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THE ANATOMY OF THE LOCOMOTOR SYSTEM

OSTEOLOGY ARTHROLOGY MYOLOGY

BY

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CUNNINGHAM'S TEXT-BOOK OF ANATOMY

VOLUME II

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FOREWORD

It is hoped that many students of anatomy will welcome the reappearance of separate bound sections of Cunningham's Text-Book of Anatomy which were last issued in this form fifty years ago. Unlike their predecessors, the volumes now issued are each complete in themselves and may be used independently of the rest of the text as the sections have been arranged so that each of the principal anatomical systems is complete within a single volume. The full index to the Text-Book has been included in each volume as an aid to cross reference from one volume to another since it is felt that many students will use two or more of these separate volumes. As a further aid to quick reference, a Table facing the first page of the index gives the pagination of each section of the book; those sections now issued as separate volumes are distinguished not only by the volume number alongside each entry, but also by the use of roman type; italic is used for those sections not yet available except in the complete Text-Book.

The sections now issued are those most frequently used in a number of medical schools where the complete Text-Book has not been adopted, and it is hoped that not only will the smaller volumes be found more convenient to handle, but that where only one or two sections are required, the considerable saving in the purchase price will be appreciated. The text is that of the ninth edition of the complete work and it will be seen that the page numbers remain the same. Pages 1 to 16, which form an introductory chapter to the complete Text-Book, have been omitted from Volume I, Human Embryology, in which the text commences on page 17. The sections now available as separate volumes are as follows:

Volume I HUMAN EMBRYOLOGY.

Volume II THE LOCOMOTOR SYSTEM.
Containing (i) Osteology. (ii) Arthrology. (iii) Myology.

Volume V THE NERVOUS SYSTEM.
Containing (i) Central Nervous System. (ii) Peripheral Nervous System. (iii) Autonomic Nervous System.

Volume VI SURFACE AND SURGICAL ANATOMY.
With an appendix on Radiographic Anatomy.

Two further volumes containing the remaining sections may be issued later if it is felt that there is a sufficient demand for them.

The complete Text-Book will remain available as a single volume and the present volumes are intended principally for those who do not require the whole text.

PLATE I.—RADIOGRAPH OF EIGHT-MONTHS FŒTUS (EVISCERATED) TO SHOW THE STATE OF OSSIFICATION OF THE SKELETON. THE RIGHT FOREARM IS SUPINATED, THE LEFT PRONATED.

Note the absence of ossific centres for the Carpus and the presence of centres for the Talus and Calcaneum (cf. Plate XVIII, Fig. 1, p. 273, and Plate XXVIII, Fig. 1, p. 321). Minute centres of ossification for the lower epiphysis of the right Femur and the upper epiphysis of the left Tibia are also faintly visible.

