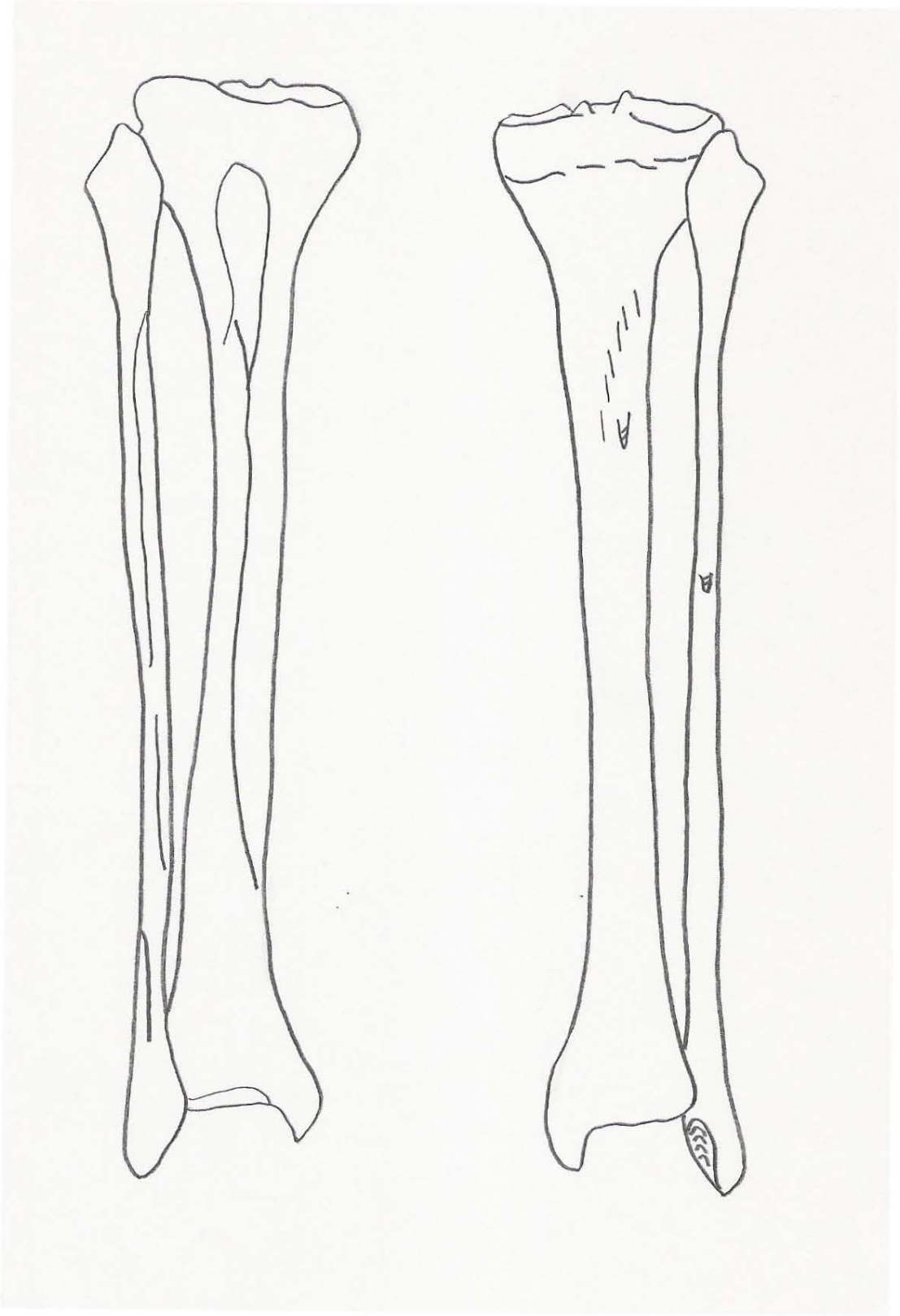


Tibia (medial) and Fibula (lateral)

Bones of the Hand

Eight carpal bones, in two rows, make up the bones of each wrist. The articular surface formed by the proximal row is convex and articulates with the distal end of the radius. The ulna takes no direct part in the wrist joint. Observe that the palmar side of the carpals are arched so as to form a tunnel through which pass the tendons and muscles of the forearm responsible for flexion of the fingers. The extensor tendons similarly lie on the back of the wrist, less protected. The majority of the movements of the hand, with the major exception of the opposition of the thumb, are brought about by muscles which lie in the forearm; some of these muscles originate as high as the epicondyles of the humerus.

The bones of the palm are known as the metacarpals, four of which are bound together by ligaments while the thumb is freely moveable. Those bones making up the fingers are the phalanges. The phalanges closest to the write are the proximal, further out medial, and making up the finger tips the distal phalanges.

Notes on Siding*

Navicular/Scaphoid – Concave surface toward you with the tubercle pointing superiorly; the bone belongs to the side to which the tubercle points.

Lunate – Place the flat surface down, concave surface facing you, the remaining facet will rise upward toward the side from which it comes.

Triquetral– Between your fingers, place the two facets that come together. The bone should be vertical with the largest facet toward you. The remaining facet will point toward the side from which it comes.

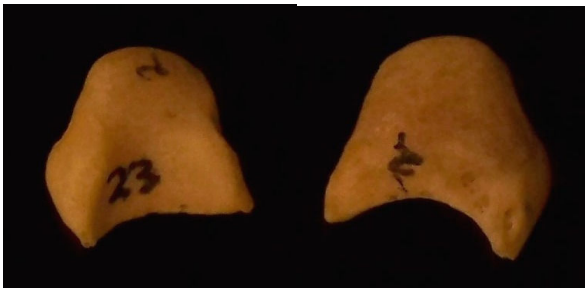
Pisiform – With the non-articular surface pointing superiorly and the facet facing you, a groove will be located on the side from which the bone comes.

Greater Multangular – Lay the bone on the table with the tubercle pointing superiorly and away from you, with the concave surfaces lateral and there will be a groove next to the tubercle on the side from which the bone comes.

Lesser Multangular – This bone has a boot shape in appearance. Take the boot and put the sole on the table, with the v-shaped toe pointing toward you. The toe of the boot points toward the side from which it comes.

Capitate – The head should be placed superiorly and the long narrow articulation toward you, the bone belongs to the side on which the long narrow articulation is observed.
Hamate – The hook and facets should be positioned away from you, with the flat surface down and the hook will lean toward the side from which it comes.
*Siding of the hands after White 2000.

Navicular. Right side. Left view from capitate and right radial articulation.



Lunate. Right side. Left view from the capitate and non-articular view.

Pisiform. Right side. Left view from triquetral and left palmar view.

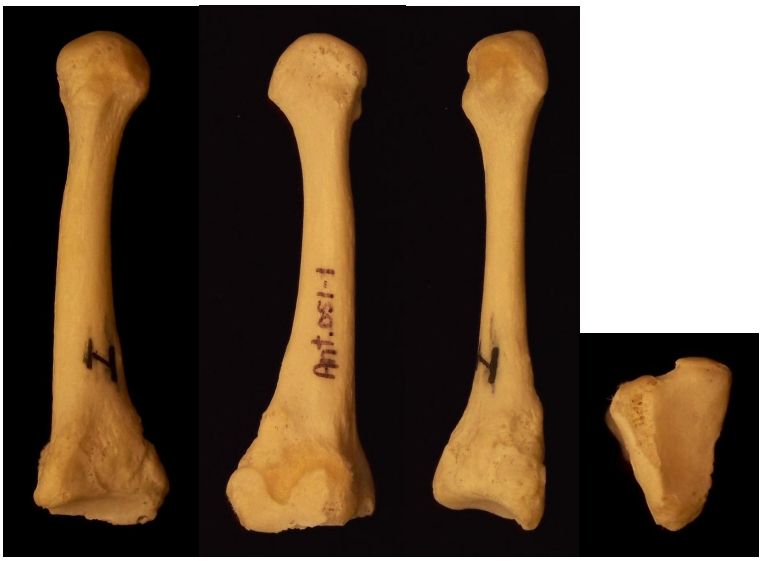
Greater Multangular or Trapezium. Right side.

Capitate. Left side. Left view from the hamate and right view from the scaphoid and trapezoid.

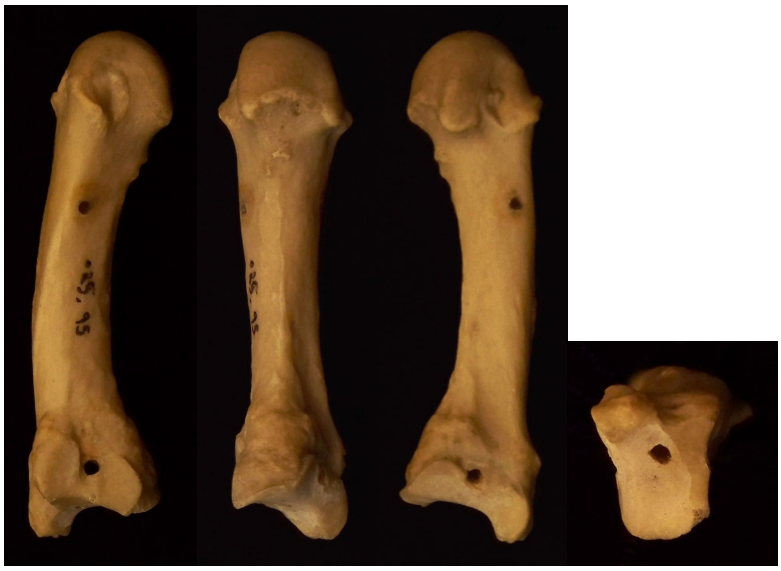
Hamate. Right side. Left view from triquetral, middle left view from the fourth and fifth metacarpal bases, middle right view from the capitate.

Triquetral. Left side. Middle view from the triquetral.

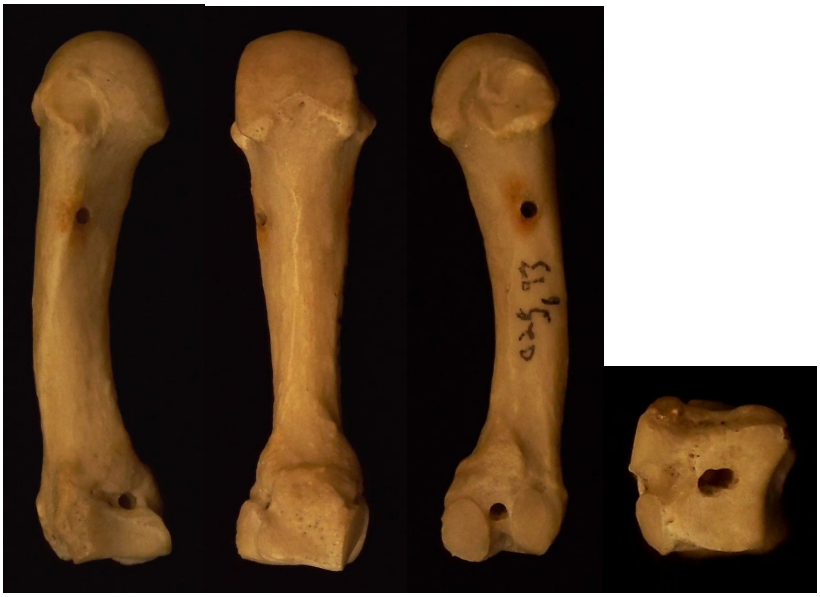
Metacarpal 1. Right side. Left palmar and right dorsal.



Metacarpal 2. Left side. Left medial, middle left lateral, middle right dorsal, right proximal base.

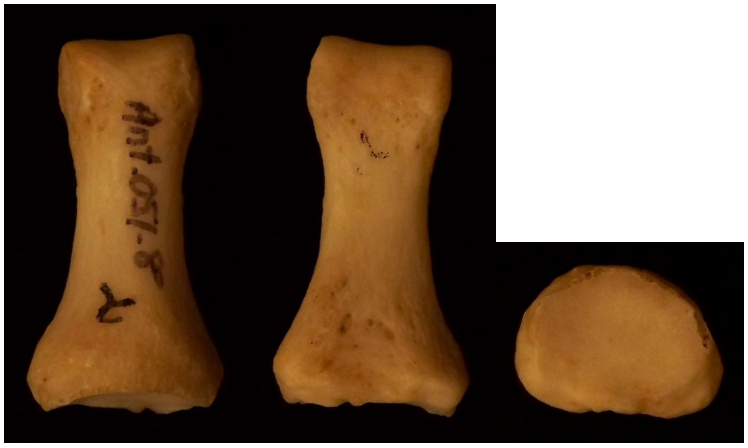


Metacarpal 3. Right side. Left medial, middle left palmar, middle right lateral, right proximal base.



