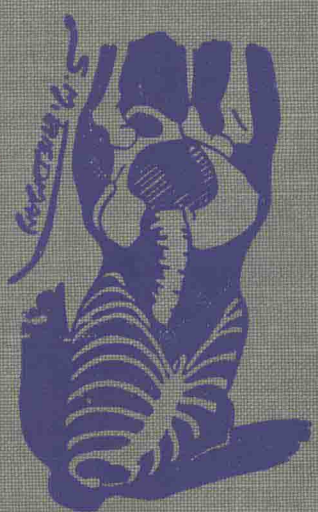

VISUAL ANATOMY

Thorax and Abdomen

By

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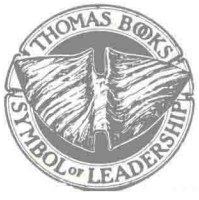

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FOR

CONSTANCE LIVINGSTONE FRIEDMAN

PREFACE

The aims and methods of this second volume of Visual Anatomy remain the same as those of the first. The intention is to present briefly and forcefully that Anatomy which I feel is essential for the practice of Medicine. The books are designed as a review for the student, undergraduate or postgraduate, who has already completed a dissection.

As before, the presentation is visual, with the written word supplementary; for descriptive Anatomy deals primarily with visual fact and not with theory. Once more, the method has been to work outward from the basic skeletal framework to the soft structures; in my opinion, a more useful approach in review. It is my earnest hope that the present volume, dealing with a region of such importance to both internist and surgeon, will be of some use to those who find it necessary to revise their Anatomy in a limited time.

As before, I have leaned on Professor Grant's excellent text for certain features of nomenclature; otherwise, the revised form of the B.N.A. has been used. I have received much helpful advice and criticism from Dr. J. Fulton and Dr. W. Sproat, as well as from numerous students, particularly the sixty men and women who formed the first year of the first class in Medicine at this University. The latter, by their careful study of the volume dealing with Head and Neck, have shown me many of my errors. Finally, as before, I am most deeply indebted to my good friend and former colleague, Dr. R. A. Macbeth, for the heavy and tedious work of carefully checking the manuscript.

S. M. F.

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THORAX

THORAX

The Framework—I. The Thoracic Vertebrae

The bony framework of the thorax consists of the thoracic vertebrae, the ribs with their cartilaginous extensions, and the sternum. In this figure several typical thoracic vertebrae are shown in order to point out some of their more important features.

The **body** of the typical thoracic vertebra is heart-shaped, the narrow end of the "heart" being placed anteriorly. The upper vertebrae approximate the shape encountered in the neck, while the lower ones become increasingly oval and broadened from side to side in conformity with the shape of the lumbar vertebrae. The body is thinner anteriorly than posteriorly so that when the 12 thoracic vertebrae are articulated a decided anterior concavity is produced. The bodies of the thoracic vertebrae are joined together by dense *intervertebral discs* as well as by the strong *anterior* and *posterior longitudinal ligaments*. Facets for articulation with the heads of the ribs are carried by the body and since the typical rib head rests between two vertebrae such facets are found close to both the superior and inferior margins of each typical body. The 1st, 10th, 11th and 12th ribs usually articulate with only their corresponding vertebral body.

The two thin, rounded **pedicles** project posteriorly from the sides of the body somewhat closer to its superior than its inferior surface and thus form the boundaries of shallow vertebral notches above and deep vertebral notches below. In the articulated spine adjacent vertebral notches become continuous to form the *intervertebral foramina* through which the spinal nerves emerge.

Articular processes project upwards and downwards just behind the pedicle. Each process bears an *articular facet* for articulation with corresponding facets on the adjacent vertebrae. These facets are oriented almost vertically (i.e., in the coronal plane) and provide an effective barrier to dislocation in this part of the spinal column, without hindering rotation or flexion.

The **laminae** extend backwards and medially from the articular processes. The thoracic laminae are deep in the vertical dimension so that in the articulated column they overlap one another and fully protect the spinal canal. Adjacent laminae are united by the elastic *ligamenta flava*.

The midline **spine (spinous process)** is long and tapering, ending in a stout, easily palpated knob. The thoracic spines are downwardly inclined, the tip of each being approximately opposite the body of the vertebra next below.

The stout, club-shaped **transverse process,** projecting both laterally and posteriorly, carries a large facet for articulation with the corresponding rib. This facet is absent from the 11th and 12th vertebrae whose corresponding ribs have a ligamentous mooring instead of free articulation with their transverse processes.

The bony interlocking and the dense ligamentous and fibrocartilaginous unions between these vertebrae suffice in themselves to support and prevent dislocation of the thoracic spinal column. The cancellous vertebral bodies themselves, however, may be compressed by trauma, or may collapse as the result of disease. In these cases, intervertebral spacing is maintained by the rigidity of the dense bone of the articular processes.