[*Facing p.* 104

PLATE II

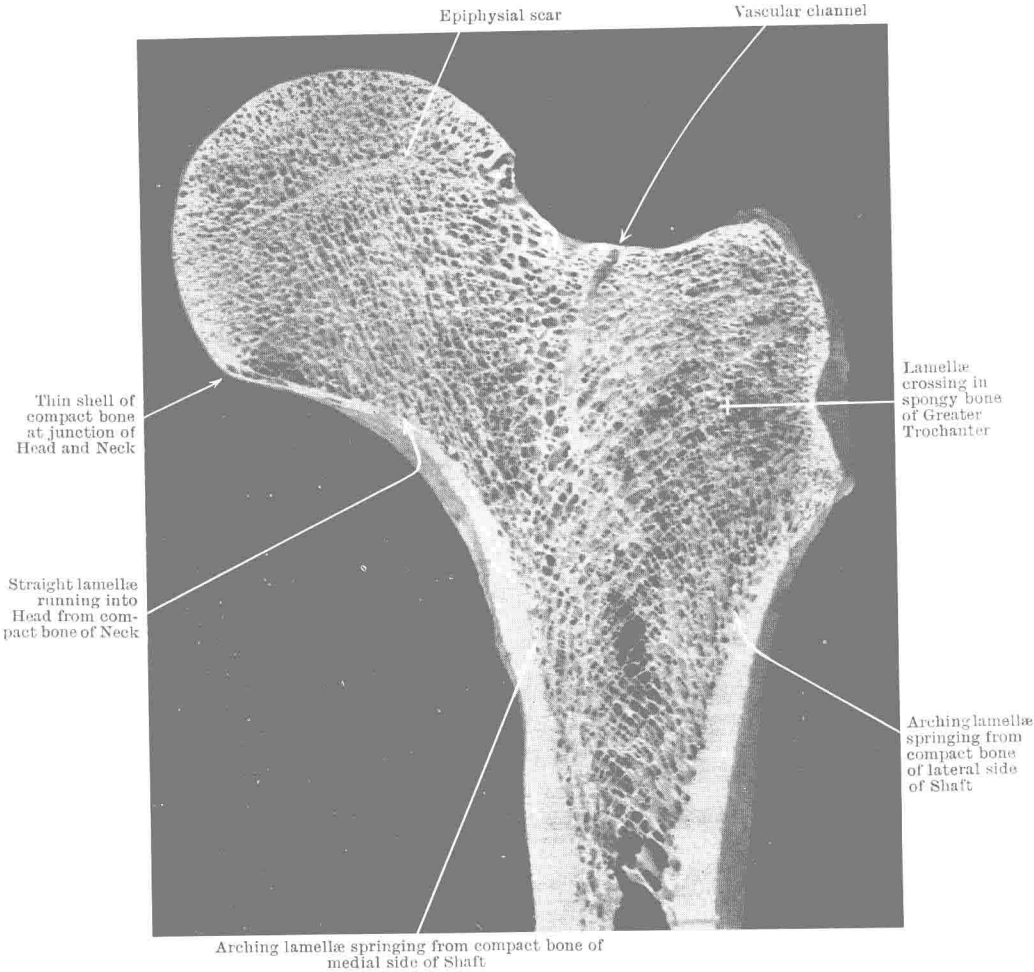

FIG. 1.—PHOTOGRAPH OF CORONAL SECTION OF UPPER END OF LEFT FEMUR TO SHOW ITS ARCHITECTURE.

Note how the compact bone of the Shaft thins out over the Greater Trochanter and the Head, and the manner of crossing of the different systems of lamellæ in the spongy bone.

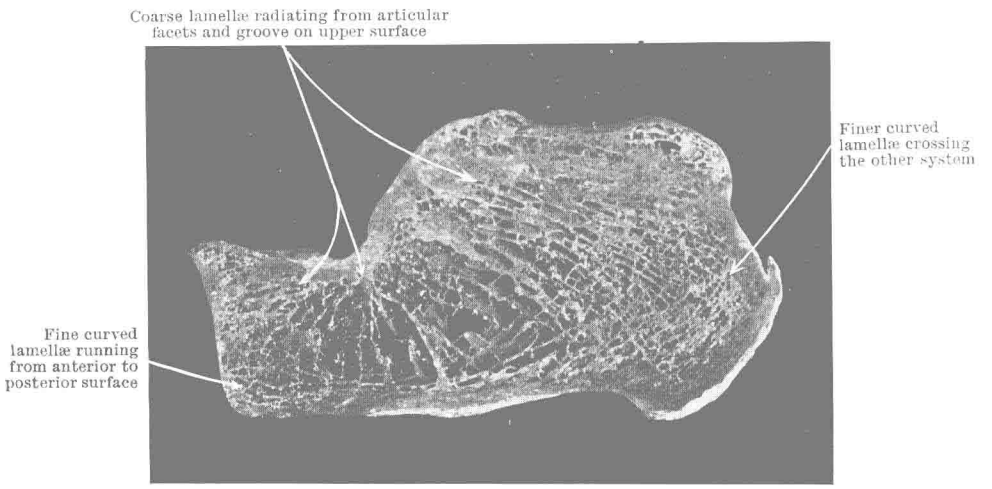

FIG. 2.—PHOTOGRAPH OF SAGITTAL SECTION OF CALCANEUM TO SHOW ITS ARCHITECTURE.

Note the thin shell of compact bone and the arrangement of the lamellæ of the spongy bone in two main systems.