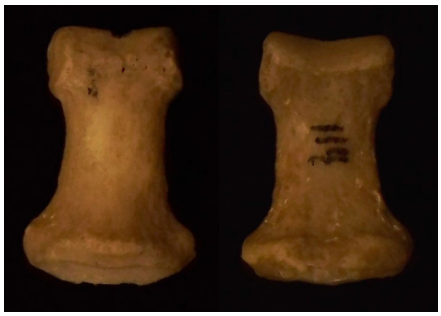
Metacarpal 4. Right side. Left medial, middle left palmar, middle right lateral, right proximal base.

Metacarpal 5. Right side. Left medial, middle left palmar, middle right lateral, right proximal base.



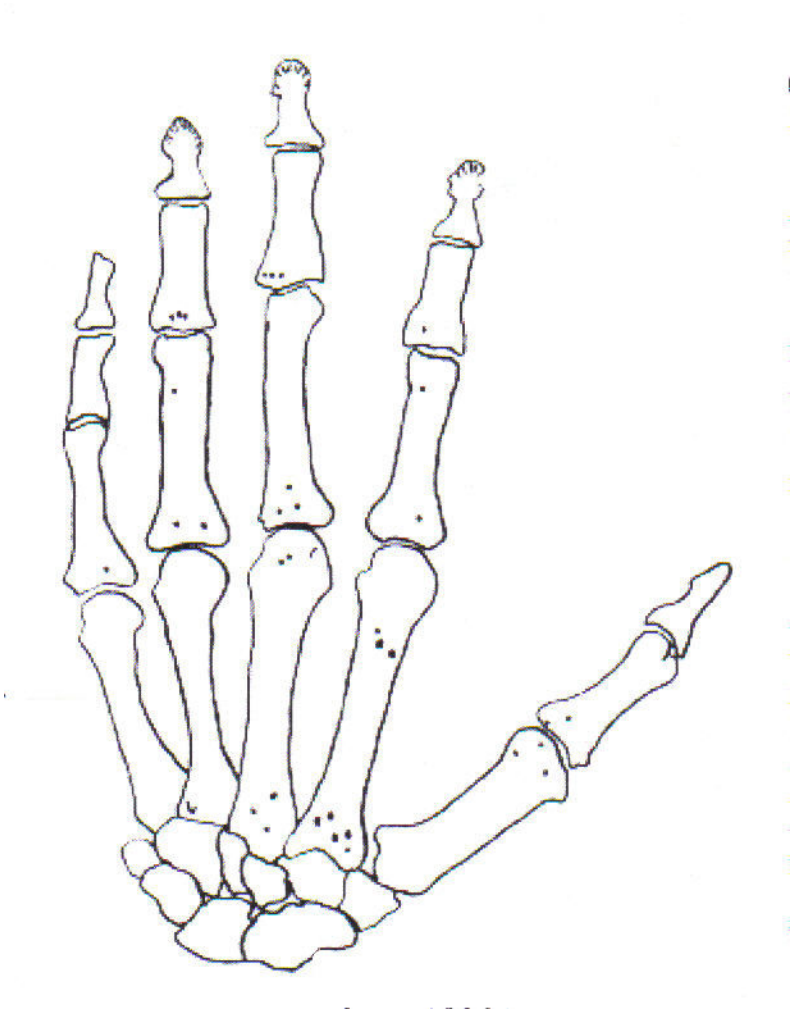
First Proximal Phalange of the Hand. Left dorsal, middle palmar, right proximal base.

Proximal Non-First Phalanges of the Hand. Left dorsal, middle palmar, right proximal base.



Medial Phalanges of the Hand. Left dorsal and right palmar.

First Distal Phalange of the Hand. Left dorsal and right palmar.



Hand

Bones of the Feet

The tarsus or posterior portion of the foot is comprised of seven individual bones. A part of the ankle joint is formed by the talus: articulating superiorly and medially with the tibia, laterally with the fibula, inferiorly with the calcaneus, and distally with the navicular bone. The calcaneus or heel is the largest of the tarsal bones, it is located inferiorly and posteriorly in the foot. The other tarsal bones are the cuboid, navicular, and three cuneiform bones. Between the first metatarsal bone and the first cuneiform bone the tarso-metatarsal joint does not allow opposition between the great toe and the remaining digits as in some lower primate forms. In man, the analog in the hand represented by the first carpo-metacarpal joints does permit this unique function.

The middle portion of the foot is made up of the metatarsal bones. The phalanges are the toe bones. Only a proximal and distal phalanx are present in the great toe while the other digits have a middle phalanx as well.

The tarsal bones are much larger than the carpal bones due to their weight bearing requirements. The tarsals and metatarsals form a unit with a limited degree of flexibility. The articulation of the talus and distal epiphysis of the tibia and fibula allow for a strictly hinge-like motion. The most flexible joints within the tarsals are those between the anterior surface of the talus and the navicular, and between the anterior surface of the calcaneus and the cuboid. The motions by which the sole of the foot may be slightly turned medially or laterally, take place at these two joints. Observation of the sole of the articulated foot skeleton will show a considerable concavity between the tuberosity of the calcaneus and the distal ends of the metatarsals. This concavity in life is filled with muscles and any weakening of this arch causes the weight of the body to come to rest on the muscles with painful results. Note the firm articulation between the tarsals and the proximal portions of the metatarsals.

The phalanges of the foot may be readily distinguished from those of the hand by their shortness and roundness of the shaft.

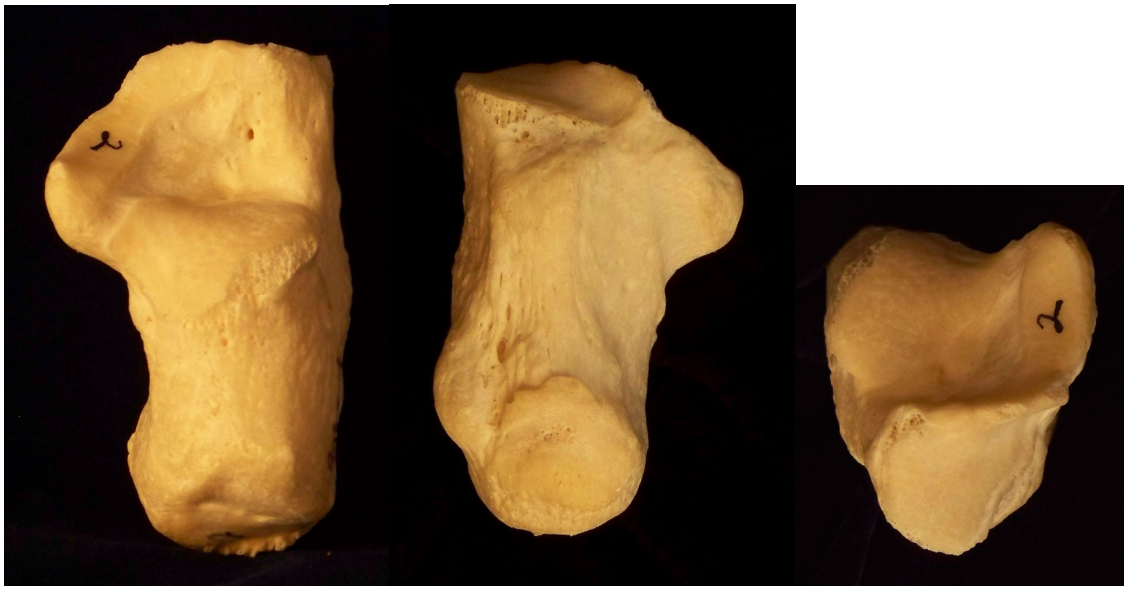
Notes on Siding*

Calcaneus	Place heel posteriorly, sustentaculum tali (projection) is medial. The projection points toward the opposite side from which the bone comes.
Talus -	Place the rounded head anteriorly, the trochlear surface for the tibia is superior, the straightest side is medial, and the angular projecting articulation points laterally. The angular projection points toward the side from which the bone comes.
Navicular	Position the concave surface posteriorly, the convex surface should be anterior with the wide surface superior and the tuberosity medial. The tuberosity points toward the side from which the bone comes.
Cuboid	Hold the large non-articulating surface toward you, the tuberosity points toward the side from which the bone comes.
Cuneiform I	Represents the largest of the cuneiform bones. The large articulating surface is anterior, the sharp ridge superior, and the rough surface without any articulation is medial.
Cuneiform II	Represents the smallest of the cuneiform bones. If the rectangular rough surface without articulations is placed superiorly, the concave triangular facet posteriorly, then the surface with "L" shaped facets is medial.
Cuneiform III	Medium in size compared to the other cuneiform bones. If the rectangular rough surface without articulations is placed superiorly, the triangular articulation posterior (small notch at the apex), then the surface with the two small facets is medial.

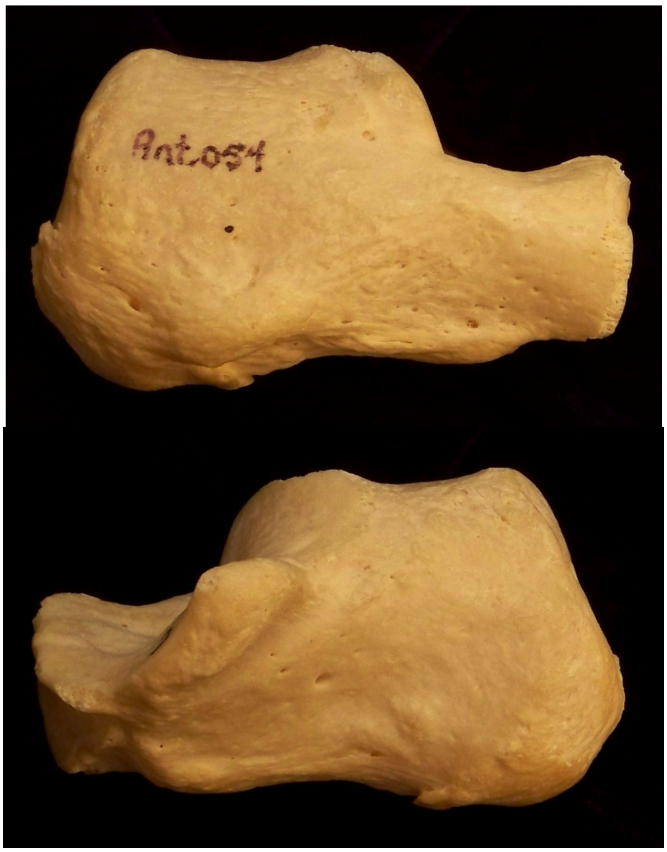
*Siding of the hands after White 2000.

Non-Metric Traits of the Feet

Bipartite anterior calcaneal facet	Division of the anterior calcaneal facet. (Mann and Hunt 2005).
Calcaneus secondarius	Accessory bone on the anterior aspect of the anterior calcaneal facet. Notch on the calcaneal facet will be porous, centrally roughened, and concave (Mann and Hunt 2005).
Os trigonum	Accessory bone in the area of the posterior tubercle of the talus (Mann and Hunt 2005).

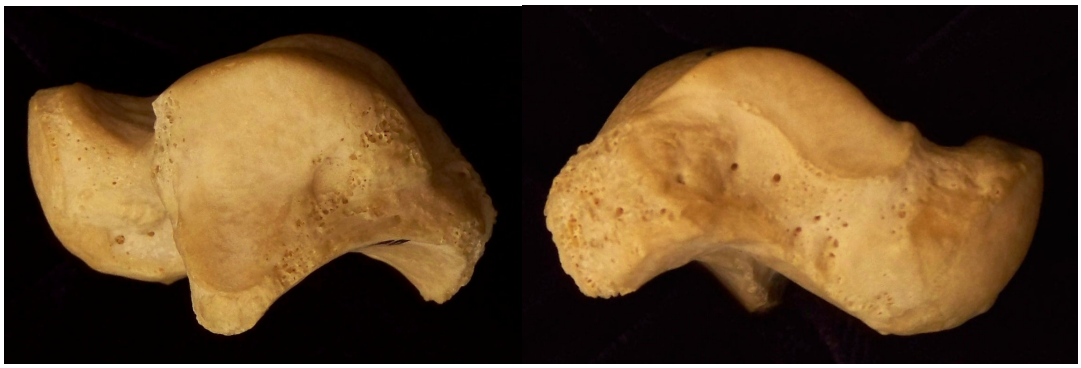


Calcaneus. Right side. Left superior, middle inferior, and right anterior view.

