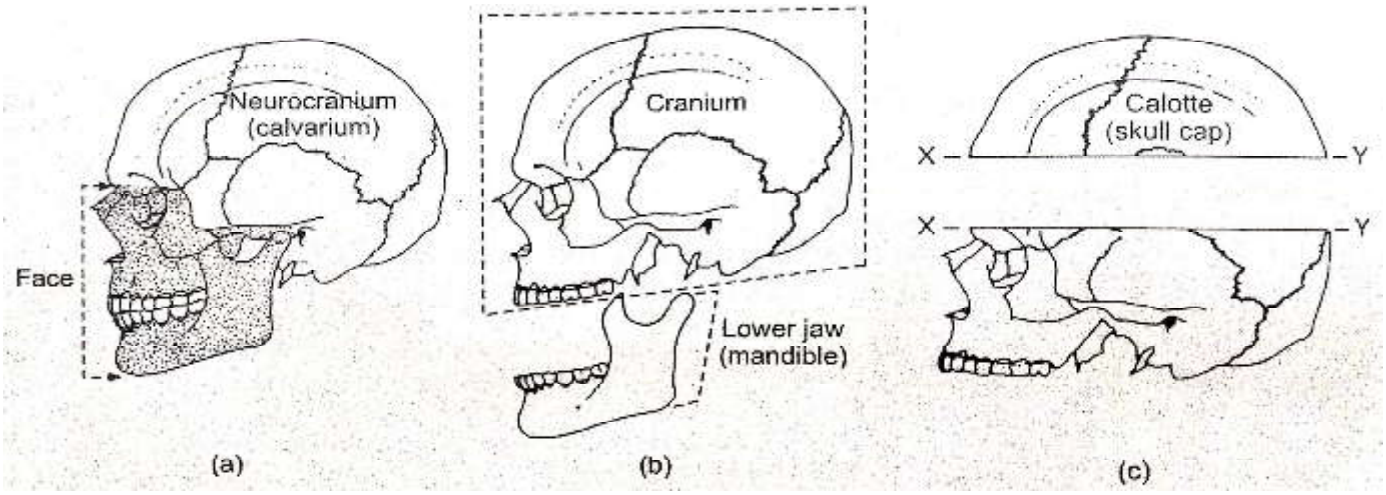


Fig. 1: Skull and its different parts (a) Skull; (b) Cranium; (c) Calotte

Source: Mukherjee et al., 2009

For the purpose of morphological study a human cranium is observed from five different positions or normas viz., *norma verticalis,norma frontalis, norma lateralis, norma occipitalis* and *norma basalis*. Such studies of the normas help understand the shape of a cranium from particular views. Secondly, such study helps to observe relative contribution of different cranial bones in structuring a particular aspect. Thirdly, different surface characters of a particular aspect of the cranium can be studied. Finally, studies of the normas are essential, rather indispensable, in comparative craniology with apes' crania and also in comprehending evolutionary changes in cranium. For example,-

Norma verticalis study helps to understand the general contour of the skull, the eminences, the nature of the sutures, and also the size of the skull.

i) The general outline of this aspect is oval or rounded pentagonal-the angular points are situated, two on the frontal, two on the parietals and one on the occipital. The contour is broader behind than in front.

ii) In this view, portions of four cranial bones are visible viz., frontal, two parietals and occipital.

iii) The area is traversed by three sutures – (a) *Coronal suture*, placed between the posterior border of the frontal bone and the anterior borders of the parietal bones; (b) *Sagittal suture*, placed on the median plane between the interlocking upper borders of the two parietal bones; (c) *Lambdoid suture*, placed between the posterior borders of the parietal bones and superior border of the occipital bone.

iv) The sagittal suture connects the other two sutures the meeting point with the coronal suture is termed *bregma*, and that with the lambdoid suture is *lambda.*

v) Temporal lines are seen to rise from anterior corners of the frontal bone, diverge progressively as they proceed posteriorly.

Norma frontalis helps to understand the elevation of the forehead, the supraorbital ridges, the orbits, the nasal aperture, the maxillae, the zygomatic, and many surface features of that part. This view exhibits a more or less oval outline, wider above than below and it may be divided into two major parts – the upper, which is mostly formed by the frontal bone; and the lower or facial part, which is very irregular with two orbits and the anterior bony aperture of the nose. Most of the lateral margins and the lower border of the facial part are formed by the mandible.

The upper part:(i) Just above the orbits are the curved elevations of the frontal bone, known as supraorbital (or superciliary) ridges, which are connected by a median elevation, termed *glabella*. (ii) Below glabella the nasal bones meet the frontal bone in the *fronto-nasal suture*, and the meeting point of the frontonasal suture and the *internasal suture* is termed *nasion*. (iii) Above the supraorbital ridges two rounded eminences, one on each side, are noticed which are known as *frontal eminences*.

The lower part: (i)The orbits are more or less quadrangular in shape. Its upper margin is formed entirely by the frontal bone, while the lateral margin is formed by the zygomatic process of the frontal bone above, and by the frontal process of the zygomatic bone, below. (ii) The nasal aperture is pear shaped and is bounded by the nasal bones and the maxilla. The two nasal bones articulate with each other in *internasal suture* in the median plane and both articulate with the frontal bone above in *frontonasal suture*.

