THE CARPUS

is the lower end; and at the fifth year, in the upper end. The upper epiphysis fuses with the body at the age of seventeen or eighteen years, the lower about the age of twenty. An additional center sometimes found in the radial tuberosity, appears about the fourteenth or fifteenth year.

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THE HAND.

The skeleton of the hand (Figs. 219, 220) is subdivided into three segments: the carpus or wrist bones; the metacarpus or bones of the palm; and the phalanges or bones of the digits.

The Carpus (Ossa Carpi).

The carpal bones, eight in number, are arranged in two rows. Those of the proximal row, from the radial to the ulnar side, are named the navicular, lunate, triangular, and pisiform; those of the distal row, in the same order, are named the greater multangular, lesser multangular, capitate, and hamate.

Common Characteristics of the Carpal Bones. Each bone (excepting the pisiform) presents six surfaces. Of these the solar or anterior and the dorsal or posterior surfaces are rough, for ligamentous attachment; the dorsal surfaces being the broader, except in the navicular and lunate. The superior or proximal, and inferior or distal surfaces are articular, the superior generally convex, the inferior concave; the medial and lateral surfaces are also articular where they are in contact with contiguous bones, otherwise they are rough and tuberculated. The structure in all is similar, viz., cancellous tissue enclosed in a layer of compact bone.

Bones of the Proximal Row (upper row). — The Navicular Bone (os naviculare manus; scaphoid bone) (Fig. 221).—The navicular bone is the largest bone of the proximal row, and has received its name from its fancied resemblance to a boat. It is situated at the radial side of the carpus, its long axis being from above downward, lateralward, and forward. The superior surface is convex, smooth, of triangular shape, and artic-
ulates with the lower end of the radius. The interior surface, directed downward, lateralward, and backward, is also smooth, convex, and triangular, and is divided by a slight ridge into two parts, the lateral articulating with the greater multangular, the medial with the lesser multangular. On the dorsal surface is a narrow, rough groove, which runs the entire length of the bone, and serves for the attachment of ligaments. The volar surface is concave above, and elevated at its lower and lateral part into a rounded projection, the tubercle, which is directed forward.
and gives attachment to the transverse carpal ligament and sometimes origin to a few fibers of the Abductor pollicis brevis. The lateral surface is rough and narrow, and gives attachment to the radial collateral ligament of the wrist. The medial surface presents two articular facets; of these, the superior or smaller is flattened of semilunar form, and articulates with the lunate bone; the inferior or larger is concave, forming with the lunate a concavity for the head of the capitate bone.
Articulations.—The navicular articulates with five bones: the radius proximally, greater and lesser multangular distally, and capitate and lunate medially.

The Lunate Bone (os lunatum; semilunar bone) (Fig. 222).—The lunate bone may be distinguished by its deep concavity and crescentic outline. It is situated in the center of the proximal row of the carpus, between the navicular and triangular. The superior surface, convex and smooth, articulates with the radius. The inferior surface is deeply concave, and of greater extent from before backward than transversely: it articulates with the head of the capitate, and, by a long, narrow facet (separated by a ridge from the general surface), with the hamate. The dorsal and volar surfaces are rough, for the attachment of ligaments, the former being the broader, and of a somewhat rounded form. The lateral surface presents a narrow, flattened, semilunar facet for articulation with the navicular. The medial surface is marked by a smooth, quadrilateral facet, for articulation with the triangular.

Articulations.—The lunate articulates with five bones: the radius proximally, capitate and hamate distally, navicular laterally, and triangular medially.

The Triangular Bone (os triquetrum; cuneiform bone) (Fig. 223).—The triangular bone may be distinguished by its pyramidal shape, and by an oval isolated facet for articulation with the pisiform bone. It is situated at the upper and ulnar side of the carpus. The superior surface presents a medial, rough, non-articular portion, and a lateral convex articular portion which articulates with the triangular articular disk of the wrist. The inferior surface, directed lateralward, is concave, sinusously curved, and smooth for articulation with the hamate. The dorsal surface is rough for the attachment of ligaments. The volar surface presents, on its medial part,
THE CARPUS

225

an oval facet, for articulation with the pisiform; its lateral part is rough for ligamentous attachment. The lateral surface, the base of the pyramid, is marked by a flat, quadrilateral facet, for articulation with the lunate. The medial surface, the summit of the pyramid, is pointed and roughened, for the attachment of the ulnar collateral ligament of the wrist.