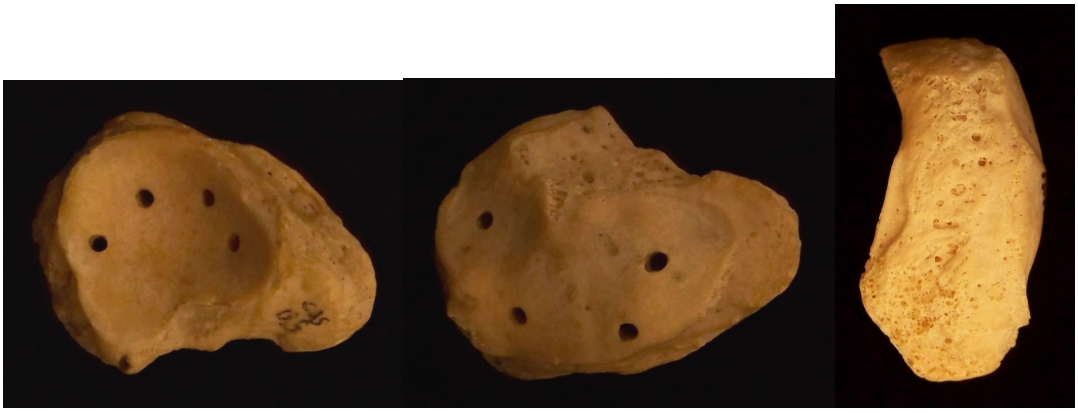


Calcaneus. Right side. Top lateral and bottom medial.

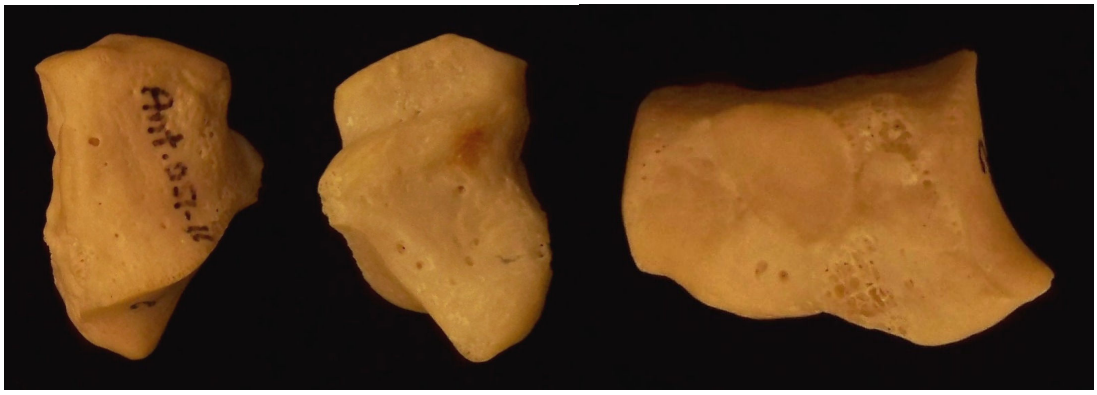
Talus. Left side. Left superior and right inferior.



Talus. Left side. Left medial and right lateral.



Navicular. Left side. Left articulation with talus, middle articulation with cuneiforms, and right non-articular view.



Cuboid. Right side. Left non-articular view, middle cuboid tuberosity, right view from the lateral cuneiform.

Cuboid. Right side. Left view from the calcaneus and right view from the 4th and 5th metatarsal bases.

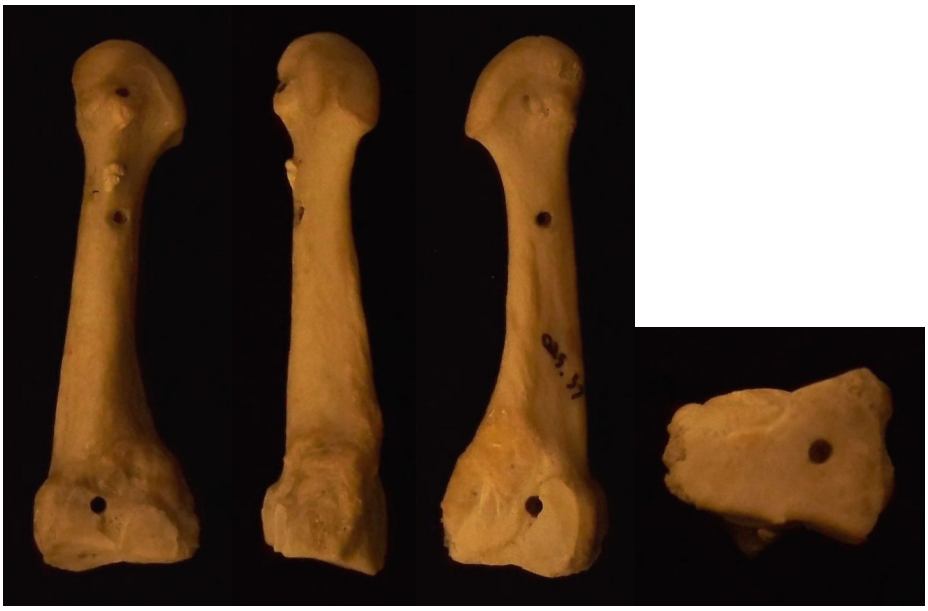
Cuneiform I. Left side. Left view from navicular, middle left medial view, middle right kidney shaped articulation, right view from 2nd cuneiform.

Cuneiform II. Left side. Left view from navicular, middle view from 3rd cuneiform, right view from 1st cuneiform.

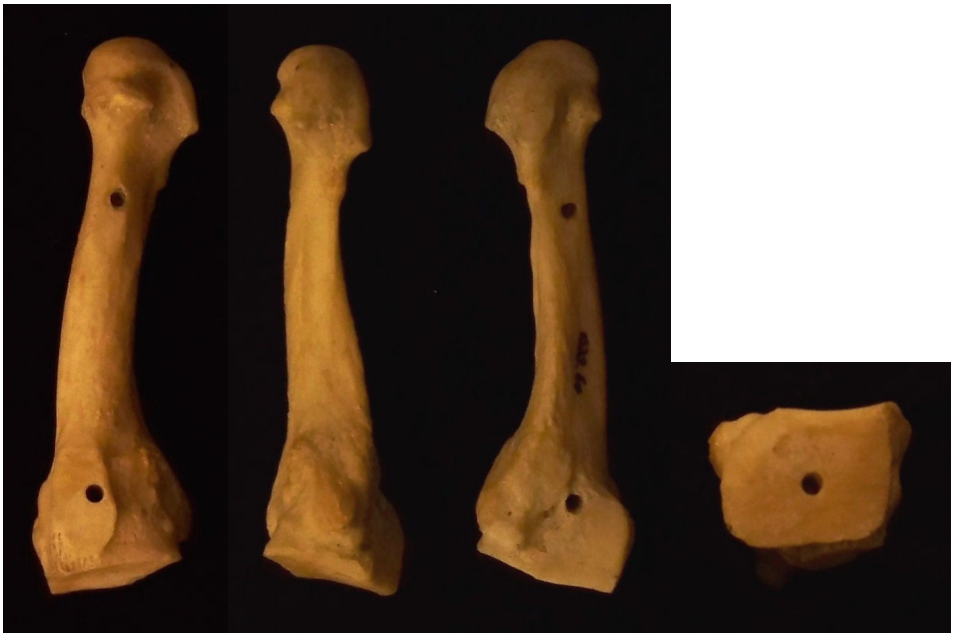
Cuneiform III. Left side. Left view from 2nd cuneiform, middle left Africa shaped articulation, middle right view from navicular, right view from cuboid.

Metatarsal 1. Left side. Left medial, middle left plantar, middle right lateral, right dorsal, bottom proximal base.

Metatarsal 2. Left side. Left medial, middle left plantar, middle right lateral, right proximal base.

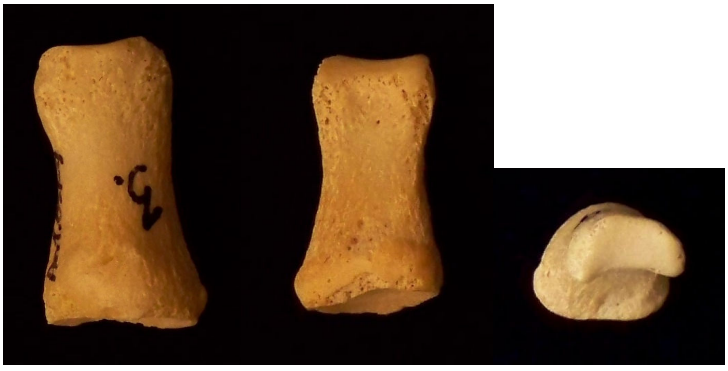


Metatarsal 3. Left side. Left medial, middle left plantar, middle right lateral, right proximal base.

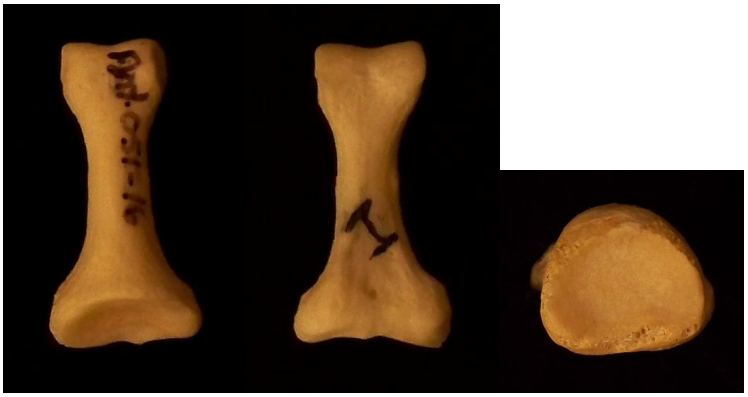


Metatarsal 4. Left side. Left medial, middle left plantar, middle right lateral, right proximal base.

Metatarsal 5. Right side. Left medial, middle left plantar, middle right lateral, right proximal base.



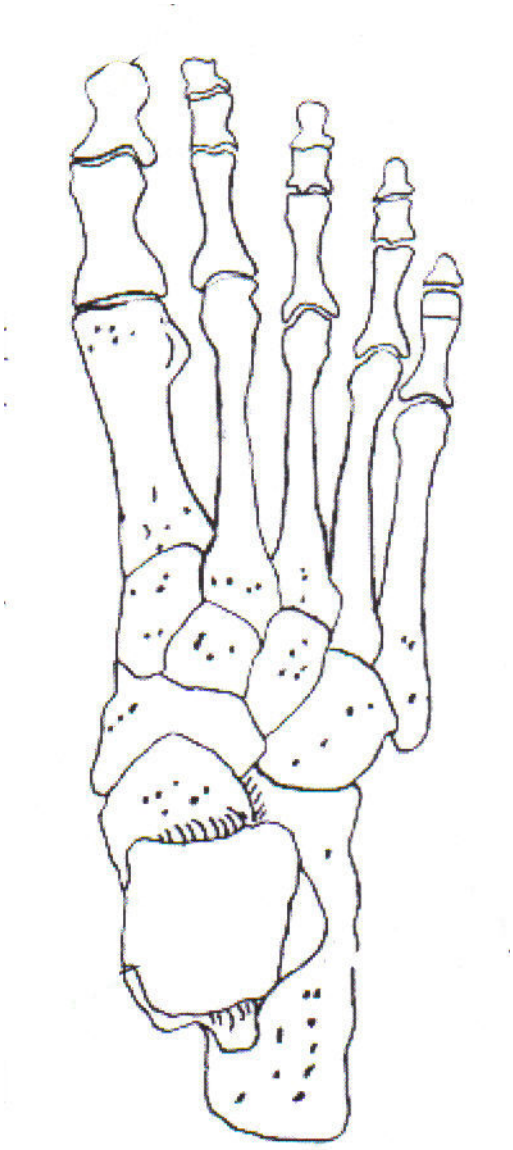
Proximal Phalanges of First Toe. Left dorsal, middle plantar, right distal articulation.



Proximal Phalanges of Non-First Toes. Left dorsal, middle plantar, right proximal base.

Medial Phalanges.

Distal Phalanges. Left dorsal, middle plantar, and right proximal base.



Foot

The Vertebral Column and Thorax

Sternum

Manubrium – bone that is trapezoidal in shape, makes up the superior aspect of the sternum.

Jugular notch – concave notches on either side of the superior aspect of the manubrium, for articulation with the clavicles.

Corpus or body – flat, rectangular bone making up the major portion of the sternum. The lateral aspects contain the notches for the true ribs, called the costal notches.

Xiphoid process – variably shaped bone found at the inferior aspect of the corpus. Process may fuse late in life to the corpus.

Clavicle

Sternal end – rounded end, articulates with manubrium.

Acromial end – flat end, articulates with scapula.

Conoid tuberosity – muscle attachment located on the inferior aspect of the shaft, pointing posteriorly.