PLATE III

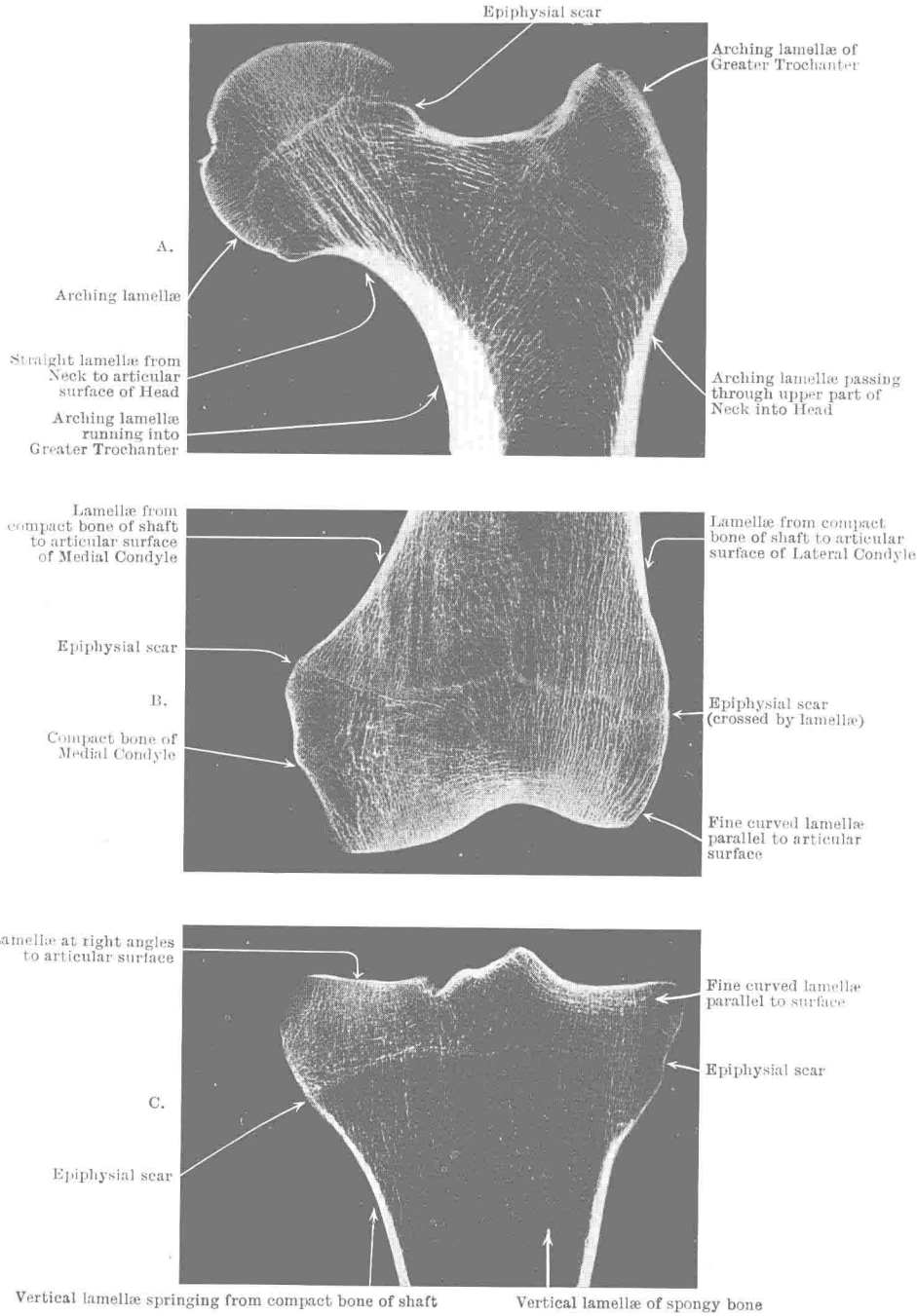

PLATE III.—RADIOGRAPHS OF CORONAL SECTIONS OF A. UPPER END OF FEMUR; B. LOWER END OF FEMUR; C. UPPER END OF TIBIA, OF A WOMAN AGED 34.

Note the persisting epiphysial scars and the arrangement of the systems of lamellæ in the spongy bone.

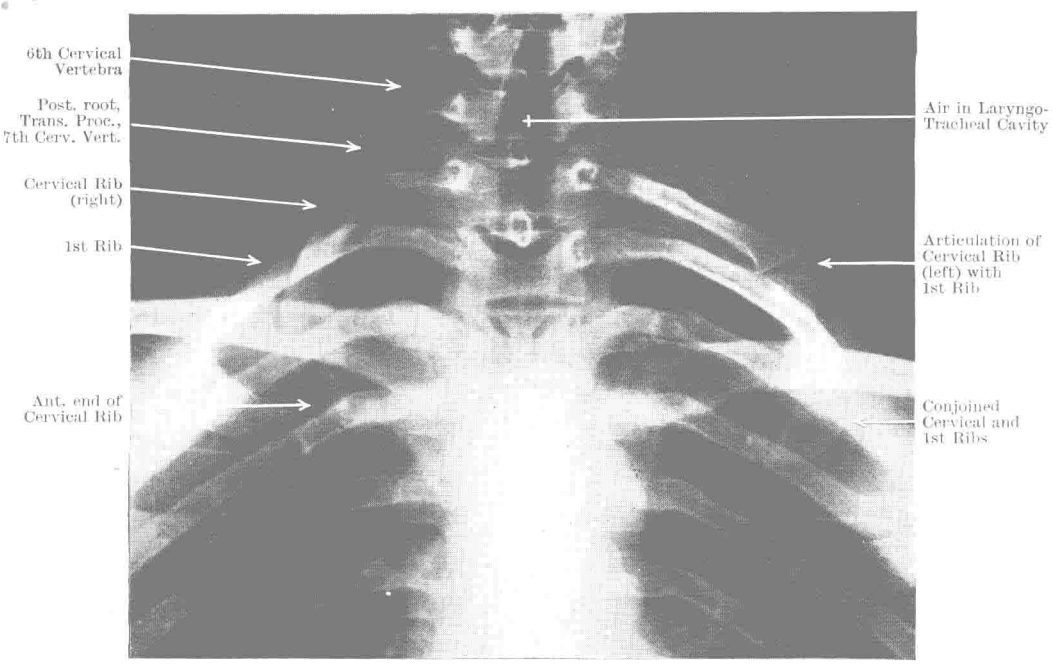

FIG. 1.—RADIOGRAPH OF CERVICO-THORACIC REGION OF WOMAN AGED 35, SHOWING A PAIR OF WELL-DEVELOPED CERVICAL RIBS.

