Fifth Edition

SURFACE AND RADIOLOGICAL ANATOMY

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S. G. IAN HAMILTON

For students and general practitioners

SURFACE AND RADIOLOGICAL ANATOMY

FOR STUDENTS AND GENERAL PRACTITIONERS

FIFTH EDITION BY

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SURFACE AND RADIOLOGICAL ANATOMY

PREFACE TO THE FIFTH EDITION

In this book we have ventured to travel beyond the usually accepted scope of works on surface anatomy. It has been our aim to provide an introduction to the study of anatomical structures which are accessible to examination in the living subject.

To the time-honoured methods of physical examination we have added radiological methods. General recognition, indeed, is now given to the value of radiology for the study of anatomy. A knowledge of the normal appearances is indispensable as a background to the proper utilization of radiology for clinical purposes. By the extensive use of illustrations we have attempted to supply a means of co-ordinating radiological anatomy with those features which can be determined by external examination and with those details which can be determined only by dissection.

The physical examination may with profit be extended to include percussion and auscultation, and the examination of internal structures by digital exploration or by the employment or special instruments such as the laryngoscope and aural speculum. We have, therefore, in appropriate places, described the anatomical features which may be thus investigated. The book has been arranged in sections which correspond with the "parts" in which the body is customarily dissected.

In an introductory section we have set forth some general considerations relating to radiological technique, to the structure of the skin and to the group action of muscles. In sections that follow, more detailed information relating to each "part" is given.

Surface contours have been shown in their relation to underlying structures by a series of parallel illustrations, a method which has also been employed for the elucidation of the more difficult radiographic appearances. In this way we believe that a better appreciation of surface and radiological anatomy can be obtained than by the provision of elaborate descriptions.

We have stressed the study of surface contours for the importance they have in marking the positions of deeper structures, and have preferred to draw attention to the landmarks by which the positions of structures may be recognized rather than to apply to the living subject stereotyped projections based upon the cadaver.

All radiographs except one have been reproduced as negatives in view of the general practice of examining original radiographs in this form: for a like reason all but one have been reproduced completely untouched.

In the present edition many of the original radiographs have been replaced by new ones and a number of new illustrations have been added. The text has been extensively revised and rearranged. Description of the techniques used in radiology has been moved to the introductory chapter on general anatomy and methods, leaving the main part of the book for the description of the general and radiological anatomy unencumbered by points of radiological technique.

It should be appreciated that the book has been written for at least three different categories of readers. First, for medical students to supplement their knowledge of anatomy gained through dissection. Some of the radiology may be in too great detail for them, especially that of the hilar vessels of the lung, and the cerebral and coronary arteries. Most of the radiological anatomy will however be of value later in their clinical course which will include radiological diagnosis.

Secondly, it is hoped that the book may be of value to trainee radiographers, though they need not learn the names of all the muscles and nerves.

Finally, the trainee radiologist should find the book of value since it is necessary for him to become familiar with the normal radiological anatomy.

We wish to record our indebtedness to Professor T. W. Glenister, Dr D. Brown and Dr Jean R. W. Ross of the Anatomy Department, Charing Cross Hospital Medical School, for the help they have

given in the revision of the text and figures. To Dr G. du Boulay, Radiologist at St Bartholomew's Hospital, we are indebted for cerebral angiograms and some other figures and for criticism of the section on the radiology of the skull. We also wish to express our thanks to Mr E. J. Park, F.I.S.T., Chief Technician, Anatomy Department, Charing Cross Hospital Medical School, for the help he has given with revision.

We owe much to Mr A. K. Maxwell and Mr F. B. Price for the skill and care they have shown in the execution of the illustrations, and recognize in them an indispensable contribution to the book. To them we feel deeply grateful.

We have been fortunate in the cordial relationship which has existed between us and Messrs W. Heffer & Sons Ltd, Printers and Publishers. Finally, we wish to thank Mr H. G. Newman, Works Director of Messrs W. Heffer & Sons Ltd, and his staff, for their help and patience.