Ribs

Head

Neck

Tubercle

Shaft

Costal groove

Scapulae

Ventral surface

Dorsal surface

Spine

Coracoid process

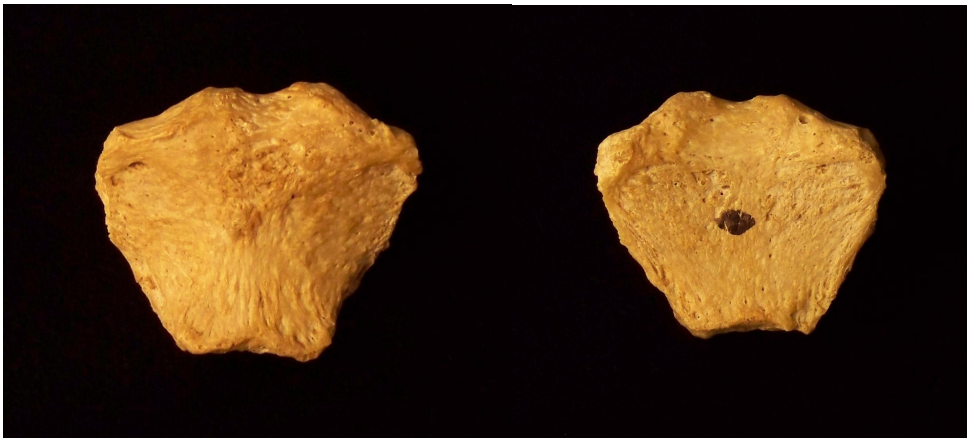
Acromion

Glenoid fossa

Axillary margin

Medial angle

Vertebral margin



Manubrium. Left anterior aspect, right posterior aspect.

Sternum and Xyphoid Process. Left anterior aspect, right posterior aspect.

Clavicle. Left side. Top superior and bottom inferior.

First Rib. Left superior and right inferior.

Second Rib. Left inferior and right superior.

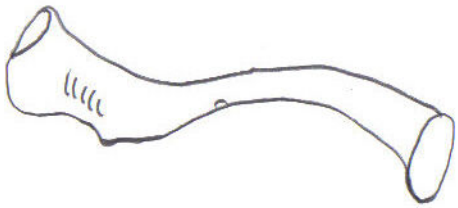
Typical Rib. Left inferior and right superior.

Eleventh Rib. Left posterior view and left superior view.

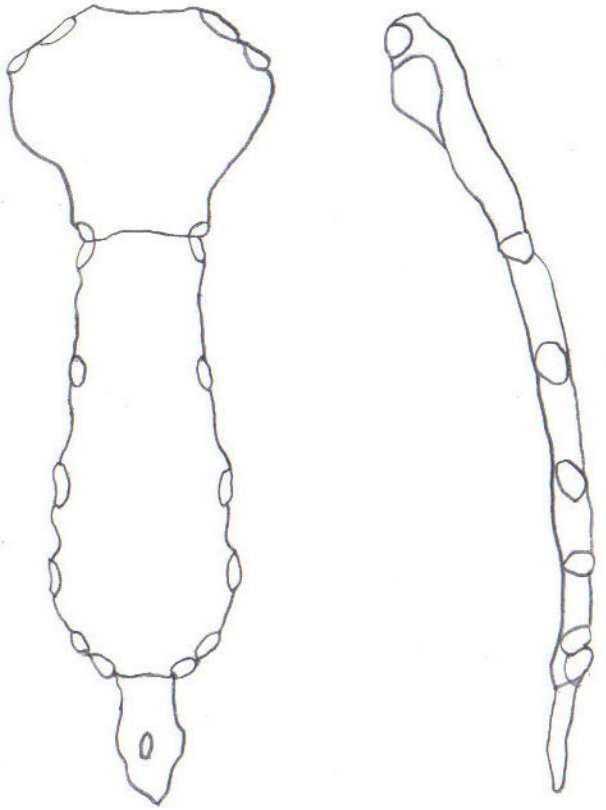
Twelfth Rib. Top shows anterior view and bottom shows posterior view.

Scapula. Left side. Top anterior and bottom posterior.

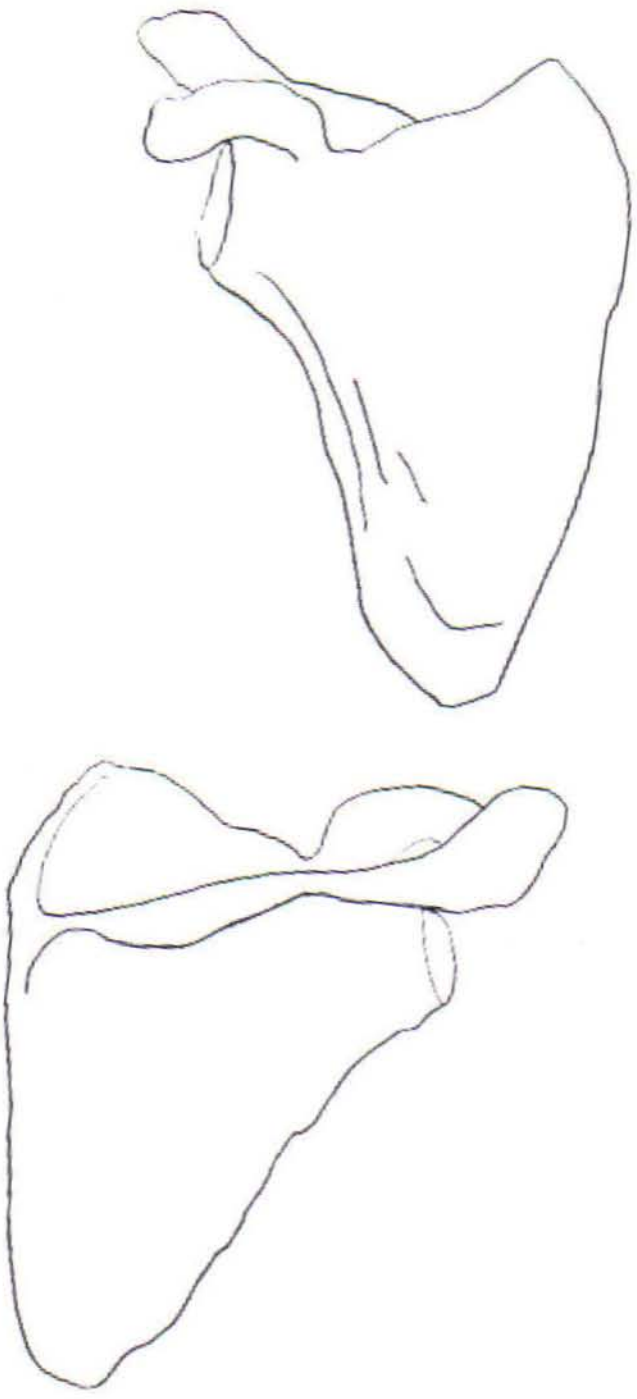
Scapula. Top lateral and bottom superior.



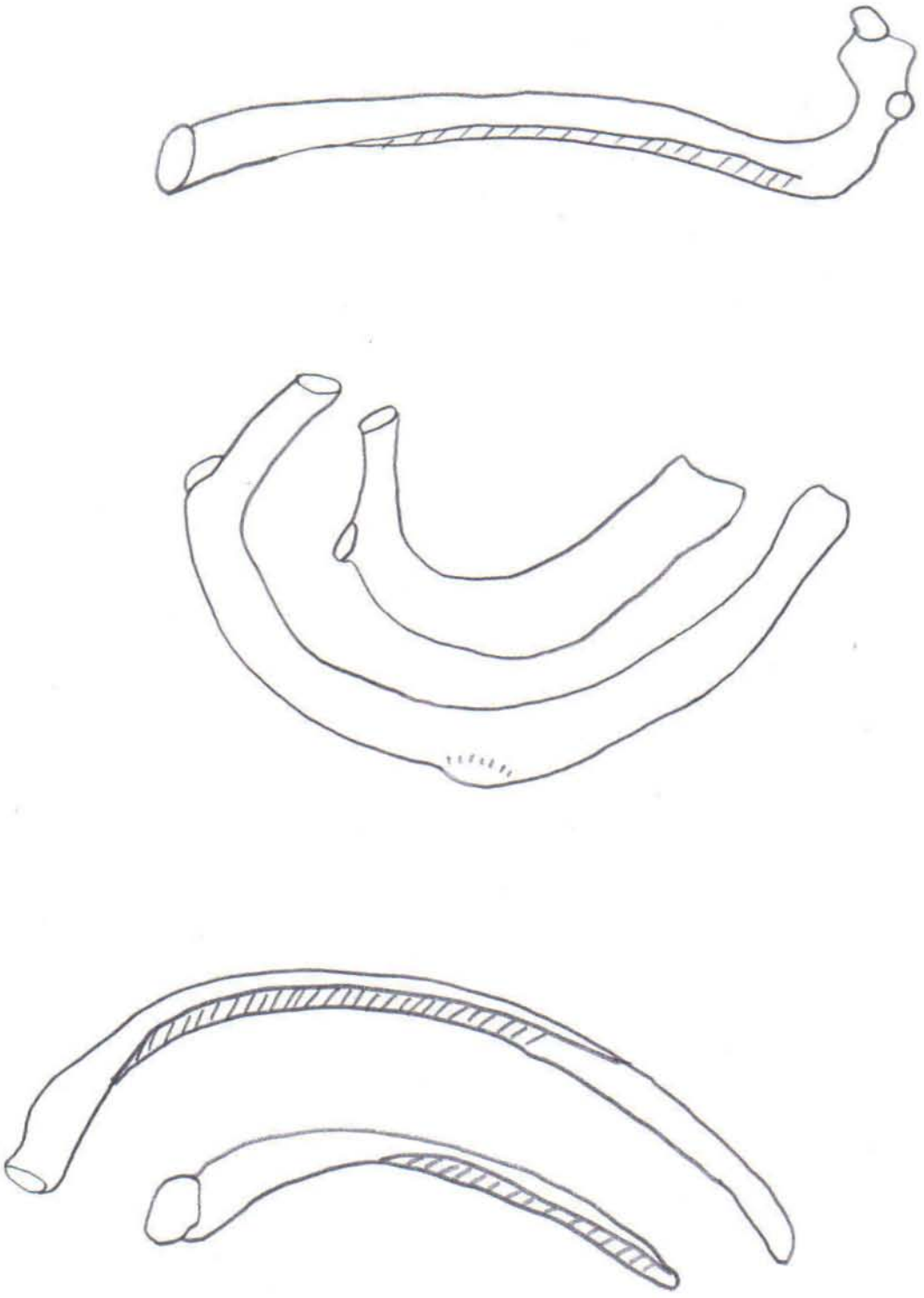
Clavicle



Sternum



Scapula



Ribs

Vertebrae

Body - Development of the vertebrae can be used in aging of individuals. In the first stage of development there are three separate portions, the two neural arches and the body. The neural arches fuse to each other first, around age 2-4 years of age. The body and neural arches later fuse at approximately 3-6 years of age. The body of a juvenile vertebra will exhibit billowing around the margins; these disappear as the end plates fuse to the body.

Foramen - Central hole through which the spinal cord passes.

Transverse foramina - Foramen on each of the transverse processes of the cervical vertebrae. Through these foramina the vertebral arteries pass.

Arches – Encloses the spinal column.

Spinous process – Posteriorly projecting aspect of the vertebra; attachment for muscles and ligaments that varies in size.

Superior articular facets & Inferior articular facets – Oval shaped facets located on the superior and inferior aspects of the posterior part of the vertebrae. As they articulate with each other, they are faced in opposite directions depending on their location in the spinal column.

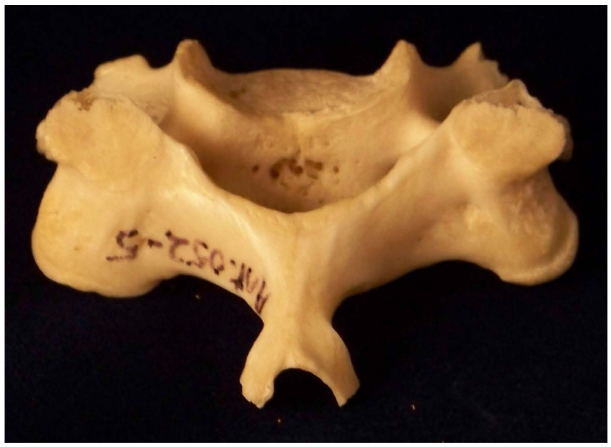
Characteristics	Cervical (7)	Thoracic (12)	Lumbar (5)
Body Shape	Oval	Round	Heart
Body Size	Small	Medium	Large
Vertebral Foramen	Rounded	Round	Triangular
Transverse Process	Small	Large	Large and blunt
Transverse Foramen	Present	Absent	Absent
Spinous Process	2-6 Bifid	Long, projects inferiorly	Thick and horizontal
Articulating Facets	Superior: face posterior Inferior: face anterior	Superior: face posterior, flat Inferior: face anterior, flat	Superior: face medially, curved Inferior: face laterally, curved
Costal Facets	None	On body and transverse processes	None

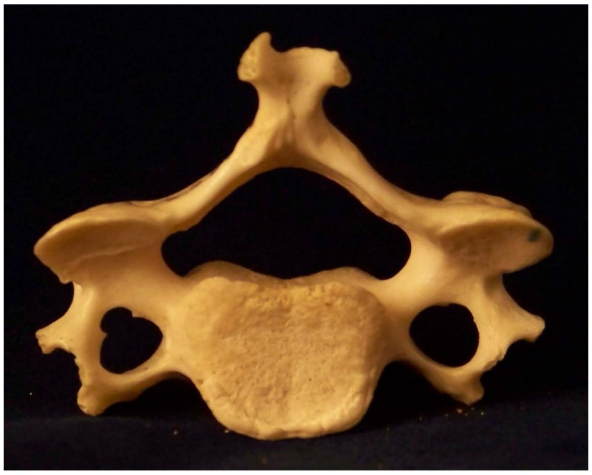
Non-Metric Traits of the Vertebral Column and Thorax

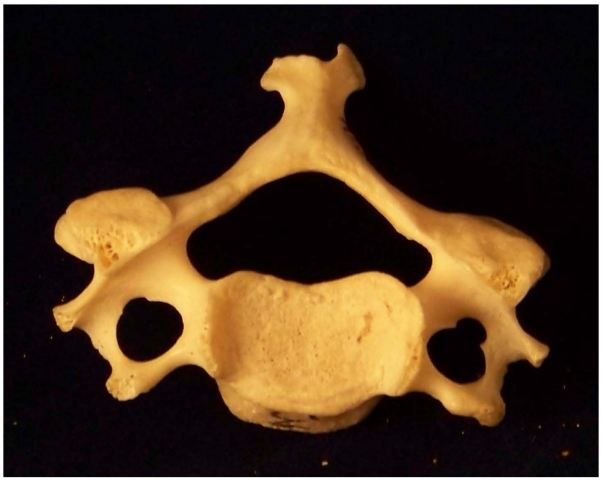
Rhomboid fossa	In the area where the costoclavicular ligament attaches, there may be a depression, crest, or plateau.
Os acromiale	Lack of fusion of the acromial epiphysis, presents with rounded margins on the epiphysis and acromion.