Clinically, it is frequently important to locate a particular thoracic spine. The simplest method is to locate the spines of C7 and T1 by their prominence at the base of the neck and then to count down. It must be remembered that a palpated spine lies opposite the body and transverse process of the vertebra next below.

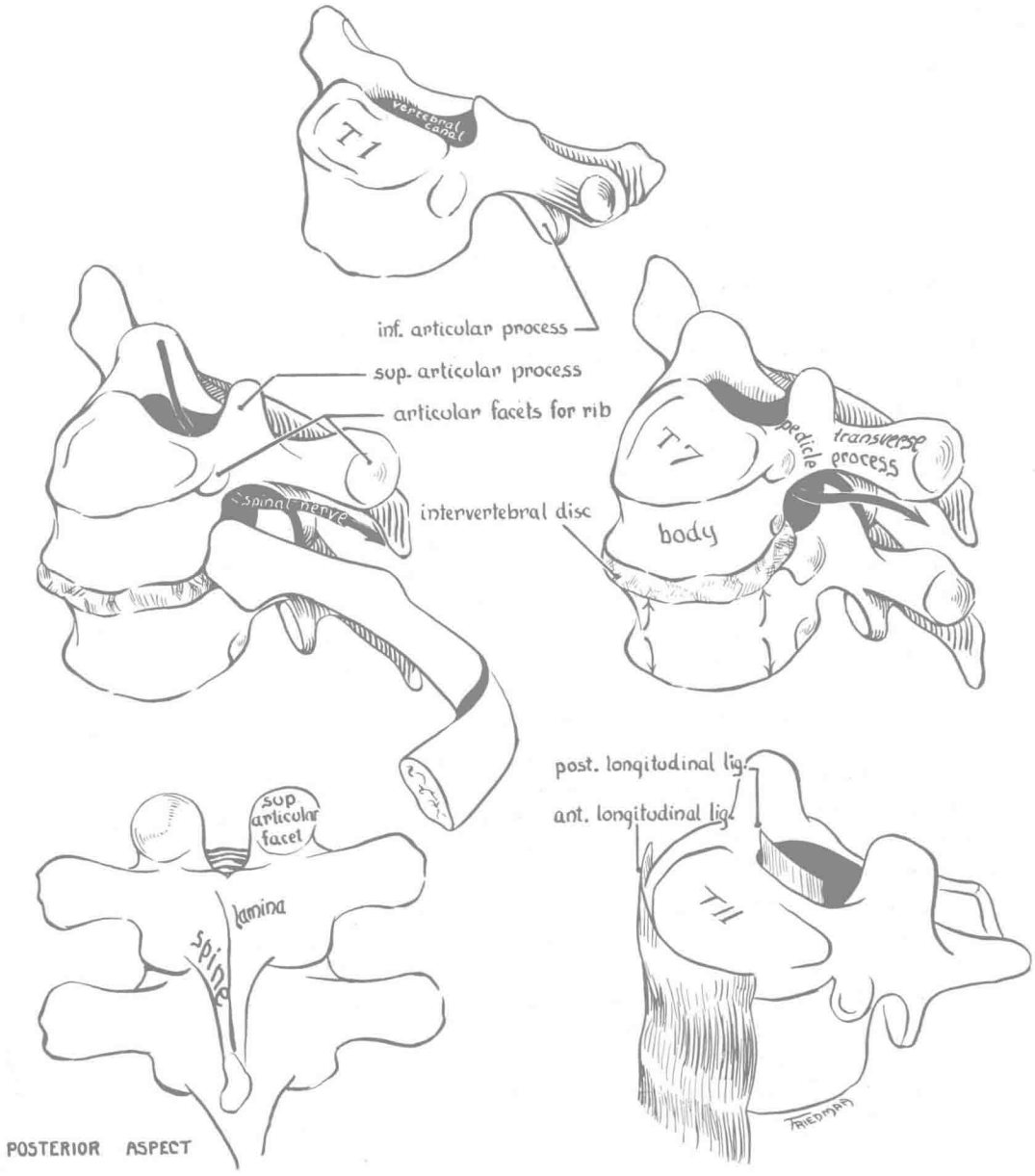
T1
vertebral canal
inf. articular process
sup. articular process
articular facets for rib
spinal nerve
intervertebral disc
T7
pedicle
transverse process
body
post. longitudinal lig.
ant. longitudinal lig.
T11
sup. articular facet
lamina
spine
POSTERIOR ASPECT
FRIEDMAN

FIGURE 1

THORAX

The Framework—II. The Ribs

The typical **rib** is an elongate shaft of bone flattened from side to side. In situ it forms an arc sweeping forward and laterally from the vertebral column. The major portion of the rib, the *body,* presents the clearly defined *subcostal groove* and the *angle.* The latter is a rather sharp change of direction in the arc of the rib, at the junction of its posterior and middle thirds. The body consists largely of cancellous bone enclosed by an outer layer of compact bone. It contains active red marrow.