Note the asymmetry of the cervical ribs and that the left one articulates with a projecting process of the first thoracic rib. For view of the right cervical rib on a larger scale see Plate LXVIII, Fig. 2, p. 721, which shows also more clearly the evidence of the presence of a "lobe of the vena azygos" in the right lung.

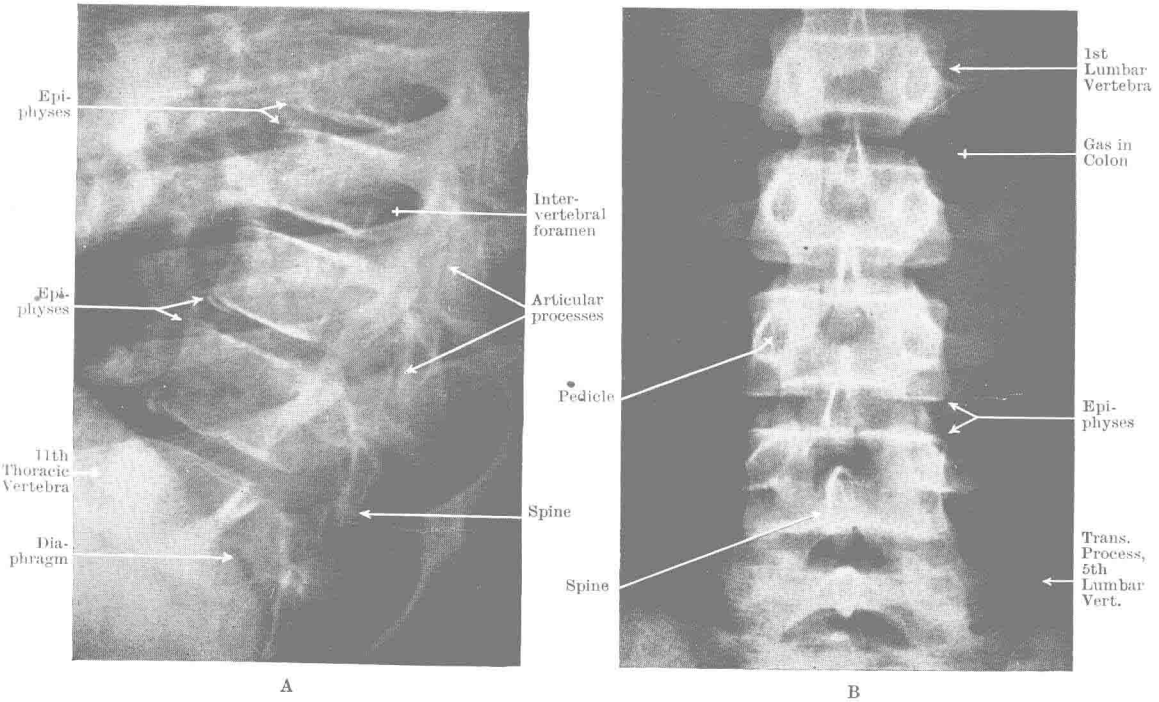

FIG. 2.—RADIOGRAPHS OF (A) THORACIC AND (B) LUMBAR VERTEBRÆ OF A GIRL AGED 12, SHOWING THE EPIPHYSES OF THE VERTEBRAL BODIES.