Atlas. Top superior and bottom inferior.

Axis. Top superior and bottom anterior.



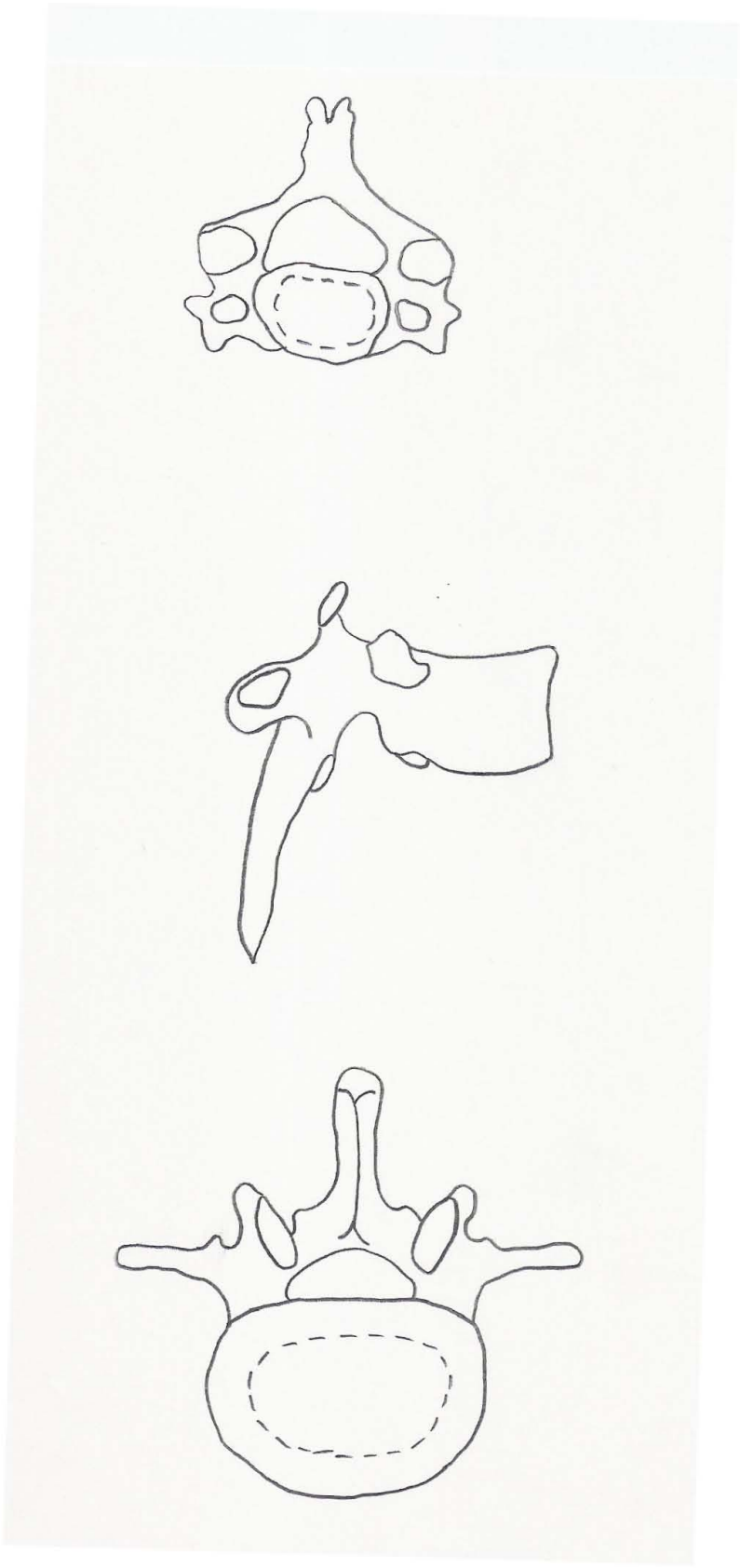




Cervical Vertebrae. Top posterior, middle inferior, bottom superior.

Thoracic Vertebrae. Top posterior, middle inferior, bottom superior.

Lumbar Vertebrae. Top posterior, middle inferior, bottom superior.



Top – Cervical. Middle – Thoracic. Bottom – Lumbar.

The Pelvic Girdle

Sacrum

A continuation of the vertebral column, the sacrum is composed of five fused vertebrae. Where the sacrum meets with the fifth lumbar vertebra it is widest, decreasing in size inferiorly. The sacrum also makes up the posterior aspect of the pelvic girdle.

Base

Apex

Promontory

Ventral surface

Transverse ridges

Anterior sacral foramina

Dorsal surface

Medial sacral crest

Posterior sacral foramina

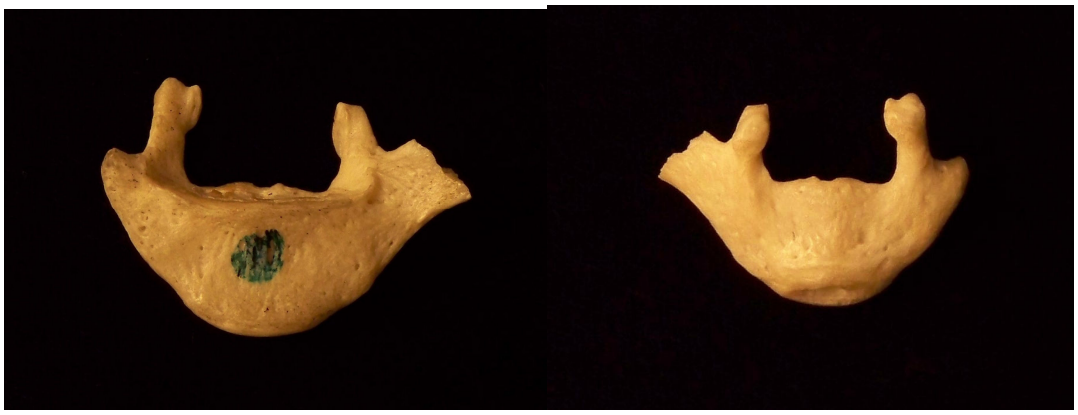
Lateral surface – Wings or ala

Coccyx

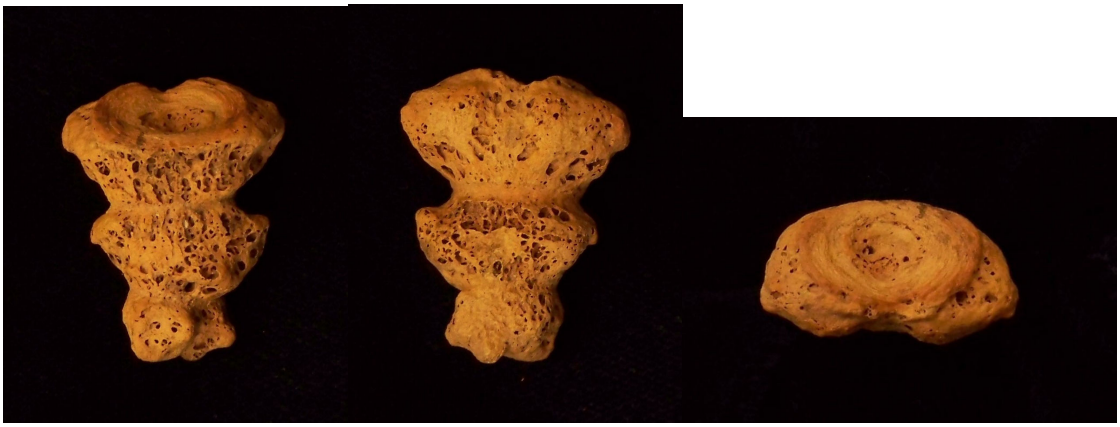
Four very small vertebrae found at the apex of the sacrum which are fused in adults, but are often absent in archaeological specimens. The corunae are the only landmarks seen on the coccyx, which are tubercles projecting superiorly from the body of the coccyx.

Sacrum. Top anterior and bottom posterior.

Sacrum. Lateral view.



Superior coccygeal body. Left view anterior and right view posterior.



Inferior coccygeal elements. Left view anterior, middle view posterior, right view superior articulation.

Superior and inferior coccygeal elements articulated.

Innominate

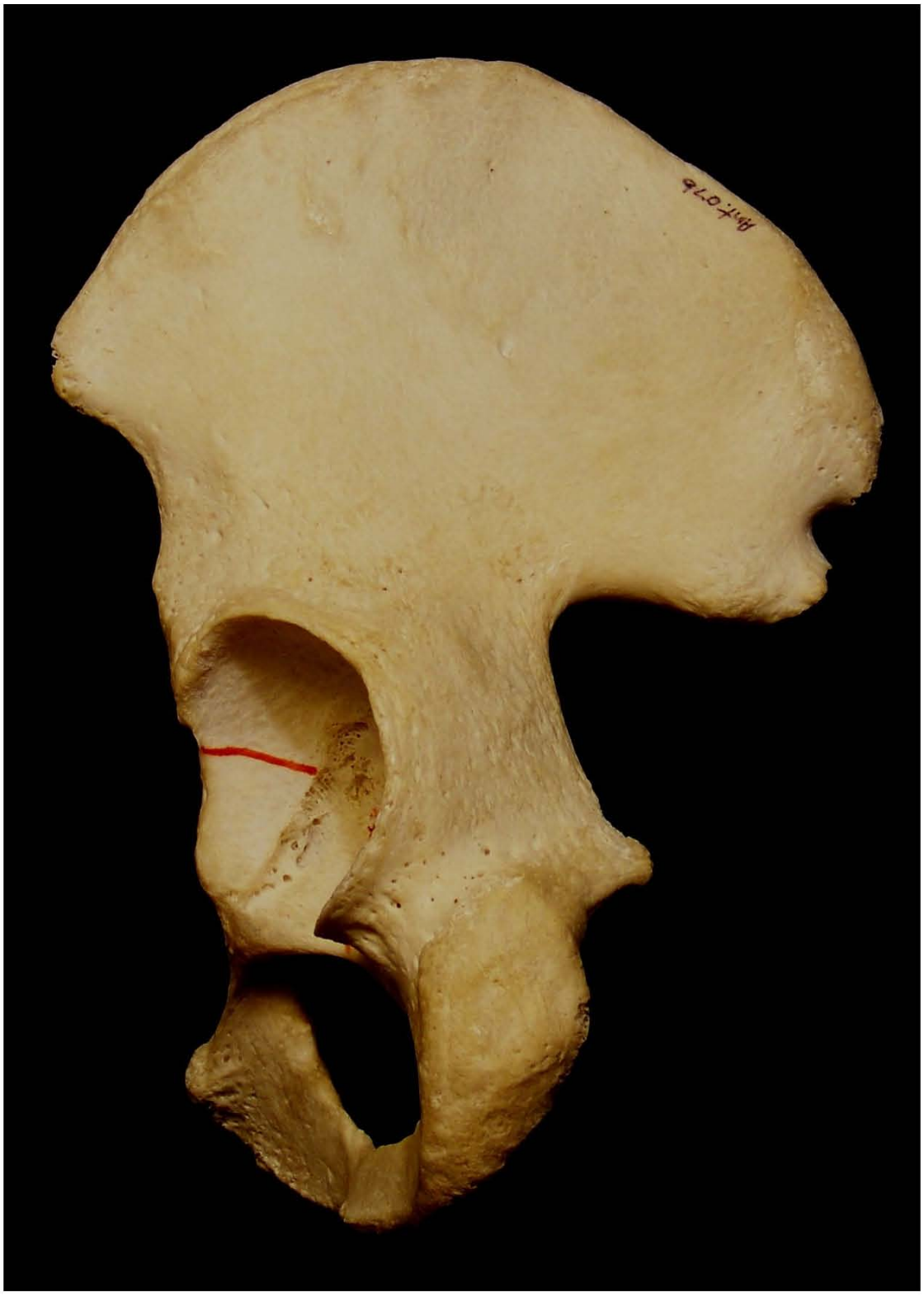
The innominate is made up of three bones which fuse late during the adolescent phase, including the ilium, ischium, and pubis. The bones fuse together at the center of the acetabulum, the fossa in which the femur articulates, each making up part of the articulation.