Articulations.—The triangular articulates with three bones: the lunate laterally, the pisiform is front, the hamate distally; and with the triangular articular disk which separates it from the lower end of the ulna.

The Pisiform Bone (as pisiforme) (Fig. 224).—The pisiform bone may be known by its small size, and by its presenting a single articular facet. It is situated on a plane anterior to the other carpal bones and is spheroidal in form. Its dorsal surface presents a smooth, oval facet, for articulation with the triangular; this facet approaches the superior, but not the inferior border of the bone. The volar surface is rounded and rough, and gives attachment to the transverse carpal ligament, and to the Flexor carpi ulnaris and Abductor digiti quinti. The lateral and medial surfaces are also rough, the former being concave, the latter usually convex.

Articulation.—The pisiform articulates with one bone, the triangular.

Bones of the Distal Row (lower row).—The Greater Multangular Bone (as multangulum majus; trapezium) (Fig. 225).—The greater multangular bone may be distinguished by a deep groove on its volar surface. It is situated at the radial side of the carpus, between the navicular and the first metacarpal bone. The superior surface is directed upward and medially; medially it is smooth, and articulates with the navicular; laterally it is rough and continuous with the lateral surface. The inferior surface is oval, concave from side to side, convex from before backward, so as to form a saddle-shaped surface for articulation with the base

of the first metacarpal bone. The dorsal surface is rough. The volar surface is narrow and rough. At its upper part is a deep groove, running from above obliquely downward and mediallyward; it transmits the tendon of the Flexor carpi radialis, and is bounded laterally by an oblique ridge. This surface gives origin to the Opponens pollicis and to the Abductor and Flexor pollicis brevis; it also affords attachment to the transverse carpal ligament. The lateral surface is broad and rough, for the attachment of ligaments. The medial surface presents two facets; the upper, large and concave, articulates with the lesser multangular; the lower, small and oval, with the base of the second metacarpal.

Articulations.—The greater multangular articulates with four bones: the navicular proximally, the first metacarpal distally, and the lesser multangular and second metacarpal medially.

The Lesser Multangular Bone (as multangulum minus; trapezoid bone) (Fig. 226).—The lesser multangular is the smallest bone in the distal row. It may be known by its wedge-shaped form, the broad end of the wedge constituting the dorsal, the narrow end the volar surface; and by its having four articular facets touching each other, and separated by sharp edges. The superior surface, quadrilateral,
smooth, and slightly concave, articulates with the navicular. The **interior surface** articulates with the proximal end of the second metacarpal bone; it is convex from side to side, concave from before backward and subdivided by an elevated ridge into two unequal facets. The **dorsal** and **volar surfaces** are rough for the attachment of ligaments, the former being the larger of the two. The **lateral surface**, convex and smooth, articulates with the greater multangular. The **medial surface** is concave and smooth in front, for articulation with the capitate; rough behind, for the attachment of an interosseous ligament.

**Articulations.**—The lesser multangular articulates with four bones: the navicular proximally, second metacarpal distally, greater multangular laterally, and capitate medially.

**The Capitate Bone** (*as capitatum; as magnum*) (Fig. 227).—The capitate bone is the largest of the carpal bones, and occupies the center of the wrist. It presents, above, a rounded portion or head, which is received into the concavity formed by the navicular and lunate; a constricted portion or neck; and below this, the body. The **superior surface** is round, smooth, and articulates with the lunate. The **interior surface** is divided by two ridges into three facets, for articulation with the second, third, and fourth metacarpal bones, that for the third being the largest. The **dorsal surface** is broad and rough. The **volar surface** is narrow, rounded, and rough, for the attachment of ligaments and a part of the Adductor pollicis obliquus.

**The lateral surface** articulates with the lesser multangular by a small facet at its anterior inferior angle, behind which is a rough depression for the attachment of an interosseous ligament. Above this is a deep, rough groove, forming part of the neck, and serving for the attachment of ligaments; it is bounded superiorly by a smooth, convex surface, for articulation with the navicular. The **medial
surface articulates with the hamate by a smooth, concave, oblong facet, which occupies its posterior and superior parts; it is rough in front, for the attachment of an interosseous ligament.