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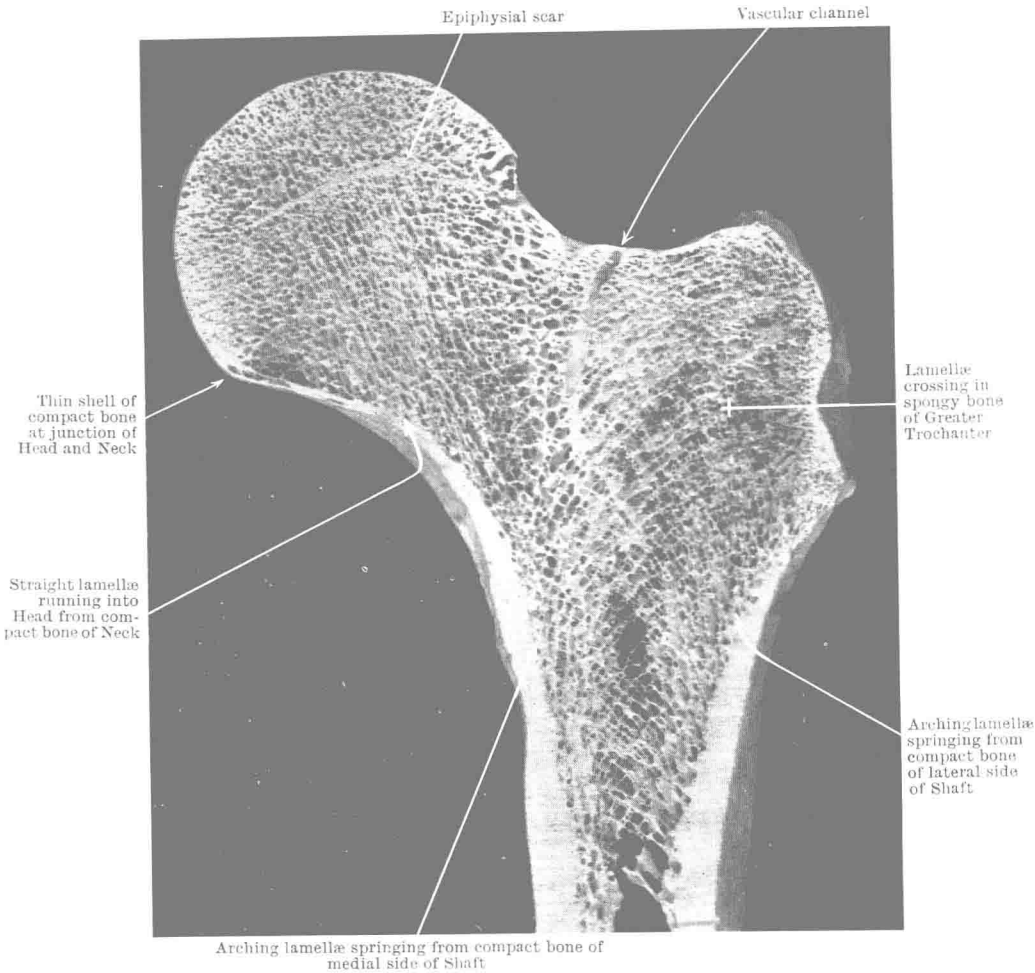

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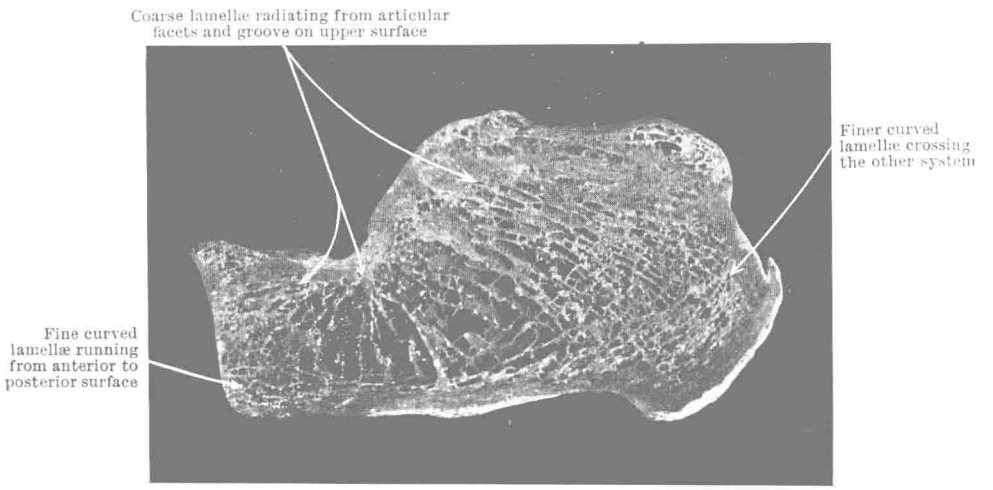