- Ilium
  - Iliac crest
  - Greater sciatic notch
  - Lesser sciatic notch
  - Iliac tuberosity
  - Preauricular sulcus
  - Auricular surface
  - Iliac fossa
  - Anterior superior and inferior spines
- Ischium
  - Ischial tuberosity
- Pubis
  - Pubic symphyses

Structures formed by the intersection of the three bones of the innominate:

- Obturator foramen
- Acetabulum
  - Lunate face
  - Fossa

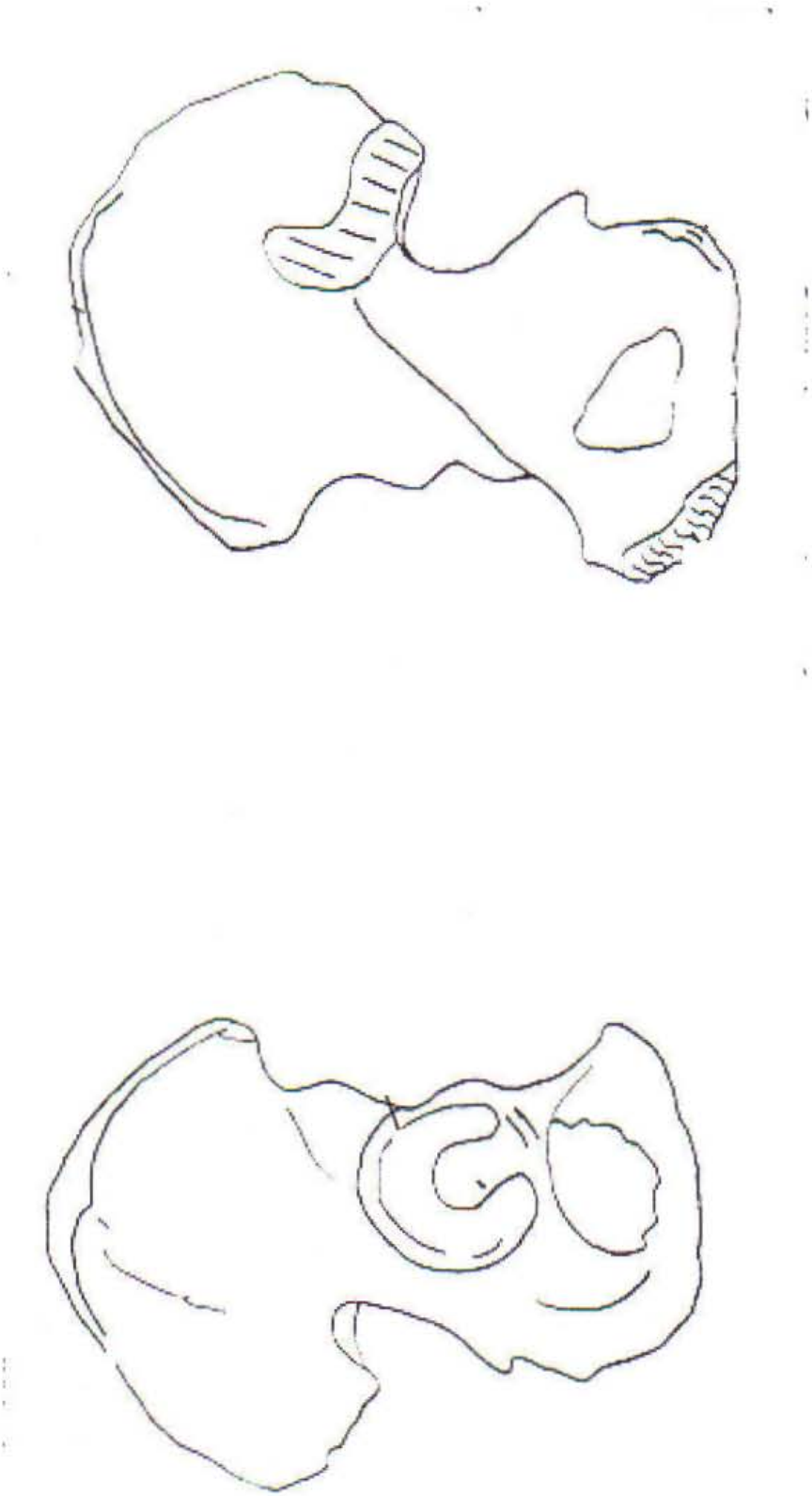
Innominate. Anterior view.



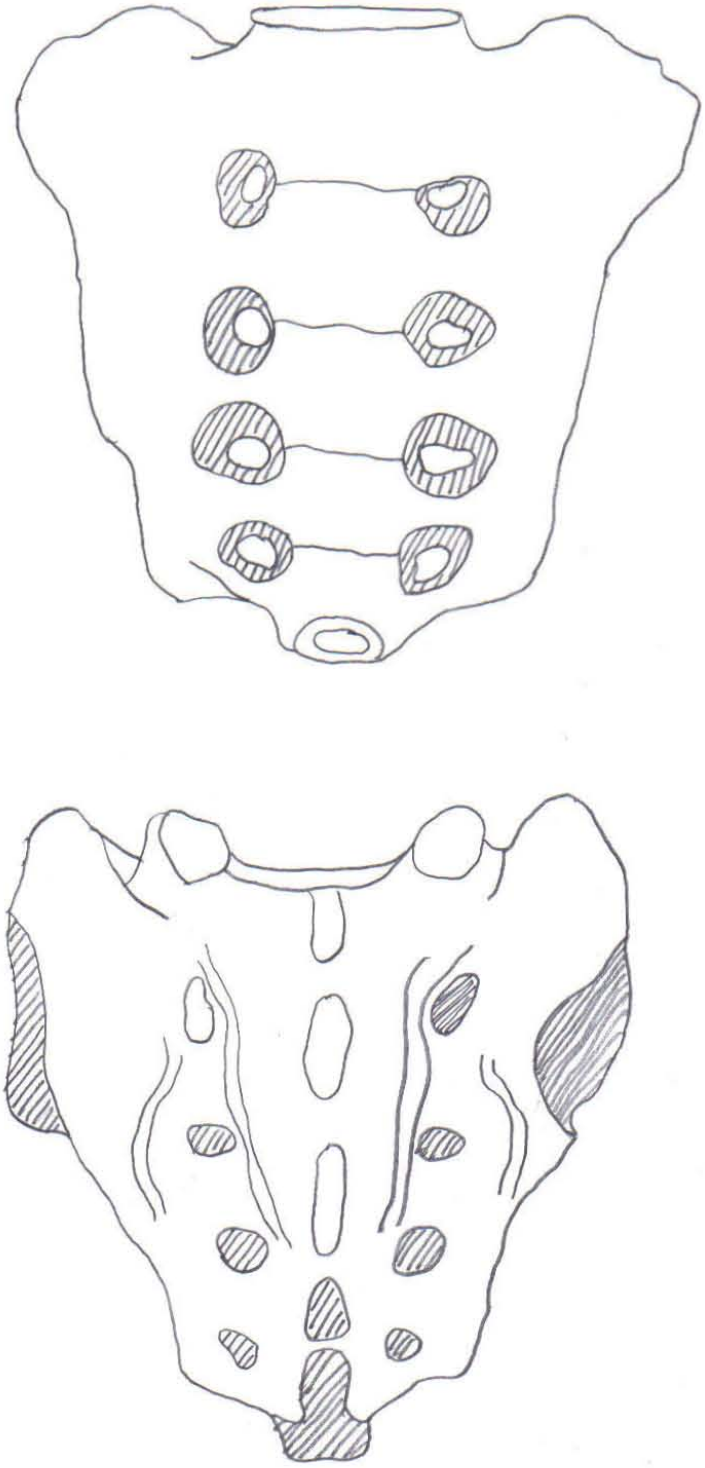
Innominate. Posterior view.

Non-Metric Traits of the Pelvic Girdle

Accessory iliac facet	Additional facet located on the iliac tuberosity in the area that articulates with the sacrum. May be unilateral or bilateral.
Accessory sacral facet	Additional facet located on the posterior aspect of the sacrum near the first sacral foramen. May be unilateral or bilateral.
Acetabular mark/notch	U-shaped depression located in the superior aspect of the acetabulum on the lunate surface. (Mann and Hunt 2005)



Innominate



Sacrum

Postcranial Measurements

For a complete list of standard postcranial measurements see Buikstra and Ubelaker (1994). Buikstra and Ubelaker (1994) have proposed a set of standard measurements and collection techniques to be employed by all practicing physical and forensic anthropologists to aid in data collection and comparison between researchers.

Aging of the Postcranium

Few options are available in aging the postcranium including epiphyseal union, bone measurements in infants, and degenerative change. Bone measurements exist for fetal material through approximately six years of age; see Johnston 1962 for further information. Degenerative change in the postcranium is similar to that seen in the articulation sites in the skull, with osteophytosis and erosion. Epiphyseal union can be extremely helpful in aging if no dentition is present or if you are working with a commingled burial. Presence, absence, and fusion of the epiphyses to the shaft of the bone is a relatively easy observation; see below for further information on aging using fusion of the epiphyses.

Epiphyseal Union

As a child an individual my have up to 600 separate bones, but by adulthood only 206 are present. This is due to the fact that there are both primary and secondary centers of ossification; as an individual ages the secondary centers will fuse to the primary centers. Below are some age estimates for when epiphyseal union occurs:

Clavicle	Sternal epiphysis fused by 25 years of age (Bass 1995)
Femur	Head and greater trochanter fused between 14-19 years of age (Bass 1995)
Fibula	Proximal epiphysis fused by 14-22 years of age Distal epiphysis fused by 11-20 years of age (Bass 1995)

Humerus	Head fused by age 24 years of age
	Medial epicondyle fused by age 19 years of age
	Distal epiphysis fused between 17-18 years of age (McKern and Stewart 1957)
Iliac Crest	Fused by age 23 (McKern and Stewart 1957)
Innominate	Pubis to ischium fused between 7-8 years of age
	Fusion of the pubis/ischium/ilium at the acetabulum by at least 17 years of age (Bass 1995)
Ischial Tuberosity	Fused by age 24 (McKern and Stewart 1957)
Radius	Proximal epiphysis fused between 16-18 years of age
	Distal epiphysis fused between 16-18 years of age (Bass 1995)
Ribs	Head and articular end fused between 18-24 years of age (Bass 1995)
Sacrum	Fuses from inferior to superior between the ages of 18-25 (Bass 1995)
Tibia	Proximal epiphysis fused between 14-23 years of age
	Distal epiphysis fused between 13-20 years of age (Bass 1995)
Ulna	Proximal epiphysis fused by 19 years of age
	Distal epiphysis fused between 17-20 years of age (Bass 1995)

Sex Estimation of the Pelvis

The pelvis is an ideal anatomical structure to use in sex estimations of adult specimens, because of the obvious functional relationship between pelvic shape and reproduction in the female. Many studies have been done to determine pelvic characteristics useful in sex estimations. The most easily identified indicators will be mentioned in this text. The first two are generally the most useful, especially for the budding osteologist. Clearly, the more experience an osteologist has in making sex estimations and the greater number and range of pelves examined, the better the estimations will be.

1. Sub-pubic angle. The inferior angle that the right and left pubic bones make when in articulation tend to be wider in females than in males; a wider angle produces a larger pelvic outlet. Angles closer to 90 degrees suggest male sex, while those 120 degrees and over would suggest a female. The female pelvis is shorter and broad to aid in the birthing process, since the male pelvis lacks this necessity it is slightly taller and more narrow.

2. Sciatic notch. A narrow sciatic notch is associated with a restricted pelvic outlet and is more commonly found in males; the sciatic notch of females tends to be wider.

3. Acetabulum. The acetabulum is larger in males, due to the larger size of the femoral head in males. As males are generally larger, the femur is larger to transmit the weight of the body.

4. Obturator foramen. The obturator foramen tends to be larger in males and rather oval in outline, whereas in females it is smaller and more triangular.