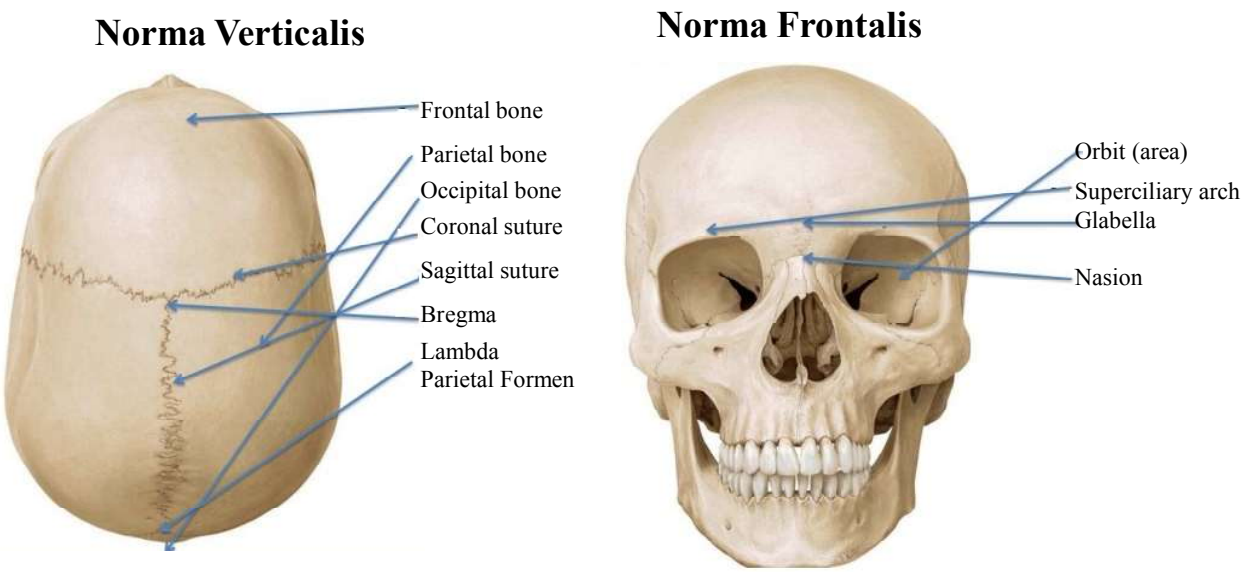


Fig. 2: Norma Verticalis and Norma Frontalis

Source: https://slideplayer.com/slide/11439793/

Norma lateralis study gives an understanding about the height of the skull, nature of the slope of the forehaead, projection of the occipital region, nature of temporal line, depth of temporal fossa, protrusion of the zygomatic bone, elevation of the nasal bones, nature of the mastoid process, and also amount of facial prognathism.

i) In this norma the outline of the cranial vault can be seen. The vault line ascends from *glabella* almost vertically up to the *frontal eminence*, rises upward and backward up to *bregma*or still further, and then descends downward and backward up to *lambda* from where it descends almost vertically up to the *external occipital protuberance* and then in an irregular line, downward and anteriorly.

ii) In this aspect are seen the temporal, parietal, zygomatic and nasal bone; most of one maxilla, half of the frontal and occipital bone, greater wing of the sphenoid and constituent bones of the medial wall of the orbit.

iii) The region bounded by the zygomatic arch, temporal line and the frontal process of the zygomatic bone is known as the *temporal fossa*, the floor of which gives origin to the temporalis muscle which mainly controls the movements of the mandible.

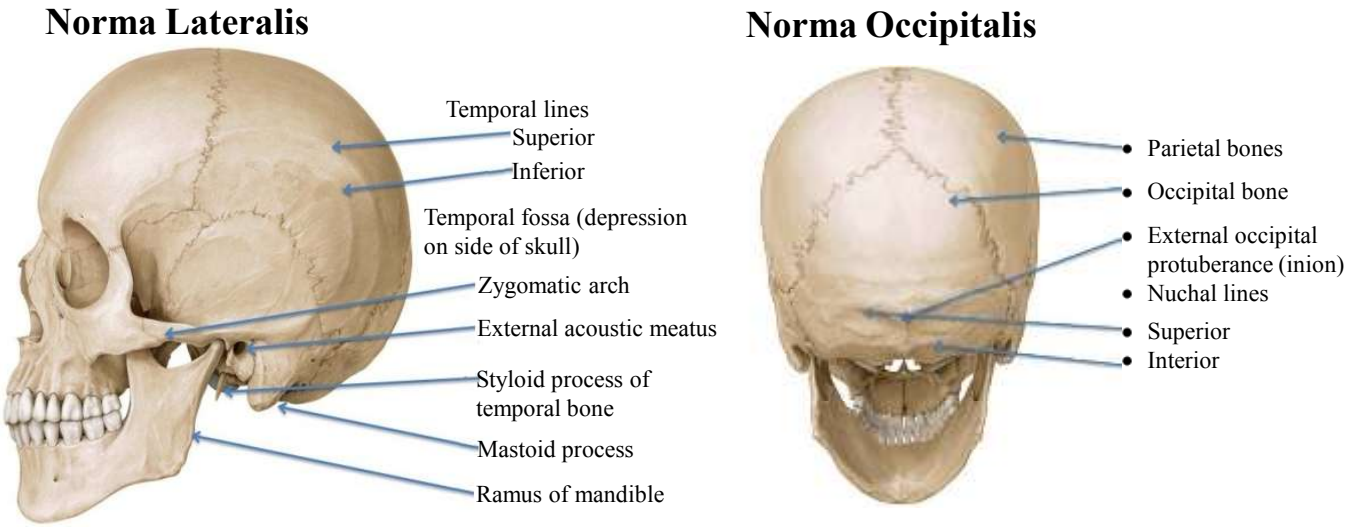


Fig. 3: Norma Lateralis and Norma Occipitalis

Source: https://slideplayer.com/

Norma occiptalis gives an understanding of the skul vault, the nature of lambdoid suture and the impression of neck muscles.

i) From this view the cranium looks like a broad arch being convex above and sidewise, and flattened below. The base of the arch ends in two mastoid process.

ii) The entire lambdoid suture is seen from this view. Inferiorly it meets the *occipitomastoid suture* and the *parietomastoid suture* at the *posteroinferior angle* of the parietal bone.

iii) In this norma is observed the *external occipital protuberance (EOP),* which is situated on the lower part of the field in the median plane with the ridges leading out from it.

iv) The *superior nuchal lines* are the distinct ridges passing laterally from the protuberance, which form the boundary lines between the scalp and the back of neck. The most prominent point on the external occipital protuberance in median plane is termed *inion*.

Norma basalis study provides information regarding position of foramen magnum, the dental arcade and the teeth, the palate, the nuchal surface of the occipital, and also numerous foramina and processes. The external surface of the base of the skull, excluding the mandible, is bounded in front by the incisor teeth, behind by the superior nuchal lines of the occipital bone, and laterally by the remaining teeth, the zygomatic arches and their posterior roots, and the mastoid processes. The surface of this norma is very irregular, and for the purpose of description the area may be divided into anterior, middle and posterior portions. The anterior portion is formed by the hard palate and is at a lower level than the rest. The remainder of the surface is divided, in an arbitrary manner, into middle and a posterior part by a transverse line drawn through the anterior margin of the foramen magnum.