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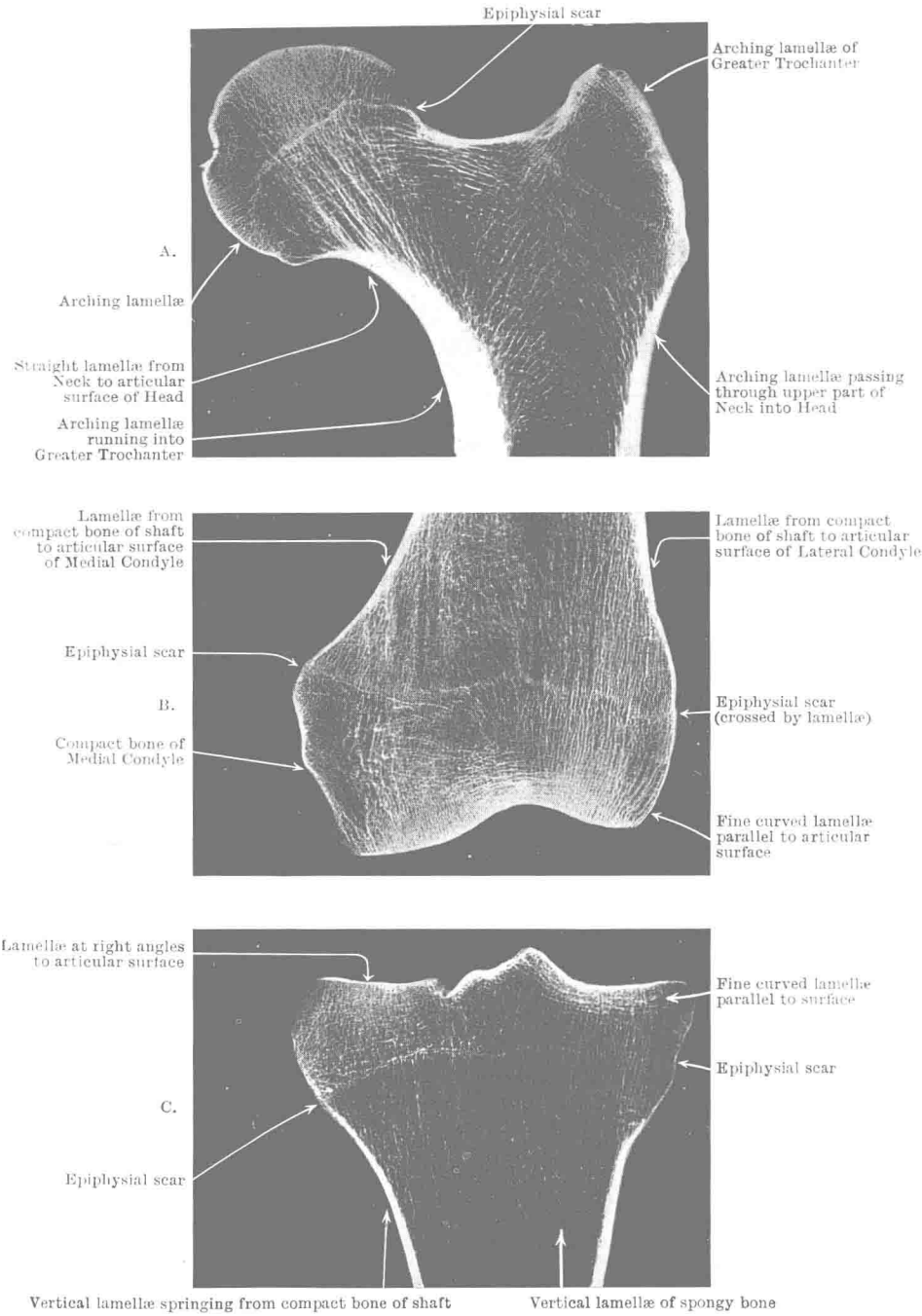

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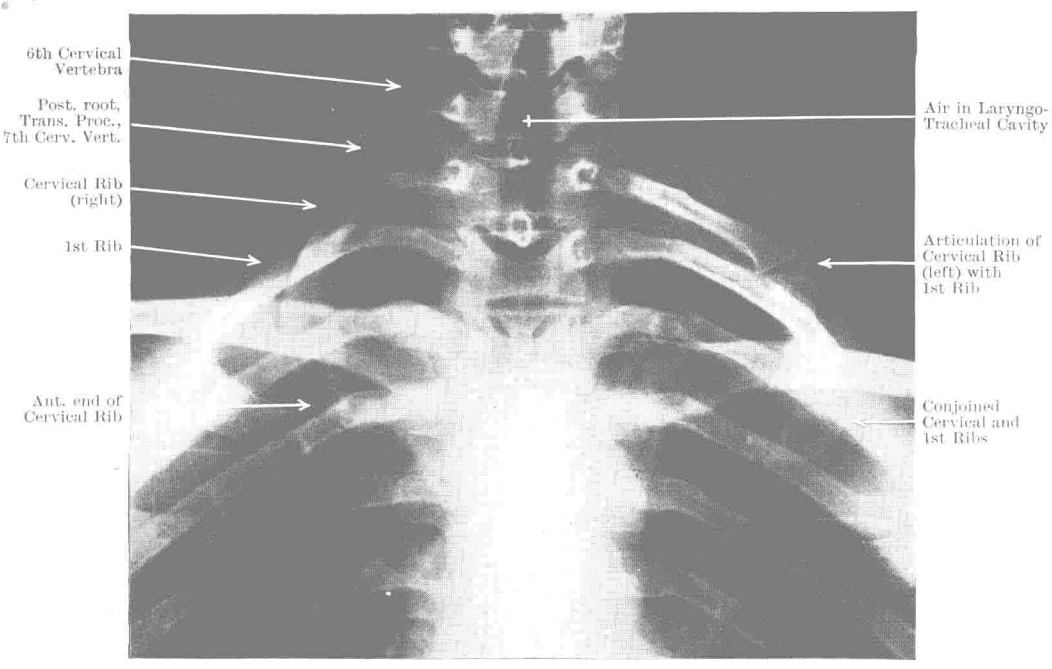