5. Pre-auricular groove. The pre-auricular groove is found in some individuals of both sexes but it tends to be irregularly pitted in females if the pelvic joint ligaments that attach there are stressed in childbirth, thus a pitted pre-auricular groove indicates an estimation of female sex. However, an absence of the groove or a non-pitted form does not indicate male sex.

6. Sacrum. The sacrum of the male tends to be relatively longer, narrow, and curved. On the other hand, the female sacrum is broader, short, and straight.

7. Pelvic inlet. The pelvic inlet of the male pelvis, when viewed from above with the ventral aspect facing you, will be heart shaped in appearance. The female pelvic inlet, when held in the same aspect, is described as elliptical in appearance.

8. Dorsal pitting. Pits or depressions located on the dorsal aspect of the pubis, near the pubic symphysis. One or more may be present. The pits have been associated with pregnancy; number or pits does not necessarily represent number of births but the process of stretching during the birthing process.

Sex Estimation of the Non-Pelvic Postcranial Bones

Sex estimation of the non-pelvic postcranial bones can be very difficult, based on research with accuracy well below 90%. Keep this in mind when employing sex estimation on these bones. However, if observing several of the bones of a single individual you will greatly increase your sex estimation accuracy. Those listed below offer the highest levels of accuracy.

Humerus – A vertical (superior/inferior) measurement of the head, and a transverse (anterior/posterior) measurement of the head can be used in sexing.

	Vertical	Transverse
Female	42.67	36.98
Male	48.76	44.66

Femur – A measurement of the greatest diameter of the femoral head may be useful in determining sex. Keep in mind there may be populational differences.

	Female	Probable Female
White Female[a]	<42.5	42.5-43.5
Black Female*	41.52	

	Male	Probable Male
White Male[a]	>47.5	46.5-47.5
Black Male*	47.17	

[a] Stewart 1979:120

*Thieme 1957: Table 1

Stature Estimation

Stature or height can be measured using any of the long bones, although the femora are considered the best option for obtaining the highest accuracy rate. A number of factors appear to influence height including sex, nutrition, geographic location, and genetics. It is suggested that stature formulae specific to sex and a particular geographic location or ethnic group be used to ensure accuracy. Below several formulae are shown after Bass (1995):

Male

Femur	White	2.32(femur in cm) + 65.53 +/- 3.94
	Black	2.10(femur in cm) + 72.22 +/- 3.91
	Mongoloid	2.15(femur in cm) + 72.57 +/- 3.80
	Mexican	2.44(femur in cm) + 58.67 +/- 2.99
Tibia	White	2.42(tibia in cm) + 81.93 +/- 4.00
	Black	2.19(tibia in cm) + 85.36 +/- 3.96
	Mongoloid	2.39(tibia in cm) + 81.45 +/- 3.27
	Mexican	2.36(tibia in cm) + 80.82 +/- 3.73
Fibula	White	2.60(fibula in cm) + 75.50 +/- 3.86
	Black	2.34(fibula in cm) + 80.07 +/- 4.02
	Mongoloid	2.40(fibula in cm) + 80.56 +/- 3.42
	Mexican	2.50(fibula in cm) + 75.44 +/- 3.52
Humerus	White	2.89(humerus in cm) + 78.10 +/- 4.57
	Black	2.88(humerus in cm) + 75.48 +/- 4.23
	Mongoloid	2.68(humerus in cm) + 83.19 +/- 4.16
	Mexican	2.92(humerus in cm) + 73.94 +/- 4.24
Radius	White	3.79(radius in cm) + 79.42 +/- 4.66
	Black	3.32(radius in cm) + 85.43 +/- 4.57
	Mongoloid	3.54(radius in cm) + 82.00 +/- 4.60
	Mexican	3.55(radius in cm) + 80.71 +/-4.04

Ulna		
	White	3.76(ulna in cm) + 75.55 +/-4.72
	Black	3.20(ulna in cm) + 82.77 +/-4.74
	Mongoloid	3.48(ulna in cm) + 77.45 +/- 4.66
	Mexican	3.56(ulna in cm) + 74.56 +/- 4.05

Female

Femur*	White	2.47(femur in cm) + 54.10 +/- 3.72
	Black	2.28(femur in cm) + 59.76 +/- 3.41
Tibia*	White	2.90(tibia in cm) + 61.53 +/- 3.66
	Black	2.45(tibia in cm) + 72.65 +/- 3.70
Fibula*	White	2.93(fibula in cm) + 59.61 +/- 3.57
	Black	2.49(fibula in cm) + 70.90 +/- 3.80
Humerus*	White	3.36(humerus in cm) + 57.97 +/- 4.45
	Black	3.08(humerus in cm) + 64.67 +/- 4.25
Radius*	White	4.74(radius in cm) + 54.93 +/-4.45
	Black	3.67(radius in cm) + 71.79 +/-4.59
Ulna*	White	4.27(ulna in cm) + 57.76 +/-4.30
	Black	3.31(ulna in cm) + 75.38 +/- 4.83

*After Trotter and Gleser (1952:495, 1977:355)

Post-Cranial Pathology and Trauma

Arthritis/Degenerative Joint Disease - Arthritis can be caused by a number of different factors both genetic and behavioral. Age of the individual should be noted to make the best possible diagnosis of type of arthritis observed. Osteophytes or small spicules of bone may be present at the margins of the joint or within the joint itself. A ridge of osteophytic change may also be present around the margin of the joint. Erosion is frequently seen along with osteophytosis; which may be seen as increased porosity or pitting.

Eburnation – Extreme erosion may occur when the soft tissue within a joint when cartilage is no longer present. The result is bone on bone contact that creates grooving on the surface of the joint, overall making a smooth shiny surface. (Aufderheide and Rodriguez-Martin 1998)

Enthesopathy – Calcified muscular or ligamentous attachments. Most often seen at the site of the Achilles tendon attachment site, ischial tuberosities,and ilial crests. (Aufderheide and Rodriguez-Martin 1998)

Fractures – Several types of fractures occur in the postcranial bones including, greenstick, impacted, simple, compound, comminuted, compressed, spiral, Colles's, and parry.

Schmorl's Nodes - Depression or cavity caused by herniation of the vertebral disc. Located on either the superior or inferior aspect of the body of a vertebra. The depressions are oval or linear in shape, with relatively smooth margins. Generally seen as a sign of advanced age. (Mann and Hunt 2005)

Spina Bifida - Incomplete closure of the neural arches of the sacral vertebrae. Note that the sacral vertebrae four and five may be open naturally. This condition is both genetic and environmentally controlled. (Mann and Hunt 2005)

Dentition

Two parts make up the structure of teeth: a portion within the mouth called the crown, and a portion within the jaw called the root. The outer surface of the crown seen in the mouth is a hard white substance called enamel. Directly beneath the enamel is a softer material called dentine. The central portion of the root contains the pulp or nerve bundle feeding the tooth, called the pulp chamber. The root itself is made of dentine and is covered on the outside with a protective substance called dentine.

Observe the crowns of the teeth as seen while in the jaw. Note that the number of teeth is the same in both the upper and lower jaw. There are four types of teeth present in the upper and lower jaw: 4 incisors, 2 canines, 4 premolars, and 6 molars for a total of 32 teeth. For comparative purposes in the study of evolutionary change, it is customary to represent the dentition by the number of teeth in each quadrant of the mouth, as 2.1.2.3.

The incisors are generally chisel-shaped, though some persons including most American Indians many have lateral ridges making them shovel-shaped (particularly the upper incisors). The upper incisors are generally wider than the lowers. The canines are more massive than incisors and when unworn are slightly projecting and pointed. Due to the narrowness of the lower incisors the lower canine usually occludes slightly forward of the upper one. The premolar or bicuspid teeth are distinguished by 2 cusps, one lingual (on the tongue side) and one buccal (on the cheek side). In the molar teeth a distinction may be made between uppers and lowers. The lower molars are square or rectangular in shape, with 4-5 cusps. The more anterior of these are generally larger decreasing posteriorly and have a more complicated cusp pattern. The upper molars are in general smaller than the lowers, and also decrease in size posteriorly. Three to four cusps are generally seen in the upper molars; if three are present, two will be on the buccal side and one on the lingual. In addition, the outline of the upper molar tends to be slightly oblique rather than rectilinear as in the lowers.

Roots of the teeth are also helpful in determining if they are uppers/lowers and siding. The roots of the incisors and canines are single, rounded, and tapering, often curved at the ends. That of the canine is considerably longer and stouter than those of the

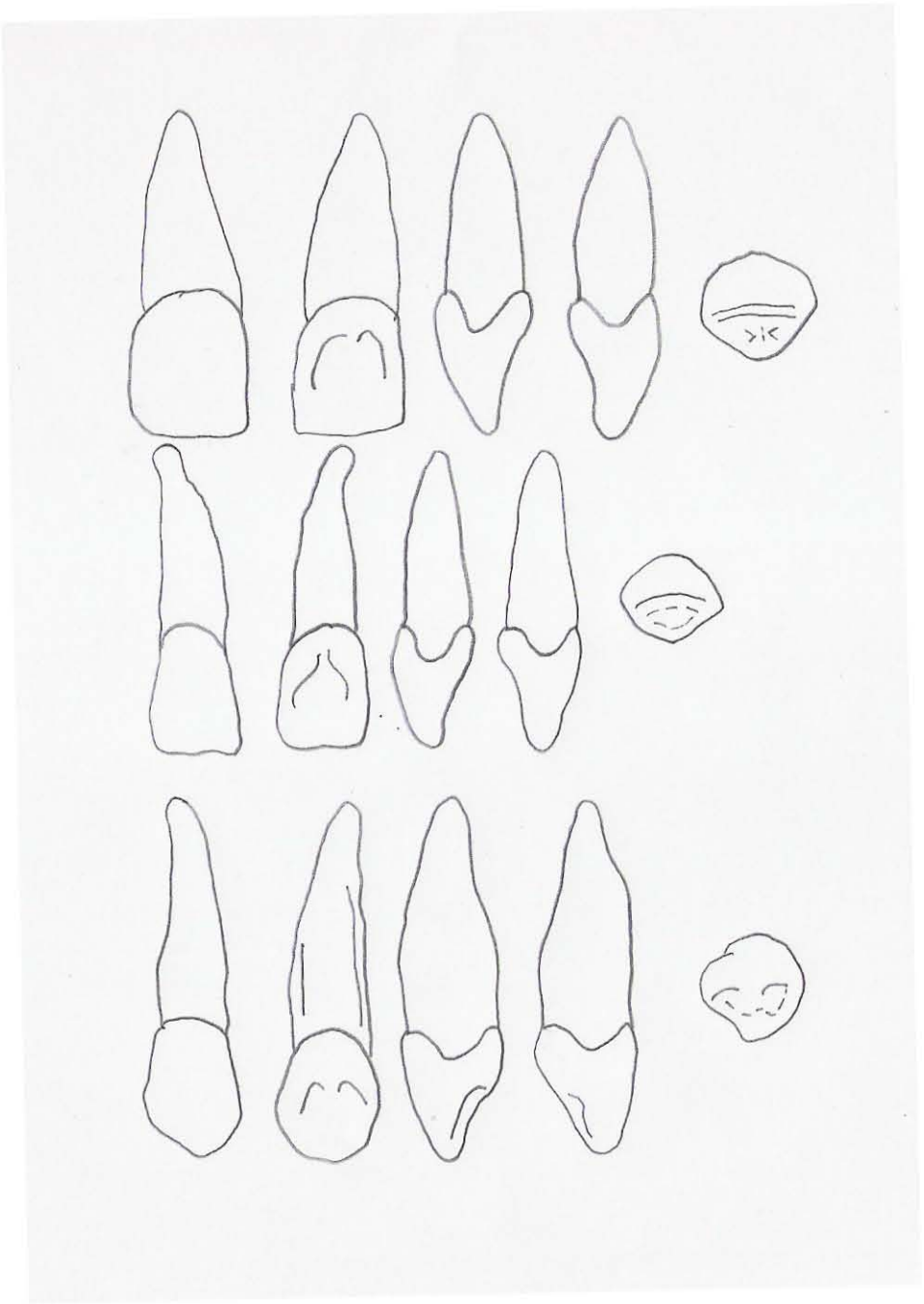
incisors. The roots of the premolars are wider and tend to be grooved in a fashion which indicates an incipient tendency to be divided into a lingual and buccal root. The roots of the molar teeth are quite distinct as between the upper and lower. The roots of the lower molars are double, having an anterior and posterior component, each generally grooved like the root of a premolar. The third lower molar generally has all parts of the root fused and somewhat curved. The typical root pattern of the upper molar is two distinct roots on the buccal side and one on the lingual side. In the second upper molar the three roots are often less widely spread than in the first, and in the third a single massive fused root is found. Individual variations make it difficult to identify loose molars exactly.

Many types of variation, often involving accessory cusps are found. Occasionally deciduous teeth will be encountered. In addition to having smaller crowns, deciduous teeth are recognized by the thinness and wide divergence of the molar roots.

