*Osteology of the Mammalia* (London, 1885); R. Wiedersheim, *Comparative Anatomy of Vertebrates,* adapted and translated by W. N. Parker (London, 1907); R. Wiedersheim and G. Howes, *The Structure of Man* (London, 1897); C. Gegenbaur, *Vergleich. Anat. der Wirbeltiere,* Band i. (Leipzig, 1901).

*Appendicular.*

The bony framework of the two appendages or extremities, as the upper and lower limbs are called, is built up on the same plan in both. Each consists of a limb girdle (shoulder and hip girdles) connecting it with the axial skeleton, a proximal single bone segment (humerus, femur), a distal double bone segment (radius, ulna; tibia, fibula), the hand and foot segments (carpus, metacarpus; tarsus, metatarsus) and the digits (phalanges). It should be understood that in the following descriptions the terms internal and external are used in relation to the mid-line of the body and not to that of the limb.

The upper limb in man may be subdivided into a proximal part or shoulder, a distal part or hand, and au intermediate shaft, which consists of an upper arm or *brachium,* and a forearm or *ante-brachium.* In each of these subdivisions certain bones are found : in the shoulder, the clavicle and scapula ; in the upper arm, the humerus; in the forearm, the radius and ulna, the bone of the upper arm in man being longer than the bones of the forearm ; in the hand, the car­pal and metacar­pal bones and the phalanges. The scapula and clavicle together form an imperfect bony arch, the Scapular Arch or Shoulder Girdle; the shaft and hand form a free divergent Ap­pendage. The shoulder girdle is the direct medium of connexion be­tween the axial skeleton and the divergent part of the limb; its anterior segment, the clavicle, articulates with the upper end of the sternum, whilst its posterior segment, the scapula, approaches, but does not reach, the dorsal spines.

The clavicle, or collar bone (fig. 14), is an elongated bone which extends from the upper end of the sternum horizontally outward, to articulate with the acromion process of the scapula. It presents a strong sigmoidal eurve, which is associated with the transverse and horizontal direction of the axis of the human shoulder. It is slender in the female, but powerful in muscular males; its sternal end thick and somewhat triangular; its acromial end, flattened from above downward, has an oval articular surface for the acromion. Its shaft has four surfaces for the attachment of muscles; and strong ligaments connecting it with the coracoid, is attached to the under surface, near the outer end, whilst near the inner a strong ligament passes between it and the first rib.

The scapula, or shoulder blade (fig. 14), is the most important bone of the shoulder girdle, and is present in all mammals. It lies at the upper and back part of the wall of the chest, reaching from the second to the seventh rib. Its form is plate-like and triangular, with three surfaces, three borders, and three angles. Its costal or ventral surface is in relation to the ribs, from which it is separated by certain muscles: one, called sub- scapularis, arises from the surface itself, which is often termed *subscapular fossa.* The dorsum or back of the scapula is traversed from behind forward by a prominent *spine,* which lies in the proper axis of the scapula, and subdivides this aspect of the bone into a surface above the spine, the *supra-spinous fossa,* and one below the spine, the *infraspinous fossa.* The spine arches forward to end in a broad flattened process, the *acromion,* which has an oval articular surface for the clavicle; both spine and acromion are largely de­veloped in the human scapula in correlation with the great size of the trapezius and deltoid muscles, which are concerned in the elevation and abduction of the upper limb. The borders of the scapula, directed upward, backward, and downward, give attach­ment to several muscles. The angles are inferior, antero-suρerior, and postero-superior. The antero-superior is the most important; it is truncated, and has a large, shallow, oval, smooth surface, the *glenoid fossa,* for articulation with the humerus, to form the shoulder joint. Overhanging the glenoid fossa is a curved beak-like process, the *coracoid,* which is of importance as corresponding with the separate coracoid bone of monotremes, birds and reptiles. The line of demarcation between it and the scapula proper is marked on the upper border of the scapula by the supra-scapular notch

The humerus, or bone of the upper arm (fig. 14), is a long bone, and consists of a shaft and two extremities. The upper extremity possesses a convex spheroidal smooth surface, the *head,* for articulation with the glenoid fossa of the scapula; it is surrounded by a narrow constricted *neck,* and where the neck and shaft become continuous with each other, two processes or *tuberosities* are found, to which are attached the rotator muscles arising from the scapular fossae. Between the tuberosities is a groove in which the long tendon of the biceps rests. A line drawn through the head of the humerus perpen­dicular to the middle of its articular surface, forms with the axis of the shaft of the bone an angle of 40°. The shaft of the humerus is triangular in section above, but flattened and expanded below ; about midway down the outer surface is a rough ridge for the insertion of the deltoid muscle, and on the inner surface another rough mark for the insertion of the coraco brachialis. A shallow groove winds round the back of the bone, in which the museulo-spiral nerve is lodged. The lower extremity of the humerus consists of an articular and a non-articular portion. The articular has a small head or *capitellum* externally for the radius, and a pulley or *trochlea* internally for the movements of the ulna in flexion and extension of the limb. The non-articular part has a projection both on its inner and outer aspect; these are known as the *internal* and *external* condyles, and of these the internal is the more prominent; each is surmounted by a *supracondylar ridge,* and the internal condyle and ridge attach the muscles passing to the flexor surface of the fore­arm, while the external are for those passing to the extensor surface.

A small, downwardly directed, hook­like process of bone is occasionally found above the internal condyle and is the vestige of the supracondylar fora- men found in so many of the lower animals (see below *Comparative Anatomy).*

Before describing the two bones of the forearm, the range of movement which can take place between them should be noticed. In one position, which is called *supine,* they lie parallel to each other, the radius being the more external bone, and the palm of the hand being directed forward; in the other or *prone* position the radius crosses obliquely in front of the ulna, and the palm of the hand is directed backward. Not only the bones of the forearm, but those of the hand are supposed to be in the supine position when they are described.

The radius (fig. 14) is the outer bone of the forearm, and like all long bones possesses a shaft and two ex­tremities. The upper extremity or *head* has a shallow, smooth cup for moving on the capitellum of the humerus; the outer margin of the cup is also smooth, for articulation with the ulna and orbicular ligament; below the cup is a constricted *neck,* and immediately below the neck a *tuberosity* for the in­sertion of the bieeρs. The shaft of the bone possesses three surfaces for the attachment of muscles, and a sharp inner border for the in­terosseous membrane. The lower end of the bone is much broader than the upper, and is marked posteriorly by grooves for the lodgment of tendons passing to the back of the hand : from its outer border a pointed *styloid* process projects down­ward; its inner border has a smooth shallow fossa (the sig­moid cavity of the radius) for articulation with the ulna, and its broad lower surface is smooth and concave, for articu­lation with the scaphoid and semilunar bones of the wrist.

The ulna (fig. 14) is also a long bone. Its upper end is subdivided into two strong processes by a deep fossa, the *greater sigmoid cavity,* which possesses a smooth surface for articulation with the trochlea of the humerus. The anterior or *coronoid* process is rough in front for the insertion of the brachialis anticus, whilst the posterior or *olecranon* process gives insertion to the large triceps muscle of the upper arm. Immediately below the outer border of the great sigmoid cavity is the *small sigmoid cavity* for articulation with the side of the head of the radius. The shaft of