Anterior part: (i)The palate is arched both antero-posteriorly and transversely. The depth and breadth of the palatine vault are greatest in the region of the molar teeth. (ii) A deep fossa, termed the incisive fossa, lies in the median plane anteriorly. Within the fossa there are four foramina – two medial, *medial incisive foramina,* and two lateral, *lateral incisive foramina.* (iii) The alveolar arch provides sixteen sockets (alveoli) for the roots of the teeth. These sockets vary in size and depth and are single or sub-divided by septa according to the teeth they contain.

Middle part: (i)There are a number of foramina in this part of the normabasalis, the important ones are *foramen ovale, foramen spinosum, foramen lacerum* and the *carotid canal*. (ii) Articular fossa (glenoid fossa) is deeply concave antero-posteriorly, wider and gently concave laterally. (iii) Anterior to this articular fossa, there is a transverse rounded elevation, termed the *articular eminence*. (iv) The tympanic part of the temporal bone separates the articular fossa from the external auditory meatus.

Posterior part: (i) The anterior portion of this part is occupied by the foramen magnum of the occipital bone. It is oval in shape, the antero-posterior diameter is greater than the transverse. Anteriorly, the margin of the foramen is slightly interrupted on each side by the occipital condyles, which projects downwards to

articulate with the atlas. (ii) Behind the condyles a depression, *condylar fossa*, is noticed. (iii) An elongated bony projection, the *styloid process*, rises from the tympanic part of the temporal bone. It is bent anteriorly. Posterior to its root there is a foramen, the *stylomastoid foramen*.

Norma Basalis

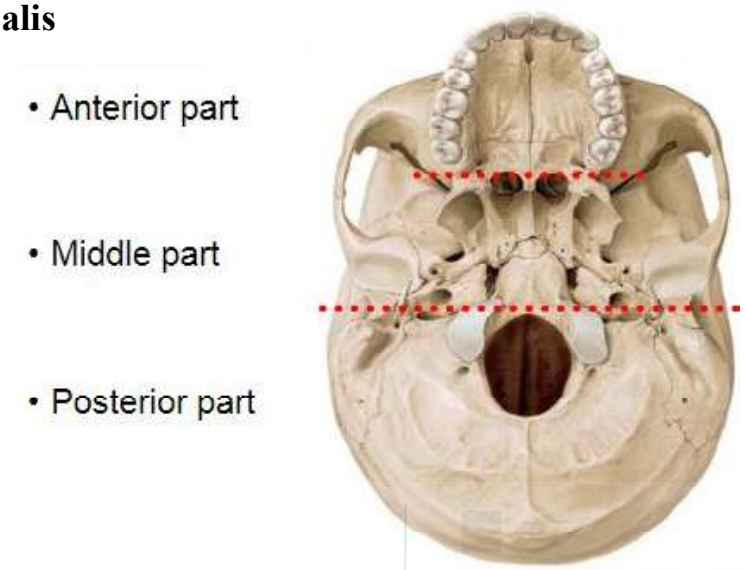


Fig. 4: Norma Basalis

Source: https://slideplayer.com/slide/11439793/

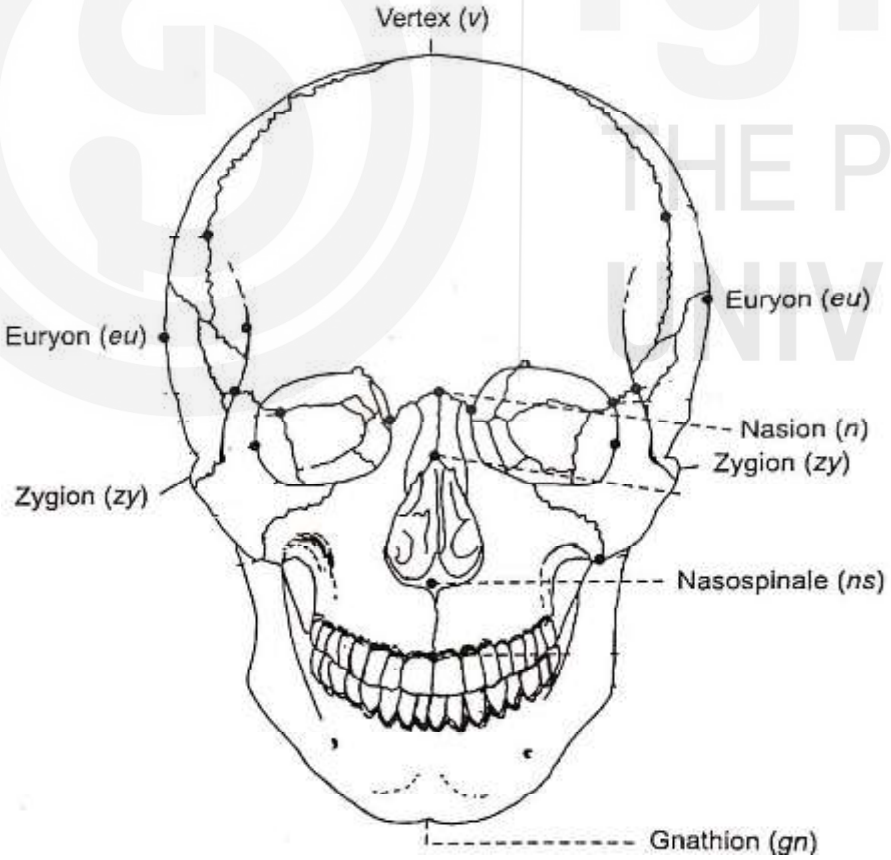


Fig. 5: Craniometric Landmarks (Frontal View)