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S. G. I. HAMILTON

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GENERAL ANATOMY AND METHODS

(1) INTRODUCTION

The anatomy of the living subject may be investigated in a variety of ways. By **inspection,** an assessment can be made of the general proportions of the body, the natural postures, the surface contours and the appearances of the skin and superficial vessels. At the same time movements, e.g., those of respiration and of the heart-beat, may be noted. Observation can be made of the way in which movements are carried out. **Palpation** gives information concerning the texture, position, size, form and mobility of the superficial and certain of the more deeply placed structures, and it also reveals the degree of tonus of the muscles. Additional information regarding the viscera can be obtained by **percussion** and **auscultation.** Differences are elicited in the sounds produced by percussion over the various viscera. Auscultation (usually carried out with the aid of a stethoscope) permits of a study of sounds such as those produced during the cardiac and respiratory cycles.

Certain of the more deeply situated parts of the body may be rendered accessible to examination by the use of special apparatus. It is possible, for example, to examine the nasal part of the pharynx, the larynx and even the trachea and major bronchi. The interior of the oesophagus, stomach, lower bowel, bladder and peritoneal cavity may likewise be inspected. The interior of the eye can be studied with the aid of the **ophthalmoscope,** and the external auditory meatus and tympanic membrane by the use of an **aural speculum.**

Radiology has proved a valuable aid to the detailed examination of the living subject. Its use has added to our knowledge of individual variability in the form and position of viscera, and of the changes which take place in the same individual under different conditions.

While the study of the cadaver must still remain the foundation of our knowledge of human anatomy, the information so obtained requires amplification by comparison with the living subject. **Post-mortem** examination affords further opportunities of modifying impressions obtained from the study of embalmed material, but the appearances of the living organs and tissues may be best appreciated when seen during the course of **surgical operations.**

(2) INDIVIDUAL VARIATION

Despite the fundamental similarity of structure in all human subjects, striking differences do occur and on these depend the recognition of an individual. Such characteristics as facial configuration, colouring, hair, height and build are usually noted, but hands, feet and other parts of the

body exhibit just as much variation although this is often overlooked. The individuality of anatomical structure is very evident if a series of subjects is examined. Peculiarities of external form are characteristic of certain peoples. The Bushwoman, for example, exhibits a distinctive accumulation of fat in the buttock which is described as steatopygia. The frequency of certain muscular and other anatomical features differs in the various races, e.g., the sternalis muscle is relatively common in the Japanese.

Surface contours are much influenced by the state of development of the musculature and the amount of fat in the superficial tissues. The prominences and depressions produced by underlying structures in a thin subject may be obscured in a fat one; an elevation produced by a bone in a thin subject may even be replaced by a depression if adjacent muscles are well developed, e.g., over the spine of the scapula.

Certain superficially placed muscles are present in some individuals but absent in others; among these the following deserve note. The **omo-cervicalis** (levator claviculae) muscle, only exceptionally present, occupies a superficial position in the posterior triangle of the neck between the trapezius and sternomastoid muscles. The **dorsi-epitrochlearis** muscle occupies a superficial position in the medial bicipital furrow of the arm and extends from the posterior wall of the axilla to the medial epicondyle of the humerus. The **palmaris longus** muscle is absent in many individuals; when present it varies greatly in size and the differences in the size of its tendon are evident on examination of the wrist in a number of living subjects.