Posteriorly, where the rib shaft is modified for articulation with the thoracic vertebrae, the body is succeeded by the stout dense *neck* capped by the expanded *head.* On the posterior aspect of the rib, the junction of body and neck is marked by a prominent *tubercle* surmounted by a facet which articulates in a true joint with the similar facet on the transverse process of the corresponding vertebra. The neck itself is roughened by the attachments of stout *costo-transverse ligaments* which join it to its corresponding transverse process as well as to the one next above.

The head carries an upper and lower articular facet separated by an interarticular crest of bone. This interarticular portion is firmly attached to the adjacent intervertebral disc while the upper facet articulates with the body of the vertebra next above and the lower facet articulates with the corresponding vertebra (see also Fig. 1). Stout *capsular ligaments* fix the head of the rib to the two vertebrae concerned.

The movements permitted through the costo-vertebral junction are shown diagrammatically. During inspiration the elevation of the ribs increases both the antero-posterior and the transverse diameter of the thoracic cavity.

The angle, although it marks the boundary between the dorsal musculature and the laterally placed Serratus Anterior, is itself free of muscular support. This factor, together with the rib angulation at this site, makes the angle the common region for rib fracture.

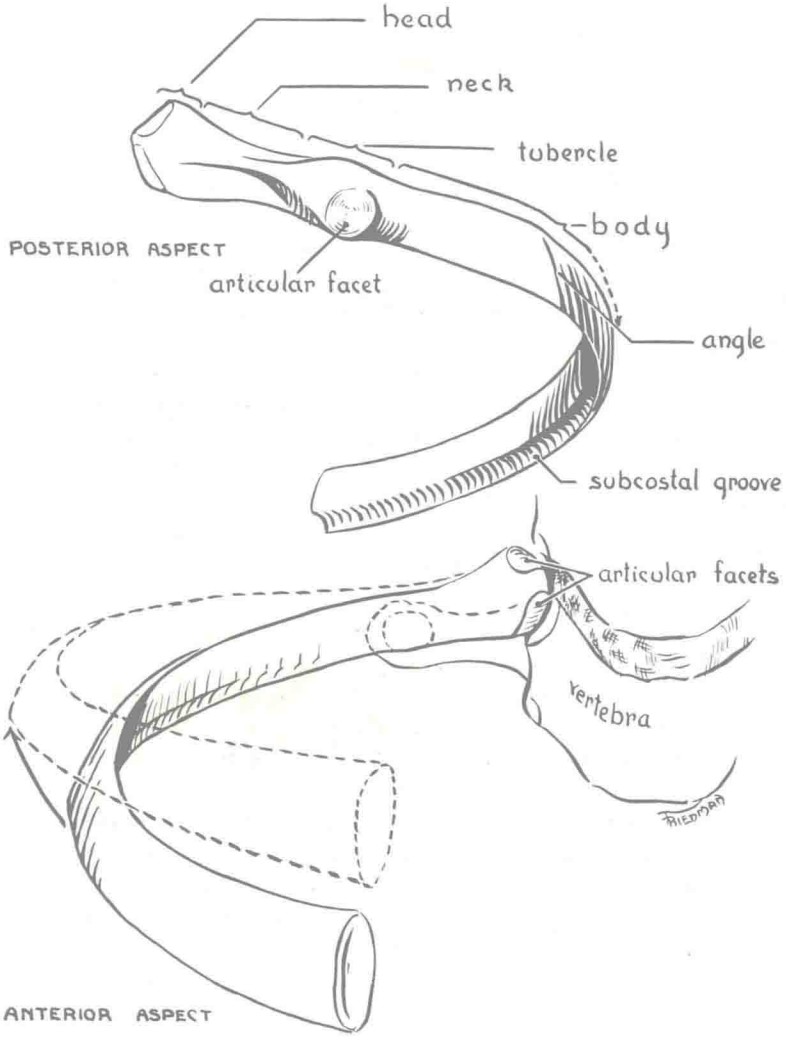
head
neck
tubercle
body
POSTERIOR ASPECT
articular facet
angle
subcostal groove
articular facets
vertebra
ANTERIOR ASPECT

FIGURE 2

THORAX

The Framework—III. The Ribs and Sternum

The ribs, the costal cartilages and the sternum, together with the vertebrae, form a bony cage which encloses and protects the thoracic viscera.

The **sternum,** placed subcutaneously in the anterior part of the thorax, is a flat, dagger-shaped bone. It consists of the short, broad *manubrium,* the elongate *body* and the small, tapering, cartilaginous *xiphoid process* (*xiphisternum*). The manubrium is joined to the body by a fibrocartilaginous plate which permits a small amount of movement between these two parts. The site of this articulation is readily palpated as the *sternal angle* (*of Louis*). The xiphoid is joined directly to the body, but being cartilaginous, is quite flexible.