Source: Mukherji et al., 2009

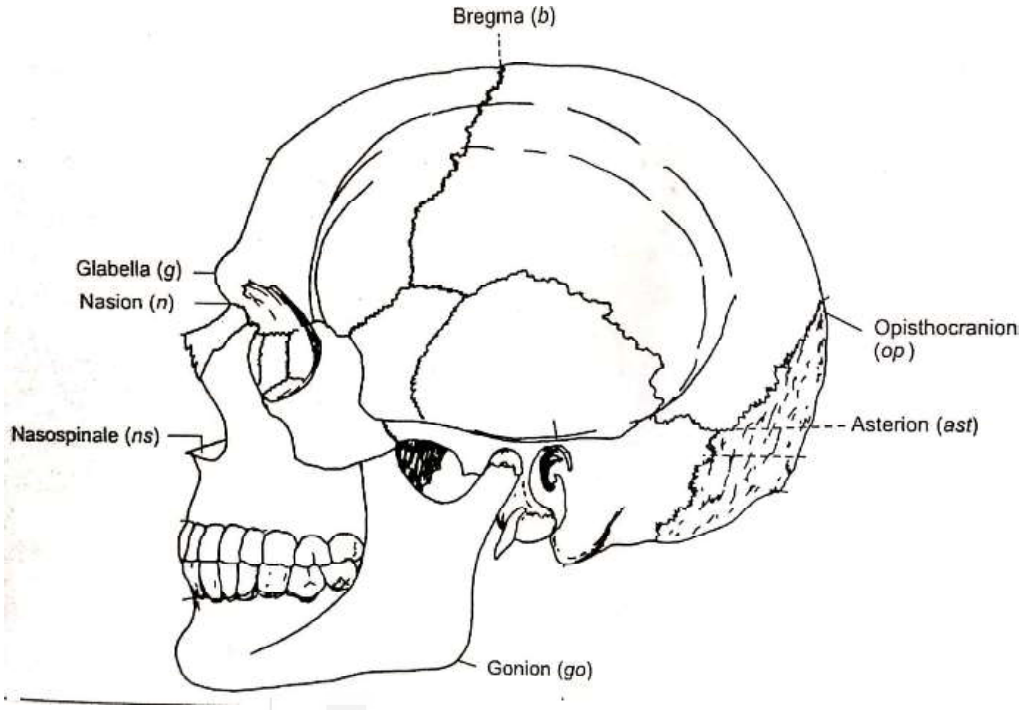


Fig. 6: Craniometric Landmarks (Lateral View)

Source: Mukherji et al., 2009

Let us learn about measurements:

Maximum Cranial Length (g-op): It is the greatest diameter of the cranium in the median sagittal plane between *glabella* and *opisthocranion*.

Glabella (g): It is the most prominent point on the median line between two eyebrow ridges, a little above the frontonasal suture.

Opisthocranion (op): It is a point on the occiput, furthest away from glabella, situated on the median line. Anatomically it is an indefinite point.

Instrument used: Spreading Caliper.

Method: The skull under measurement is conveniently placed on a cushion. One end of the caliper is held upon glabella while the other end is moved up and down along the median line on the occipital aspect of the skull until the maximum measurement is obtained. The measurement is recorded from the scale.

Maximum Cranial breadth (eu-eu): It is the greatest transverse diameter of the cranium between the two *euryons.*

Euryon (eu): It is the most lateral point on the lateral wall of the cranium, one on each side. Anatomically it is an indefinite point.

Instrument used: Spreading Caliper.

Method: The cranium is placed on a cushion. The arms of the caliper are held horizontally on the parietal eminences from behind the cranium. Then both the arms rotated simultaneously in circular fashion, starting from small circles gradually to larger ones, until the maximum reading is obtained from the scale. Care should be taken regarding symmetrical placing of the arms of the caliper transverse to the median plane and in perfectly horizontal position.

Maximum Bizygomatic Breadth (zy-zy): It is the linear distance between two *zygions.*

Zygion (zy): It is the most lateral point of the zygomatic arch, one on each side. Anatomically it is an indefinite point.

Instrument used: Spreading Caliper.

Method: Two knobs of the caliper, held horizontally, are placed on the two zygomatic arches; and are simultaneously moved forwards and backwards till the maximum reading is obtained in the scale. While taking the measurement, the operator should be sure that the scale of the caliper remains transverse to the median line.

Greatest Occipital Breadth (ast-ast): It is the linear distance from one *asterion* to the other.

Asterion (ast): It is the point behind the base of the mastoid process at the meeting point of the lambdoidal, parietosquamous and occipitosquamous sutures.

Instrument used: Spreading Caliper.

*Method:*The cranium is placed up side down on a cushion. Then, one arm of the caliper held by left hand, is fixed on one asterion, and the other arm is drawn on the other asterion. The value of the measurement is recorded from the scale.

Upper facial height(n-pr): It measures straight distance between nasion (n) and prosthion (pr).

Nasion (n): It is the point on the median line where it crosses the frontonasal suture.

Prosthion (pr): It is the tip of the gum between two medial incisors. The point often correlates with the meeting point of the integumental border of the upper lip with the median plane.

Instrument used: Sliding Caliper.

Method: Rest the cranium on its occipital region with the norma frontalis facing upwards. The sharp end of the fixed crossbar of the instrument is placed on the nasion and then the movable crossbar is slided to touch the prosthion point with its sharp end.

Nasal Length (n-ns): It is the linear distance between *nasion*and *nasopinale*.

Nasion (n): It is the point on the median line where it crosses the frontonasal suture.

Nasopinale (ns): It is the point, usually within the bone substance of the nasal spine, where a line drawn tangent to the two curved lower borders of the piriform aperture crosses the median line. In practice, the pint is usually taken at the base of the nasal spine as close as possible to the median line.

Instrument used: Sliding Caliper.

Method: The pointed end of the fixed crossbar is placed on nasion, guarded by thumb, while the movable crossbar is drawn on nasaopinale. To get a more correct value, measurements on both the sides of the spine may be taken and average value is recorded.

Nasal Breadth: It is the greatest breadth between the lateral margins of the nasal aperture measured perpendicularly to the median line. No landmark is used.

Instrument used: Sliding Caliper.

*Method:*The cranium is placed on a cushion with its face upwards and the measurement is taken from above. The fixed crossbar is first held tangent to the left border of the nasal aperture, keeping its line parallel to the median line. Then the movable casket is slowly pushed so that the line becomes tangent to the other border. Whether the crossbars are tangents to the respective borders of the nasal aperture, is judged by looking vertically. The value of the measurement is obtained from the scale, between the two crossbars.