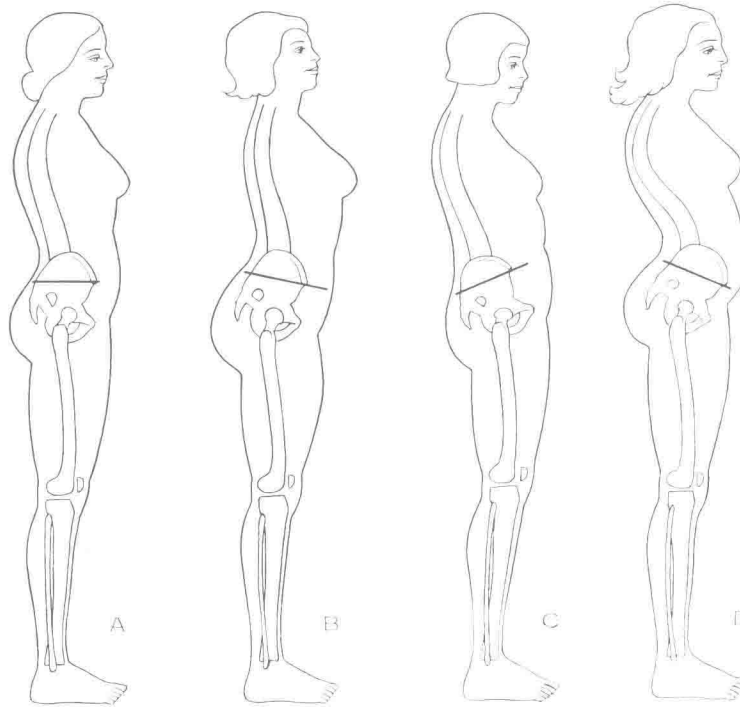

FIG. 1.—Diagrams illustrating differences of posture (adapted from Sturmdorf: *Surg., Gynec. Obstet.*, 1931). A shows a good posture; in B there is a forward tilt of the pelvis and exaggerated posterior concavity of the lumbar region (lordosis); in C there is flattening of the lumbar region; and in D (swayback type) there is a marked degree of lordosis. Compensatory modifications of the posture of the chest and head are seen in B, C and D.

Differences occur in the detailed form of bones. The **peroneal** tubercle of the calcaneum may be inconspicuous or it may form a salient prominence which is very evident on inspection of the foot. The humerus may exhibit a projection, the **supracondylar process,** a short distance above the medial epicondyle (Fig. 76). Occasionally, in this situation, a flange of bone is present which is perforated by an **"entepicondylar foramen"** through which pass the median nerve and brachial artery.

There are individual differences of habit in what is popularly known as **"posture."** The stance, i.e., the standing attitude, of different people shows distinctive features which are so characteristic that they often serve for recognition of the individual. The sitting position may also show individual characteristics which depend on differences in the positions at the various joints. The movements of individuals are likewise distinctive, and recognition of a person by his gait is an everyday experience. The differences depend on variations of detail in the sequence and range of movement at different joints. The joint postures on which attitudes depend affect the relative position of parts of the skeleton; thus the level of the scapulae relative to the vertebral column shows much variation. The general form of the trunk is greatly influenced by postural habit. If the upper ribs occupy a more oblique position than usual the upper part of the chest appears flattened; if they are more horizontal the chest becomes "barrel shaped." If the lumbar convexity of the spine is pronounced (Fig. 1), the hollow of the back is correspondingly exaggerated (lordosis). A forward bend of the upper thoracic spine, which is often combined with a lateral and forward displacement of the scapulae towards the side of the chest, produces the familiar "round shoulders."

Protuberance of the abdomen is usually produced by an excess of subcutaneous fat in the anterior abdominal wall. Prominence of the lower part of the abdomen may also be produced by a forward tilt of the pelvis (Fig. 1), or may be due to a weakness of the musculature of the abdominal wall. Forward tilting of the pelvis is a normal feature in young children. Protuberance of the abdomen is sometimes due to gas in the alimentary canal, pregnancy, a pathological enlargement of some organ or an accumulation of fluid in the peritoneal cavity. It tends to modify body balance, as exemplified in the characteristic stance and gait of the pregnant woman.

Radiology shows that there are wide individual variations in the size and shape of the bones and viscera. In addition many minor variations are seen which are invisible on inspection or palpation such as those of the pattern of branching of the segmental bronchi (p. 166) or of vessels, e.g., the renal artery (p. 251).

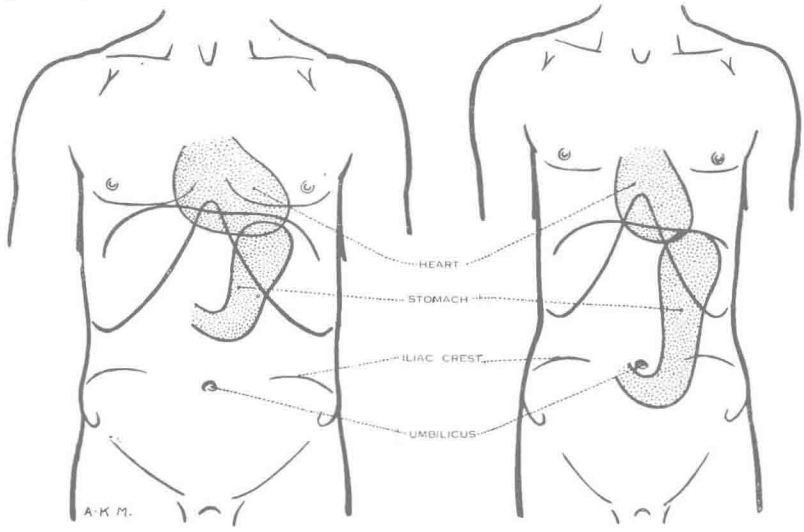

FIG. 2.—Diagrams of the stocky and slender body types, to show the forms of stomach and heart which characterize these types.