Teeth of non-industrial peoples are often deeply worn, as more processing of food occurs within the mouth. The type of wear seen in the dentition and the kind of pathology present give an indication of the diet and the cultural habits of the individual. Microscopic study of sections taken through the teeth can provide additional information about the individual's health and nutritional status.

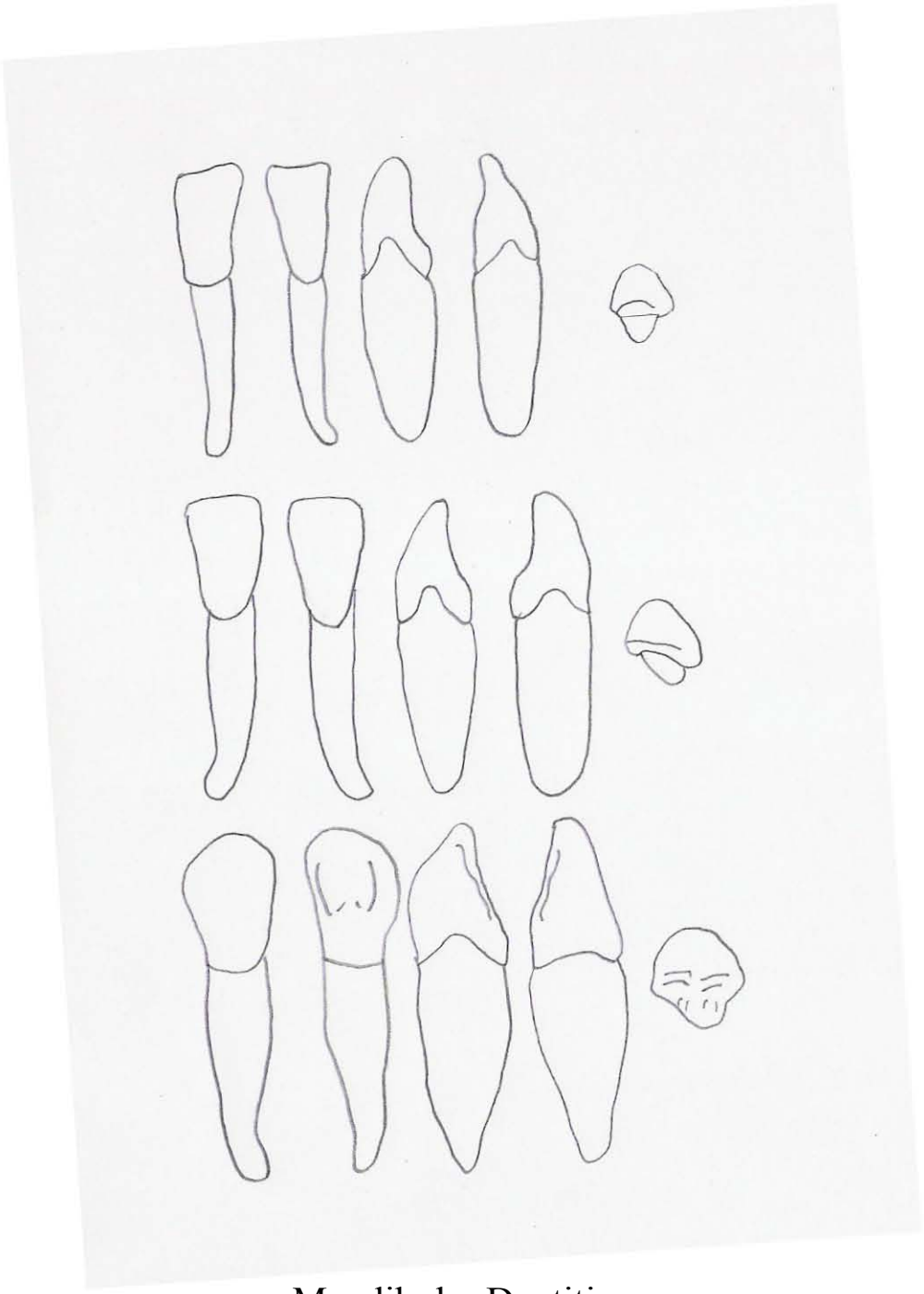
Terms

Buccal – The surfaces of the premolars and molars facing toward the cheek.
Cusp – A protuberance on the grinding surface of the canine, pre-molar, or molar.
Distal – The tooth surface farthest from the median line of the dental arch (posterior aspect).
Incisal edge – The cutting edge of an incisor.
Labial – The surfaces of the incisors and canines facing toward the lips.
Lingual – The tooth surfaces facing toward the tongue.
Mesial – The tooth surface closest to the median line of the dental arch (anterior aspect).
Occlusal surface – The biting or grinding surface of a tooth.
Ridge – A linear elevation on a tooth surface.



Maxillary Dentition

Top – central incisor. Middle – lateral incisor. Bottom – canine.



Mandibular Dentition

Top – central incisor. Middle – lateral incisor. Bottom – canine.

Top – maxillary premolar 1

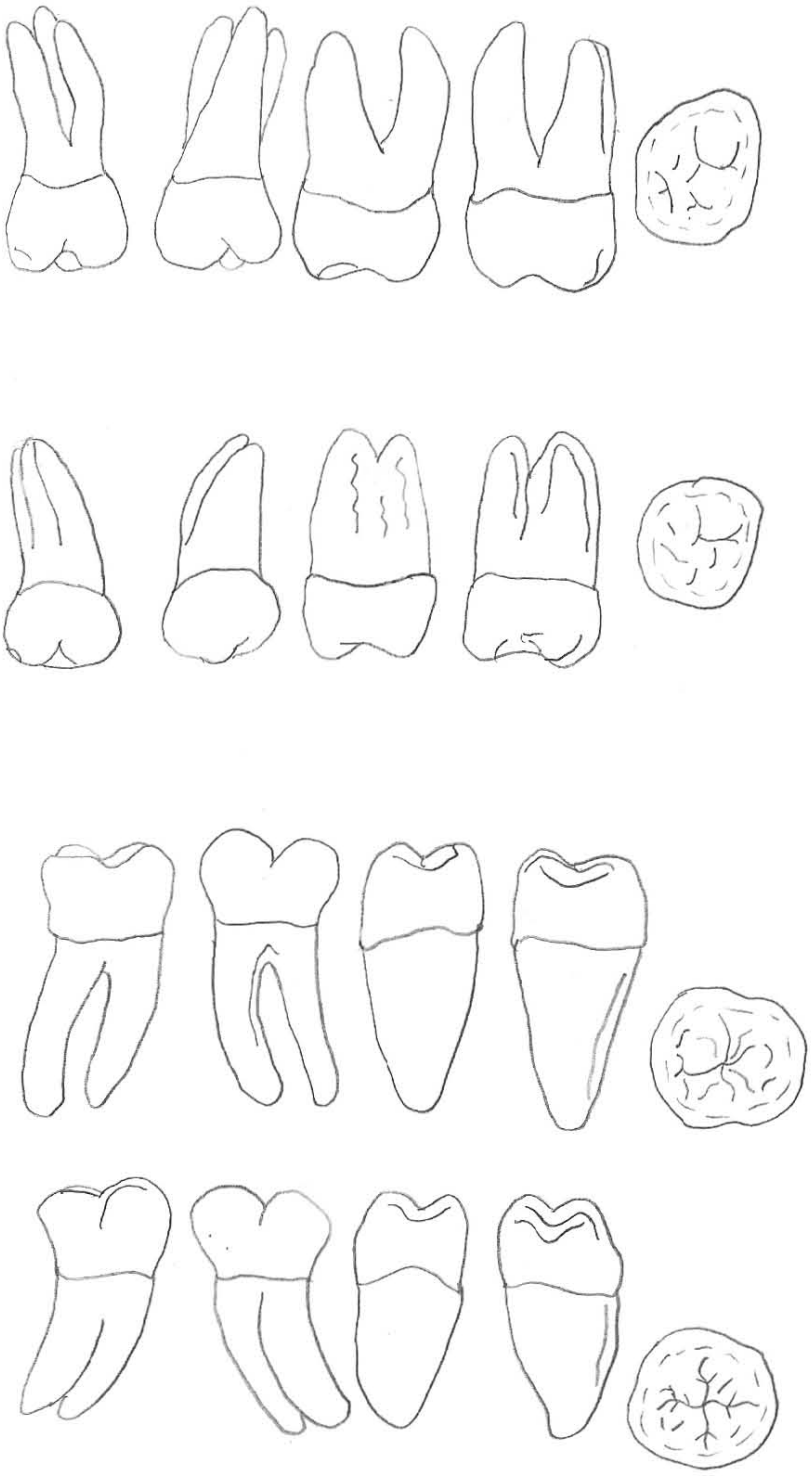
Middle – maxillary premolar 2

Bottom – maxillary molar 1

Top – mandibular premolar 1

Middle – mandibular premolar 2

Bottom – maxillary molar 1



Top – Upper Molars 2 & 3 Bottom – Lower Molars 2 & 3

Dental Variation

Carabelli's cusp – Additional cusp on the mesio-lingual border of the upper molars. Seen at the highest frequency among those of European descent. (Hillson 1996)

Enamel extension – Found on teeth with multiple roots, enamel extends down the root. Most commonly found in upper premolars and molars. (Hillson 1996)

Enamel pearl – Found in association with enamel extensions, except the enamel forms a small nodule. Most commonly found in upper second and third molars. (Hillson 1996)

Shovel-shaped incisors – The marginal ridges on the lingual aspect of the incisor are prominent with a deep central fossa. If on the lingual and labial surface this is termed double shoveling.

Supernumerary – Additional teeth, may be seen at multiple locations within the maxillary or mandibular alveoli. These teeth may be peg shaped.

For more information on non-metric dental variation see Hillson's (1996) Dental Anthropology or Turner et al. (1991) for an introduction to the series of dental casts of several non-metric traits available through Arizona State University.

Dental Pathology

Abscess – Cavitations in the bone surrounding the tooth root, resulting in the loss of a tooth and eventually absorption of the bone.

Caries – Destruction of one of the three dental structures (enamel, dentine, or cementum), caused by bacteria in the mouth. These may be located on the occlusal surface, smooth surface, within the pulp chamber, at the cemento-enamel junction, or on the root. May be seen as a brown spot in the early phase, followed by creation of a cavity within the affected structure.

Dental enamel hypoplasia – Defect in the enamel of the tooth caused due to developmental issues during secretion of the structure. May cause bands of varying thickness around the circumference of the tooth; also seen in the form of pitting. Thought to be associated with a number of physiological stressors including but not limited to malnutrition, parasites, and weaning.

References

Aufderheide, A.C. and C. Rodriguez-Martin
1998 *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge University Press, Cambridge.

Bass, W.M.
1995 *Human Osteology: A Laboratory and Field Manual, 4th Edition*. Missouri Archaeological Society, Inc, Columbia.

Brothwell, D.R.
1965 *Digging Up Bones*. Cornell University Press, New York.

Buikstra, J.E. and D.H. Ubelaker
1994 *Standards for Data Collection from Human Skeletal Remains*. Arkansas Archeological Survey Research Series No. 44. Arkansas Archeological Survey, Fayetteville.

Hillson, S.
1998 *Dental Anthropology*. Cambridge University Press, Cambridge.

Johnston, F.E.
1962 Growth of the Long Bones of Infants and Young Children at Indian Knoll. *Human Biology* 23:66-81.

Mann and Hunt
2005 *Photographic Regional Atlas of Bone Disease: A Guide to Pathologic and Normal Variation in the Human Skeleton.* Charles C. Thomas, Springfield.

McKern, T.W. and T.D. Stewart
1957 Skeletal Age Changes in Young American Males. *U.S. Army Quartermaster Research and Development Command, Technical Report* EP-45.

Moorrees, C.F.A., E.A. Fanning, and E.E. Hunt, Jr.
1963 Formation and Resorption of Three Deciduous Teeth in Children. *American Journal of Physical Anthropology 21*:205-213.

Stewart, T.D.
1979 *Essentials of Forensic Anthropology*. Thomas, Springfield.

Thieme, F.P.
1957 Sex in Negro Skeletons. *Journal of Forensic Medicine* 4:72-81.

Trotter, M. and G.C. Gleser
1952 Estimation of Stature from Long Bones of American Whites and Negroes. *American Journal of Physical Anthropology* 10:463-514.
1977 Corrigenda to "Estimation of Stature from Long Limb Bones of American Whites and Negroes." *American Journal of Physical Anthropology* 47:355-356.

Turner, C.G., C.R. Nichol, and G.R. Scott
1991 Scoring Procedures for Key Morphological Traits of the Permanent Dentition: The Arizona State University Dental Anthropology System. In *Advances in Dental Anthropology*, edited by M.A. Kelley and C.S. Larsen, pp. 13-31. Wiley-Liss, Inc, New York.

White, T.D.
2000 *Human Osteology*. Academic Press, San Diego.