Cranial Index: It is the percent of maximum cranial breadth per unit maximum cranial length and is expressed by the formula:

Cranial Index = Maximum Cranial Breadth/Maximum Cranial Length × 100

Range-Variation (According to Garson)

Type	Range
Ultradolichocranial	X-64.9
Hyperdolichocranial	65.0-69.9
Dolichocranial	70.0-74.9
Mesocranial	75.0-79.9
Brachycranial	80.0-84.9
Hyperbrachycranial	85.0-89.9
Ultrabrachycranial	90.0-X

Nasal Index: It is the percent of nasal breadth per unit nasal length and is expressed by the formula:

Nasal Index = Nasal Breadth/Nasal Length X 100

Classification

Type	Range
Leptorrhine	X – 46.9
Mesorrhine	47.0 – 50.9
Chamaerrhine	51.0 – 57.9
Hyperchamaerrhine	58.0 +

OSTEOMETRY

Osteometry, a branch of Anthropometry, is engaged in taking measurements of bones of humans skeleton other than those of the skull. As biological anthropology intends, primarily, to study human variation as well as evolutionary development, osteometry provides the basis of comparative anatomy with respect to physical dimensions of the bones. Such measurements also help understand sexual dimorphism and bilateral asymmetry (in case of paired bones). Some of the measurements can be taken directly on the bones, while some others are measured on scientific drawings of the bones.

There are five types of bones in the body. They are long bones, short bones, flat bones, irregular bones and sesmoid bones.

Long bonesbone has an elongated shaft or diaphysis and two expanded ends (epiphyses) which are smooth and articular. Examples of typical long bones are humerus, radius, ulna, femur, tibia and fibula, metacarpals, metatarsals and phalanges. The following is the brief description of long bones (Humerus, Radius, Ulna, Femur, Tibia and Fibula) and their important measurements.

Humerus: The humerus is a heavy and longest bone that extends from the scapula to the elbow. It has a cylindrical shaft and two (upper and lower) extremities. The upper extremity has a smooth rounded head that fits into the glenoid cavity of the scapula. Just below the head, there are two processes- a greater tubercle on the lateral side and a lesser tubercle on the anterior side. The lower extremity consists, anteriorly the two smooth condyles (a lateral capitulum and a medial trochlea), and two fossae- lateral (radial) and medial (coronoid); and posteriorly, the olecranon fossa which lodges the olecranon process of ulna. The capitulum articulates with the head of the radius.

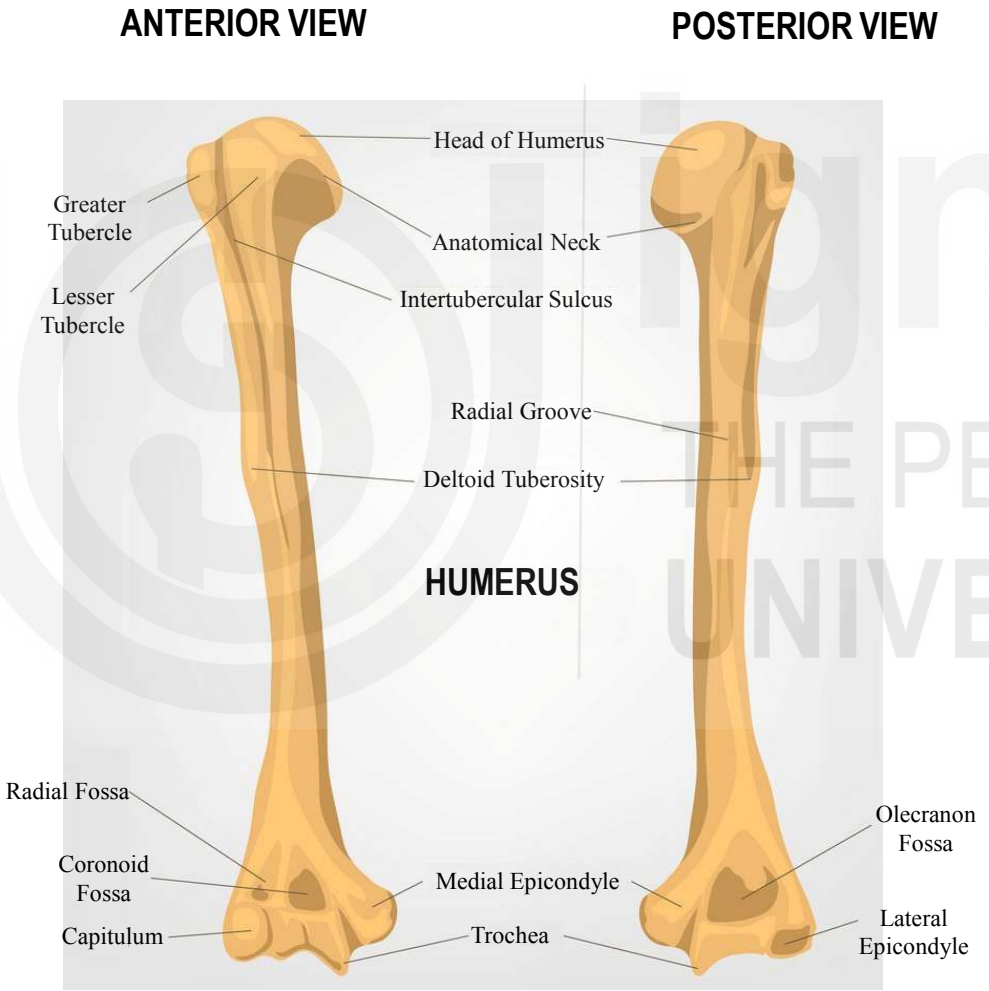


Fig. 7: Humerus

Source: https://www.vectorstock.com

- Maximum Length: It measures the straight distance between the highest point of the head of the humerus and deepest point on trochlea.

  Instrument Used: Osteometric Board

  Method: The bone is placed in the osteometric board such that the highest point of the head touches the fixed vertical wall of the board, keeping the long axis of the bone as close as possible to the side wall of the board. Then the loose vertical piece is adjusted in such a way that the vertical surface

touches the deepest point on trochlea. The length is recorded directly from the graph paper, placed on the board.