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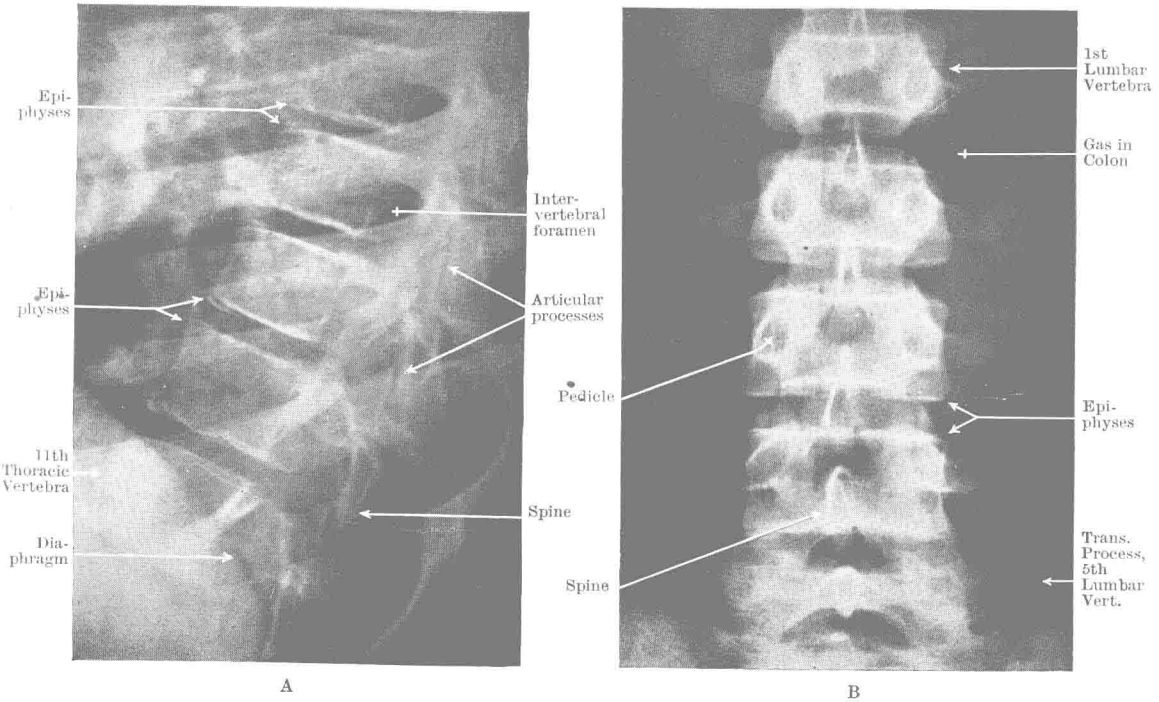

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INTRODUCTION

BONES AND CARTILAGES

THE body is supported by an internal framework or *skeleton* of **bones** [σκελετός (skeletos) = dried]. This skeleton accounts for about one-seventh of the body-weight in a man and rather less in a woman; and the bones are supplemented in many places by gristle or **cartilage**—more so in a growing person than in an adult.

Uses of Bones.—Bones give support to the softer tissues which surround them and in some cases form protective boxes or cages for internal organs such as, for example, the brain in the skull, the heart and lungs in the chest and the spinal cord in the backbone. They also act as levers to which muscles or their tendons are attached and can transmit either tensile or compression stresses without appreciable deformation.

In addition, the spaces found inside bones are used for the production of blood-cells, for these spaces contain bone-marrow in which the blood-corpuscles develop, and the bone-substance itself is a store of lime-salts upon which the body may draw when necessary.

Articulation of Bones (see also the Section on Joints).—Since a continuous rigid framework would prevent movement, the bony skeleton is divided into separate bones joined by softer tissues which are, as a rule, sufficiently flexible to allow movement to take place.

The union between two or more adjacent bones is called a joint or *articulation* (*articulus*, diminutive of *artus* = a joint) and the bones so united are said to *articulate* with each other at the joint. The surface of one bone which comes into direct relation with another at a joint is its **articular surface** and, when the bones can glide or rotate on each other freely, an actual space is present between them; the articular areas are then covered with an adherent layer of smooth glistening **articular cartilage**. The bone underlying the cartilage is also smooth so that the articular part of a dried bone is easily identified even although the cartilage has been removed. In other cases, where less movement is required, the union of adjacent bones is made by some form of connective tissue, such as fibrous tissue or cartilage, when the articular surface will usually be rough; or else the union may be made complete by fusion of the two bones so that movement is prevented. Movements at joints are controlled or produced chiefly by muscles which are attached to the bones, but the bones are held together by all the tissues which surround them. In the majority of cases fibrous tissue runs from bone to bone as thickened bands or ligaments (*ligamentum* = a band or bandage, from *ligare* = to bind). These ligaments or other soft tissues maintain the continuity of the skeleton and transmit tensile stresses when required. Compression stresses cannot be transmitted through ligaments of this kind and the articular ends of long bones are likely to be enlarged so as to distribute such stresses and provide a good bearing surface in any normal position of the joint.