Articulations.—The capitate articulates with seven bones: the navicular and lunate proximally, the second, third, and fourth metacarpals distally, the lesser multangular on the radial side, and the hamate on the ulnar side.

The Hamate Bone (os hamatum; unciniform bone) (Fig. 228).—The hamate bone may be readily distinguished by its wedge-shaped form, and the hook-like process which projects from its volar surface. It is situated at the medial and lower angle of the carpus, with its base downward, resting on the fourth and fifth metacarpal bones, and its apex directed upward and lateralward. The superior surface, the apex of the wedge, is narrow, convex, smooth, and articulates with the lunate. The interior surface articulates with the fourth and fifth metacarpal bones, by concave facets which are separated by a ridge. The dorsal surface is triangular and rough for ligamentous attachment. The volar surface presents, at its lower and ulnar side, a curved, hook-like process, the hamulus, directed forward and lateralward. This process gives attachment, by its apex, to the transverse carpal ligament and the Flexor carpi ulnaris; by its medial surface to the Flexor brevis and Opponens digiti quinti; its lateral side is grooved for the passage of the Flexor tendons into the palm of the hand. It is one of the four eminences on the front of the carpus to which the transverse carpal ligament of the wrist is attached; the others being the pisiform medially, the oblique ridge of the greater multangular and the tubercle of the navicular laterally. The medial surface articulates with the triangular bone by an oblong facet, cut obliquely from above, downward and medialward. The lateral surface articulates with the capitate by its upper and posterior part, the remaining portion being rough, for the attachment of ligaments.

Articulations.—The hamate articulates with five bones: the lunate proximally, the fourth and fifth metacarpals distally, the triangular medially, the capitate laterally.

The Metacarpus.

The metacarpus consists of five cylindrical bones which are numbered from the lateral side (ossa metacarpalia I–V); each consists of a body and two extremities.

Common Characteristics of the Metacarpal Bones.—The Body (corpus; shaft).—The body is prismatic in form, and curved, so as to be convex in the longitudinal direction behind, concave in front. It presents three surfaces: medial, lateral, and dorsal. The medial and lateral surfaces are concave, for the attachment of the Interossei, and separated from one another by a prominent anterior ridge. The dorsal surface presents in its distal two-thirds a smooth, triangular, flattened area which is covered in the fresh state, by the tendons of the Extensor muscles. This surface is bounded by two lines, which commence in small tubercles situated on either side of the digital extremity, and, passing upward, converge and meet some distance above the center of the bone and form a ridge which runs along the rest of the dorsal surface to the carpal extremity. This ridge separates two sloping surfaces for the attachment of the Interossei dorsales. To the tubercles on the digital extremities are attached the collateral ligaments of the metacarpophalangeal joints.

The base or Carpal Extremity (basis) is of a cuboidal form, and broader behind than in front: it articulates with the carpus, and with the adjoining metacarpal bones; its dorsal and volar surfaces are rough, for the attachment of ligaments.

The head or Digital Extremity (capitulum) presents an oblong surface markedly convex from before backward, less so transversely, and flattened from side to side; it articulates with the proximal phalanx. It is broader, and extends farther up-
ward, on the volar than on the dorsal aspect, and is longer in the antero-posterior than in the transverse diameter. On either side of the head is a tubercle for the attachment of the collateral ligament of the metacarpophaangeal joint. The dorsal surface, broad and flat, supports the Extensor tendons; the volar surface is grooved in the middle line for the passage of the Flexor tendons, and marked on either side by an articule eminence continuous with the terminal articular surface.

Characteristics of the Individual Metacarpal Bones.—The First Metacarpal Bone (os metacarpale I; metacarpal bone of the thumb) (Fig. 229) is shorter and stouter than the others, diverges to a greater degree from the carpus, and its volar surface is directed toward the palm. The body is flattened and broad on its dorsal surface, and does not present the ridge which is found on the other metacarpal bones; its volar surface is concave from above downward. On its radial border is inserted the Opponens pollicis; its ulnar border gives origin to the lateral head of the first Interosseus dorsalis. The base presents a concavo-convex surface, for articulation with the greater-multangular; it has no facets on its sides, but on its radial side is a tubercle for the insertion of the Abductor pollicis longus. The head is less convex than those of the other metacarpal bones, and is broader from side to side than from before backward. On its volar surface are two articular eminences, of which the lateral is the larger, for the two sesamoid bones in the tendons of the Flexor pollicis brevis.