- Least Girth of Shaft: It measures the least circumference of the shaft, found usually at the lower half of deltoid tuberosity.

  *Instrument Used:*Tape.

  Method: The tape is wound around the circumference of the shaft at the middle.

- Caliber Index: Least girth of the shaft/Maximum length × 100

Radius: Radius is the lateral bone of the forearm. It has two extended ends-the head and the lower end, and a shaft. The head at the upper end of the radius articulates laterally with the humerus and a notch of the ulna. On the shaft, just below the head is a process called the radial tuberosity. The lower end of the radius contains styloid process which is projected downwards from the lateral surface.

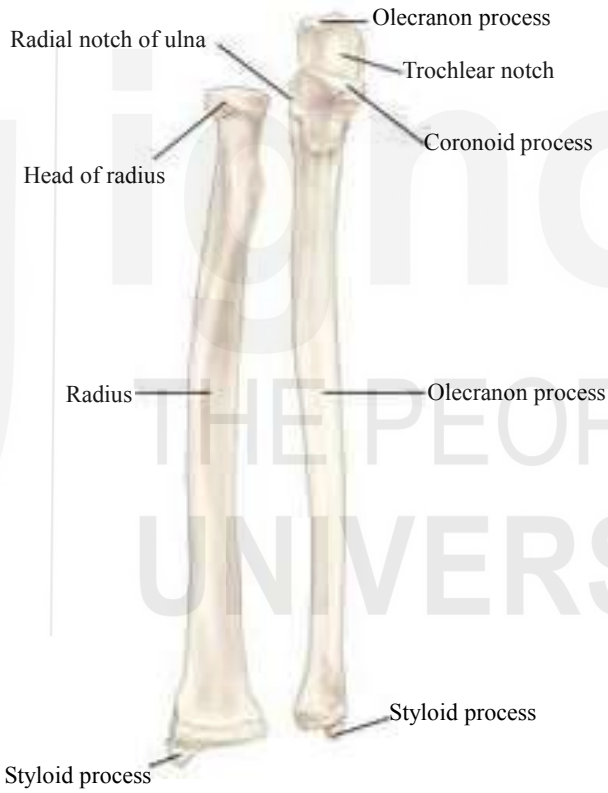


Fig. 8: Radius and Ulna

Source: https://www.britannica.com/science/ulna

- Physiological Length or Functional Length: It measures the straight distance between the deepest points of both the articular surfaces i.e., foeveacapitelliand semilunar facet of the distal end.

  Instrument Used: Pelvimeter or Spreading Caliper

  *Method:*The bone is held horizontally on the table and the ends of the two arms of the caliper are placed on the deepest points of the two articular surfaces.

  Least Girth of Shaft: It measures the circumference of the shaft at its thinnest part. It usually lies below the middle of the bone i.e. in-between the middle and distal epiphysis.

*Instrument Used:*Tape.

- Caliber Index: Least Girth of Shaft/Physiological Length × 100

Ulna: It is a thick, strong and its upper end looks like a hook. The Ulna bone faces anteriorly and is the medial bone of the forearm. The upper end has two processes the olecranon and the coronoid process. The lower end has the knoblike head of the ulna, articulates with a notch of the radius laterally and with a disk of fibrocartilage inferiorly. In cross-section the shaft of the ulna is triangular and becomes gradually narrow from the upper to the lower end.

- Physiological Length: It measures the straight distance between the deepest point on the upper surface of coronoid process to the deepest point of the distal articular surface.

  Instrument Used: Spreading Caliper or Pelvimeter

  *Method:*The bone is placed with its volar surface upward. Then the tip of left arm of the caliper is placed on the distal point and the tip of the right arm on the proximal point. The value of measurement is noted from the scale.

- Girth of Ulna: It measures the least circumference, generally found at the distal end of the bone.

  *Instrument Used:*Tape.

- Caliber Index: Girth of Ulna/Physiological Length X 100

Femur: The femur is the longest bone in the human body. The femur extends from the hip joint to the knee joint. It consists of upper and lower ends and a shaft. The upper end has a large rounded head, a neck and a greater and a lesser

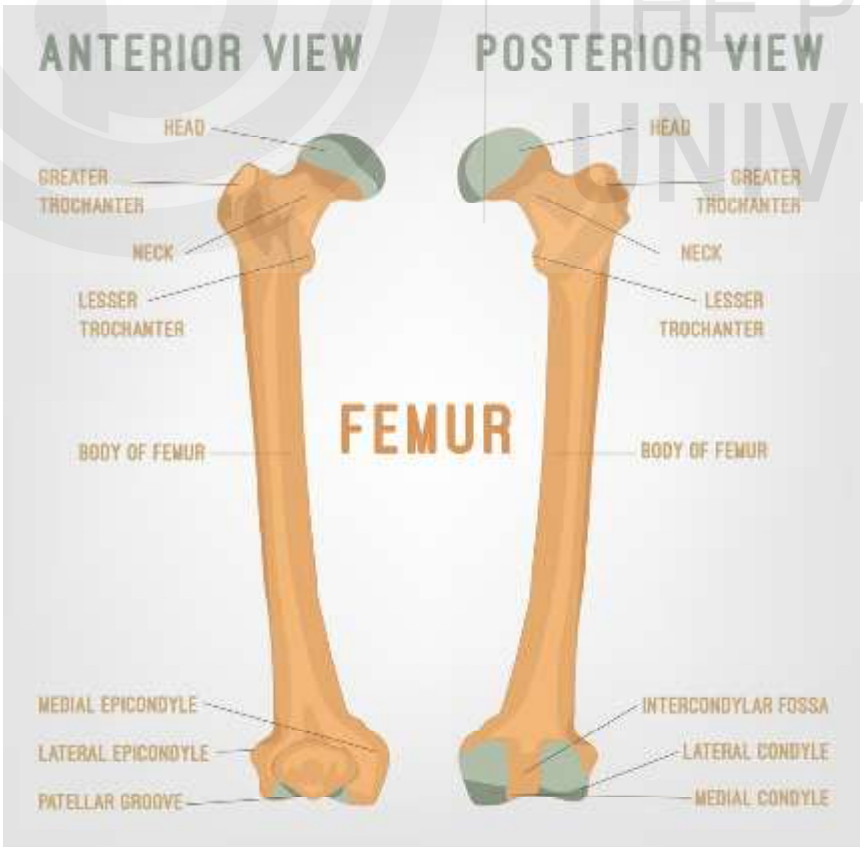


Fig. 9: Femur

Source: https://www.vectorstock.com/royalty-free-vector/human-femur-bones-vector-19044295

trochanter. The head of the femur projects medially into the acetabulum of the hip bone. The lower end of the femur consists of the two condyles – the lateral and medial condyles, which articulate with the head of the tibia (of the lower leg) and then patella (kneecap).