The twelve **ribs** are firmly attached by ligaments and joints to the bodies and transverse processes of the thoracic vertebrae. As already mentioned, the 1st, 10th, 11th and 12th ribs are attached only to their corresponding vertebral body, while all the others articulate between the adjacent body and the one next above. In addition, the first 10 ribs articulate in a true joint with their corresponding transverse processes.

Each rib sweeps laterally and then forward, to end by joining the *costal cartilage* at the costo-chondral junction. The upper seven costal cartilages end by articulating with the sternum in a diarthrodial joint (except for the first which is actually fused with the sternum). The costal cartilages of the 8th, 9th and 10th ribs end by articulating with the inferior surface of the costal cartilage next above. This arrangement results in the formation of the scalloped *"costal margin"* which slopes down and laterally from the xiphoid. The "costal margin" is formed mainly by the 7th, 8th and 9th costal cartilages, the 10th being rather small and occasionally failing to meet the others. The short 11th and 12th ribs are capped by small cartilages which do not articulate with the others.

It is of importance to be able to locate ribs by number in the living subject for they provide essential landmarks for the location of viscera. The 2nd costal cartilage, which always articulates with the sternum at the easily palpated sternal angle, provides the single safe reference point for all other ribs.

The *costal angle* formed by the meeting of the two "costal margins" at the sternum is, in health, less than a right angle. Any condition which tends to force an increase in thoracic capacity, e.g., asthma or emphysema, will gradually increase the costal angle. Because the chest wall is, on the whole, a relatively weak bony structure, bone diseases readily produce defects here.

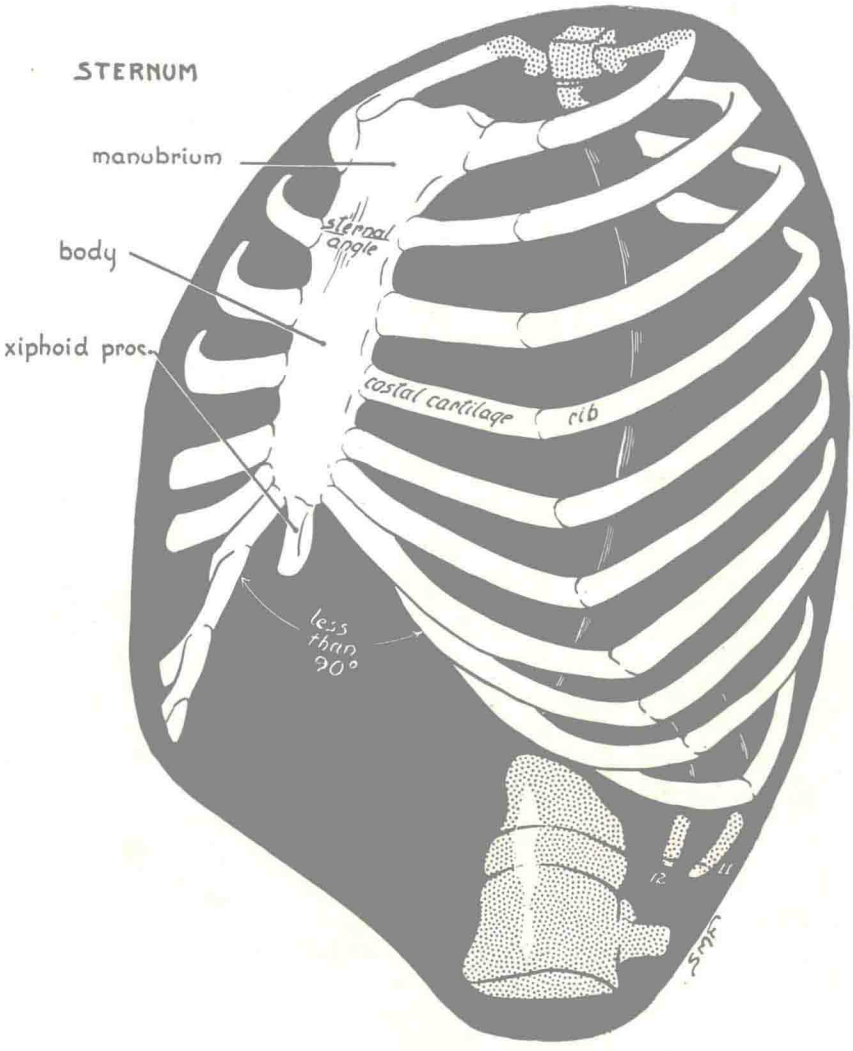

FIGURE 3