The Second Metacarpal Bone (os metacarpale II; metacarpal bone of the index finger) (Fig. 230) is the longest, and its base the largest, of the four remaining bones. Its base is prolonged upward and mediallyward, forming a prominent ridge. It presents four articular facets: three on the upper surface and one on the ulnar side. Of the facets on the upper surface the intermediate is the largest and is concave from side to side, convex from before backward for articulation with the lesser multangular; the lateral is small, flat and oval for articulation with the greater multangular; the medial, on the summit of the ridge, is long and narrow for articulation with the capitale. The facet on the ulnar side articulates with the third metacarpal. The Extensor carpi radialis longus is inserted on the dorsal surface and the Flexor carpi radialis on the volar surface of the base.

The Third Metacarpal Bone (os metacarpale III; metacarpal bone of the middle finger) (Fig. 231) is a little smaller than the second. The dorsal aspect of its base presents on its radial side a pyramidal eminence, the styloid process, which extends upward behind the capitale; immediately distal to this is a rough surface for the attachment of the Extensor carpi radialis brevis. The carpal articular facet is concave behind, flat in front, and articulates with the capitale. On the radial side is a smooth, concave facet for articulation with the second metacarpal, and on the ulnar side two small oval facets for the fourth metacarpal.

The Fourth Metacarpal Bone (os metacarpale IV; metacarpal bone of the ring finger) (Fig. 232) is shorter and smaller than the third. The base is small and quadrilateral; its superior surface presents two facets, a large one medially for articulation with the hamate, and a small one laterally for the capitale. On the radial side are two oval facets, for articulation with the third metacarpal; and on the ulnar side a single concave facet, for the fifth metacarpal.

The Fifth Metacarpal Bone (os metacarpale V; metacarpal bone of the little finger) (Fig. 233) presents on its base one facet on its superior surface, which is concavo-
convex and articulates with the hamate, and one on its radial side, which articulates with the fourth metacarpal. On its ulnar side is a prominent tubercle for the insertion of the tendon of the Extensor carpi ulnaris. The dorsal surface of the body is divided by an oblique ridge, which extends from near the ulnar side of the base to the radial side of the head. The lateral part of this surface serves for the attachment of the fourth Interosseous dorsalis; the medial part is smooth, triangular, and covered by the Extensor tendons of the little finger.

Articulations.—Besides their phalangeal articulations, the metacarpal bones articulate as follows: the first with the greater multangular; the second with the greater multangular, lesser multangular, capitate and third metacarpal; the third with the capitate and second and fourth metacarpals; the fourth with the capitate, hamate, and third and fifth metacarpals; and the fifth with the hamate and fourth metacarpal.
The Phalanges of the Hand (Phalanges Digitorum Manus).

The phalanges are fourteen in number, three for each finger, and two for the thumb. Each consists of a body and two extremities. The body tapers from above downward, is convex posteriorly, concave in front from above downward, flat from side to side; its sides are marked by rough ridges which give attachment to the fibrous sheaths of the Flexor tendons. The proximal extremities of the bones of the first row present oval, concave articular surfaces, broader from side to side than from before backward. The proximal extremity of each of the bones of the second and third rows presents a double concavity separated by a median ridge. The distal extremities are smaller than the proximal, and each ends in two condyles separated by a shallow groove; the articular surface extends farther on the volar than on the dorsal surface, a condition best marked in the bones of the first row.

The ungual phalanges are convex on their dorsal and flat on their volar surfaces; they are recognized by their small size, and by a roughened, elevated surface of a horseshoe form on the volar surface of the distal extremity of each which serves to support the sensitive pulp of the finger.