The shaft of the femur at the anterior side is nearly cylindrical and convex while it is thinnest at the middle and widens more near the lower end when compared to above.

- Physiological Length: It measures the projective distance between the highest point of the head and the tangent to the lower surface of the two condyles.

  Instrument Used: Osteometric Board.

  *Method:*The bone is placed in the Osteometric board with the condyles touching the transverse vertical wall and the anterior surface upward. The bone will naturally lie obliquely. Then the movable vertical piece is made to touch the head. Value of the measurement is recorded directly from the graph paper.

- Girth of Middle of Shaft: It measures the circumference in the middle of the shaft, measured at the level of the sagittal/transverse mid-shaft diameter.

  Instrument Used: Steel Tape.

  Method: The tape is wound around the mid-shaft region, transverse to the long axis, and the value is recorded.

- Length-Girth Index: Girth of Middle of Shaft/Physiological Length X 100

Tibia: The tibia is located on the medial side and the larger of the two lower leg bones. It consists of an upper end, lower end and a shaft. The upper end is expanded into two condyles, the medial and lateral condyles. These two have concave surfaces and articulate with the condyles of the femur. The lower end of tibia expands to form a prominence on the inner ankle called the medial malleolus. The lower end articulates with the trochlear surface of the talus at the ankle joint. The shaft of the tibia is triangular in cross-section and has three surfaces-medial, lateral and posterior, and three borders-anterior, interosseous and medial.

- Total Length of Tibia or Lateral Condylar Malleolar Length: It measures the straight distance from the cranial articular surface of the fibular condyle of tibia i.e., lateral condyle to the tip of the tibial (medial) malleolus.

  Instrument Used: Osteometric Board.

  *Method:*The bone is placed longitudinally with its anterior surface upwards and the intercondylar spine touching the short vertical wall of the board. The movable vertical piece is brought to touch the tip of the malleolus.

- Minimum Girth of Shaft: It measures the minimum circumference of shaft wherever found. It is usually found at the distal third of the bone approximately 10 cm. proximal to the tip of tibial malleolus.

  *Instrument Used:*Tape.

  *Method:*First, the position is marked, then the tape is wound around the circumference and the value is recorded.

- Length-Thickness Index: Minimum Girth of Shaft/Total Length of Tibia × 100

Fibula: The fibula is located on the lateral side of the tibia and is a long and slender one. It consists of a shaft, an upper end (head) and a lower end (the lateral malleolus). The head of the fibula articulates with the tibia just below the lateral condyle. The lateral malleolus articulates with the ankle and forms a eminence on the lateral side. The shaft of the fibula has three borders anterior, posterior and interosseous.

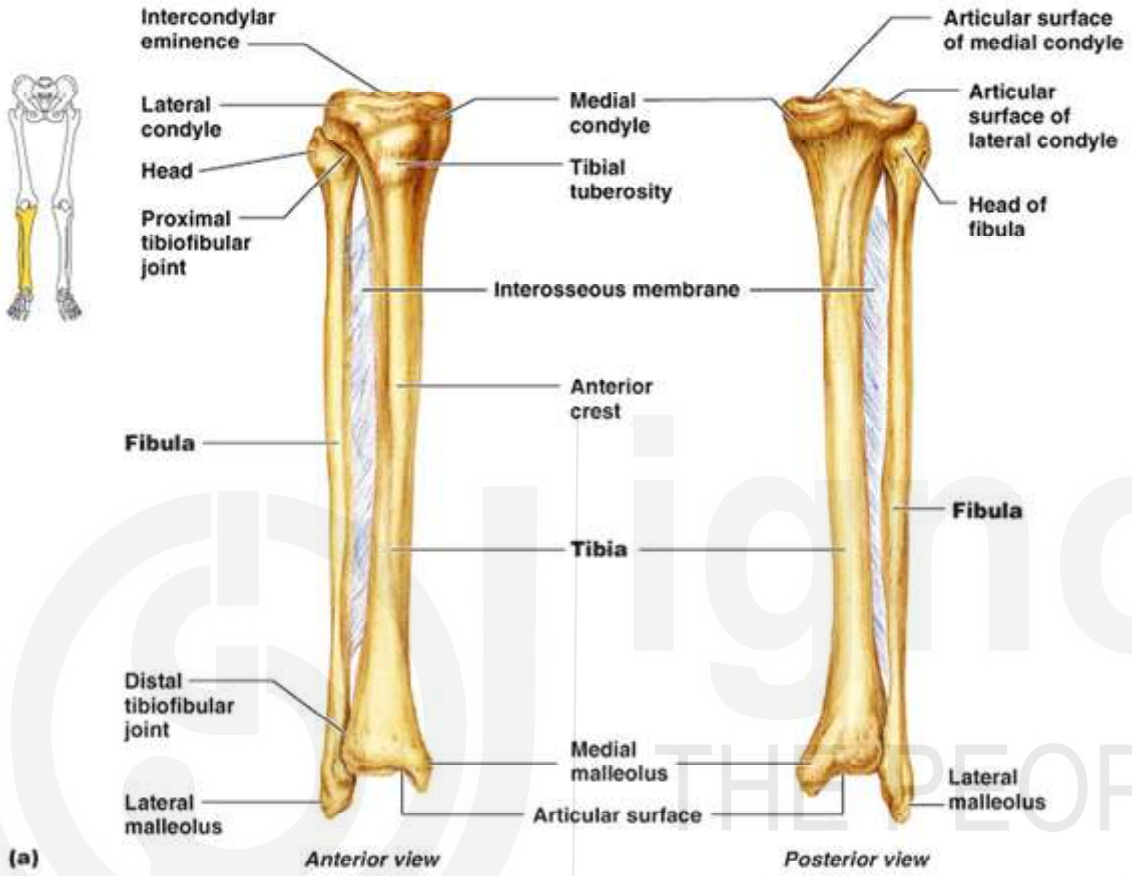


Fig. 10: Tibia and Fibula

Source: https://biology.stackexchange.com

- Maximum Length: It measures the distance between the highest point of the apex of the head and deepest point of the fibular malleolus.