Constituents of Bone.—On analysis, bone can be broken down into approximately equal parts of solids and water. The solids are partly organic matter (31 per cent)

and partly inorganic (69 per cent). The *inorganic matter* consists of various *mineral salts*, the chief of which is calcium phosphate. This makes up over 80 per cent of the mineral or inorganic matter, though not necessarily in such a simple form, and, because of its abundance, bones are one of the sources of phosphorus. The *organic matter* is *white fibrous tissue*. It consists of:—(*a*) fine fibres embedded in a little amorphous material, called 'ground-substance', which unites the fibres into interlacing bundles; (*b*) connective-tissue cells, called *bone-corpuscles*, placed in rows among the bundles of fibres. The ground substance is completely impregnated with the mineral salts and a bone which has been burned to destroy the connective tissue element (calcined) still retains its form, though it becomes brittle and inelastic and may crumble. On the other hand, if the mineral salts are removed from a bone by soaking it in dilute acid, the bone again retains its form completely but becomes flexible. It can be cut with a knife and a sufficiently long and thin bone can be tied in a knot. Bones are therefore not only hard but, because of the fibrous tissue, are also tough and elastic. This combination of organic and inorganic substances makes bones almost unique in that resistance to compression and extension is nearly equal (D'Arcy Thompson, 1942). In old age bones become more brittle owing to diminution of the elasticity of the fibrous tissue and not to any increase in the salts.

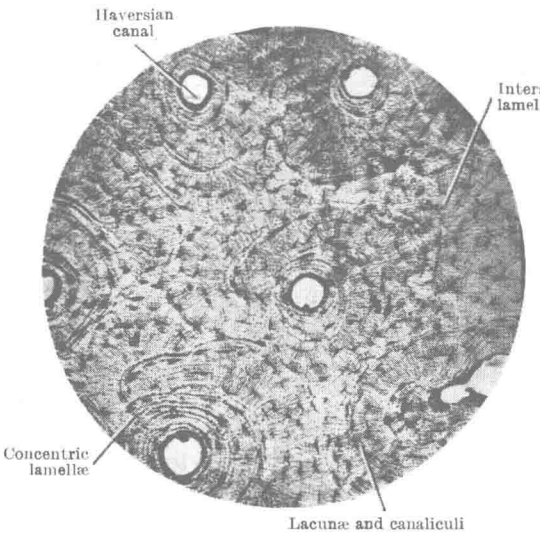

FIG. 122.—PHOTOGRAPH OF GROUND TRANSVERSE SECTION OF COMPACT BONE, showing Haversian systems (Haversian canal, concentric lamellæ, lacunæ, and canaliculi). ×*c.* 75.

Structure of Bone.—There is only one kind of bone, but it may be either compact or spongy in texture (see Plate II, p. 104). **Compact bone** is hard and dense and forms the outer shell of a bone within its covering of periosteum (see p. 109). It is frequently thick and strong and is well seen when the shaft of a long bone, such as the thigh bone or femur, is sawn across. **Spongy bone** is also hard, but this is not so evident because it consists of thin intersecting lamellæ of bone substance with spaces between them, like a sponge (*lamella* or *lamina*—a leaf, blade, layer). This arrangement is well seen when the end of a long bone such as the femur is cut across. The spaces between the lamellae are filled with red marrow.

The **microscopical structure of bone** is essentially the same in the spongy and compact varieties and is closely associated with its mode of formation. Bone substance is laid down in two ways;—(a) Successive thin layers are formed under the periosteum. These lie approximately parallel with the surface and are called **periosteal lamellæ.** (*b*) Successive thin concentric layers are deposited around blood-vessels so as to form canals which therefore contain the blood-vessels as well as any lymph-channels, nerves and loose areolar tissue associated with them. The systems of tubular lamellæ so formed are called **Haversian systems** (after Clopton Havers who first described them in detail, 1691) and consist of three to ten or more concentric tubes, the **Haversian lamellæ**, which surround the central cavity named the **Haversian canal**. The cells associated with the laying down of bone are named **osteoblasts.** Numbers of them are trapped between the lamellæ during development and remain as **osteocytes** or **bone-corpuscles** in the substance of the bone. The minute cavities occupied by the bone-corpuscles during life are called **lacunæ** (*lacuna*—a pit, hole, or cavity) and, since the living cells are connected with each other by slender cytoplasmic processes, the substance of the lamellæ formed around them is penetrated by minute channels. These are called **canaliculi** and connect