Articulations. — In the four fingers the phalanges of the first row articulate with those of the second row and with the metacarpals; the phalanges of the second row with those of the first and third rows, and the ungual phalanges with those of the second row. In the thumb, which has only two phalanges, the first phalanx articulates by its proximal extremity with the metacarpal bone and by its distal with the ungual phalanx.

Ossification of the Bones of the Hand. — The carpal bones are each ossified from a single center, and ossification proceeds in the following order (Fig. 234): in the capitate and hamate, during
THE HIP BONE

The first year, the former preceding the latter; in the triangular, during the third year; in the humate and greater multangular, during the fifth year, the former preceding the latter; in the navicular, during the sixth year; in the lesser multangular, during the eighth year; and in the pisiform, about the twelfth year.

Occasionally an additional bone, the os centrale, is found on the back of the carpus, lying between the navicular, lesser multangular, and capitate. During the second month of fetal life it is represented by a small cartilaginous nodule, which usually fuses with the cartilaginous navicular. Sometimes the styeloid process of the third metacarpal is detached and forms an additional osicle.

The metacarpal bones are each ossified from two centers: one for the body and one for the distal extremity of each of the second, third, fourth, and fifth bones; one for the body and one for the base of the first metacarpal bone. The first metacarpal bone is therefore ossified in the same manner as the phalanges, and this has led some anatomists to regard the thumb as being made up of three phalanges, and not of a metacarpal bone and two phalanges. Ossification commences in the middle of the body about the eighth or ninth week of fetal life, the centers for the second and third metacarpals being the first, and that for the first metacarpal, the last, to appear; about the third year the distal extremities of the metacarpals of the fingers, and the base of the metacarpal of the thumb, begin to ossify; they unite with the bodies about the twentieth year.

The phalanges are each ossified from two centers: one for the body, and one for the proximal extremity. Ossification commences in the body, about the eighth week of fetal life. Ossification of the proximal extremity commences in the bones of the first row between the third and fourth years, and a year later in those of the second and third rows. The two centers become united in each row between the eighteenth and twentieth years.

In the ungual phalanges the centers for the bodies appear at the distal extremities of the phalanges, instead of at the middle of the bodies, as in the other phalanges. Moreover, of all the bones of the hand, the ungual phalanges are the first to ossify.

THE BONES OF THE LOWER EXTREMITY (OSSEAE EXTREMITATIS INFERIORIS).

The Hip Bone (Os Coxae; Innominate Bone).

The hip bone is a large, flattened, irregularly shaped bone, constricted in the center and expanded above and below. It meets its fellow on the opposite side in the middle line in front, and together they form the sides and anterior wall of the pelvic cavity. It consists of three parts, the ilium, ischium, and pubis, which are distinct from each other in the young subject, but are fused in the adult; the union of the three parts takes place in and around a large cup-shaped articular cavity, the acetabulum, which is situated near the middle of the outer surface of the bone. The ilium, so-called because it supports the flank, is the superior broad and expanded portion which extends upward from the acetabulum. The ischium is the lowest and strongest portion of the bone; it proceeds downward from the acetabulum, expands into a large tuberosity, and then, curving forward, forms, with the pubis, a large aperture, the obturator foramen. The pubis extends medially and downward from the acetabulum and articulates in the middle line with the bone of the opposite side: it forms the front of the pelvis and supports the external organs of generation.

The Ilium (os ilii).—The ilium is divisible into two parts, the body and the ala; the separation is indicated on the internal surface by a curved line, the arcuate line, and on the external surface by the margin of the acetabulum.

The Body (corpus osis. ilii).—The body enters into the formation of the acetabulum, of which it forms rather less than two-fifths. Its external surface is partly articular, partly non-articular; the articular segment forms part of the lunate surface of the acetabulum, the non-articular portion contributes to the acetabular fossa. The internal surface of the body is part of the wall of the lesser pelvis and gives origin to some fibers of the Obturator internus. Below, it is continuous with the pelvic surfaces of the ischium and pubis, only a faint line indicating the place of union.

1 Allen Thomson demonstrated the fact that the first metacarpal bone is often developed from three centers: that is to say, there is a separate nucleus for the distal end, forming a distinct epiphysis visible at the age of seven or eight years. He also stated that there are traces of a proximal epiphysis in the second metacarpal bone, Journal of Anatomy and Physiology, 1869.