  Instrument Used: Osteometric Board

  Method: The bone is placed lengthwise on the board, apex of the head touching the short vertical wall. Then the movable vertical piece is made to touch the tip of the distal end. The value of the measurement is recorded from the graph paper.

- Minimum Girth of Bone: It measures the minimum circumference of the bone approximately under the upper epiphysis.

  *Instrument Used:*Tape.

  Method: Middle of the shaft is marked and the tape is wound around that region.

- Caliber Index: Minimum Circumference of the Shaft/Maximum Length × 100

REFERENCES

- Mukherji, D. Mukerji, D &Bharati, P. (2009). *Laboratory Manual for Biological Anthropology.* New Delhi: Asian Books Private Limited.
- Singh, I. P. &Bhasin, M. K. (1968). *Anthropometry.* Delhi: BharatiBhawan.

SUGGESTED READINGS

Unit 1 Introducing Palaeoanthropology

Begun, D. R. (2013).*A Companion to Paleoanthropology*. UK: Blackwell Publishing Ltd.

Henke, W., & Tattersall, I. (Eds.).(2007). *Handbook of paleoanthropology* (Vol. 3). Heidelberg: Springer.

Jurmain R., Kilgore, L. &Trevathan, W. (2011).*Essentials of Physical Anthropology*.8th Edition. USA: Wadsworth Cengage Learning.

Unit 2 Life through Ages and Dating Methods

Knight, C. R. (2001). *Life through the ages*. Indiana: Indiana University Press.

Oakley, K. P. (1964). *Frameworks for Dating Fossil Man*. Transaction Publishers.

Walker, M. (2005). *Quaternary Dating Methods*.John Wiley and Sons.

Unit 3 Primate Origins and Miocene Hominoids

Ciochon, R. L. &Fleagle, J. G. (1987).*Primate Evolution and Human Origins*. New York: Aldine De Gruyter.

Fleagle, J. G. (1998). *Primate Adaptation and Evolution*. London: Academic Press.

Poirier, F. E. (1973). Fossil Man: An Evolutionary Journey. USA: The C. V. Mosby Company.

Unit 4 History of Human Evolution

Aiello, L., & Dean, C. (1990). *An introduction to human evolutionary anatomy*. London: Academic Press.

Bhattacharya, D. K. (1994).*An Outline of Prehistory*. India: PalakaPrakashan.

Jurmain, R., Kilgore, L. &Trevathan.W. (2012).*Essentials of Physical Anthropology*.9th Edition. Wadsworth: Cengage Learning.

Swindler, D. R. (1996).*An Introduction to Primates*. Washington: University of Washington Press.

Unit 5 Australopithecus

Broom, R. (1938).The Pleistocene Anthropoid Apes of South Africa.*Nature*. 142**,** 377-379.

Dart, R. A. (1925).*Australopithecus africanus* The Man-Ape of South Africa.*Nature*. 115, 195-199.

Leakey, M. G., Spoor, F., Brown, F. H., Gathogo, P. N., Kiarie, C., Leakey, L. N., & McDougall, I. (2001). New hominin genus from eastern Africa shows diverse middle Pliocene lineages. *Nature*, *410*(6827), 433-440.

Unit 6 Homo habilis

Leakey, L. S. B. (1960). Recent discoveries at Olduvai gorge. *Nature*, *188*(4755), 1050-1052.

Leakey, L. S., Tobias, P. V., & Napier, J. R. (1964).A new species of the genus Homo from Olduvai Gorge.

Tobias, P. V. (1989). The status of Homo habilis in 1987 and some outstanding problems. *Hominidae.Jaca Books, Milan*, 141-149.

Unit 7 *Homo erectus* from Africa, Asia, Europe

Antón, S. C. (2003). Natural history of *Homo erectus*. *American Journal of Physical Anthropology: The Official Publication of the American Association of Physical Anthropologists*, *122*(S37), 126-170.

Das, B. M. (2011). *Outlines of Physical Anthropology*.KitabMahal Agencies, Allahabad.

Shukla, B. R. K., &Rastogi, S. (1991). *An Introduction to Physical Anthropology and Human Genetics*.PalakaPrakashan, Delhi.

Unit 8 *Neandrthals*

Hublin, J. J. (2009). The origin of Neandertals. *Proceedings of the National Academy of Sciences*, *106*(38), 16022-16027.

Shukla, B. R. K., &Rastogi, S. (1991). *An Introduction to Physical Anthropology and Human Genetics*.PalakaPrakashan, Delhi.

Tattersall, I. (1999). *The last Neanderthal: The rise, success, and mysterious extinction of our closest human relatives*. Basic Books.

Unit 9 Archaic*Homo sapiens*

Klein, R. G. (1999). *The human career: human biological and cultural origins* (second edition). Chicago: University of Chicago Press.

Relethford, J. (2010). *The human species: An introduction to biological anthropology*.McGraw Hill Higher education publication.

Rightmire, G. P. (1998). Human evolution in the Middle Pleistocene: the role of Homo heidelbergensis. *Evolutionary Anthropology: Issues, News, and Reviews: Issues, News, and Reviews*, *6*(6), 218-227.

Unit 10 Origin of Modern Humans

Ackermann, R. R., Mackay, A., & Arnold, M. L. (2015).The hybrid origin of "modern" humans. *Evolutionary Biology*, *43*(1), 1-11.

Collard, M. &Dembo, M. (2013).Modern Human Origins.In D. R. Begun (Ed.).*A Companion to Paleoanthropology*, (First Edition). Blackwell Publishing Company.

Stringer, C., & Galway-Witham, J. (2017). Palaeoanthropology: On the origin of our species. *Nature*, *546*(7657), 212-214.