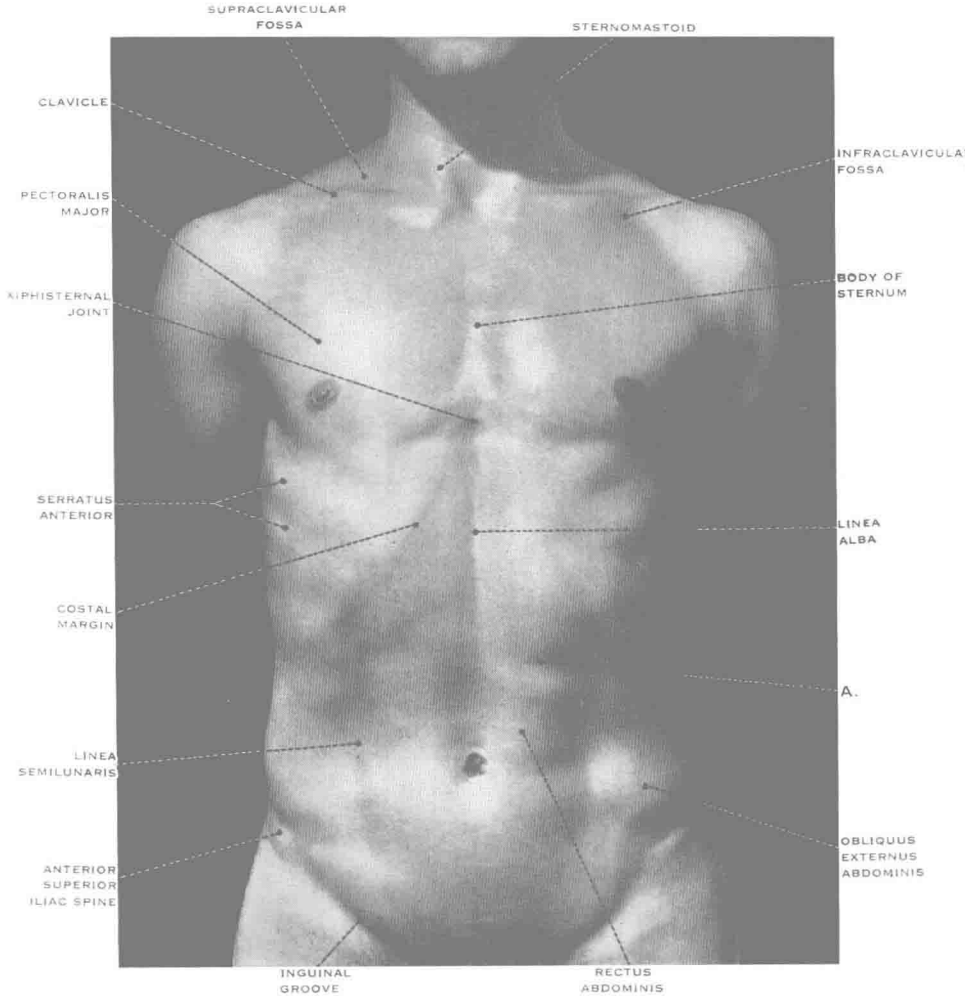

FIG. 3.—Surface features of the trunk of a young male adult. Broad type.
A—tendinous intersection of rectus abdominis muscle.

(A) BODILY TYPES

Differences in the general build of the body have a hereditary basis. Individuals may be classified into two contrasting types based primarily on the form of the trunk:—one with a **short broad trunk** and termed **"hypersthenic"** or **"pyknic"** (Fig. 3), the other with a **long narrow trunk** and termed **"asthenic," "hyposthenic"** or **"leptosomatic"** (Fig. 4). Certain associations can often be recognized between the general body-form and the position of the viscera (Fig. 2). The heart, lungs, stomach and colon exhibit considerable individual differences of form and position. The two widely contrasting types also tend to exhibit characteristic differences in temperament, in their illnesses and in the kinds of psychological disturbance to which they are liable.

The Broad Trunk. This type may be associated with relatively long or short lower limbs. The lumbar region tends to be short, the ribs are situated more horizontally than in the slender subject, the infrasternal (subcostal) angle is wider and the sternum lies at a higher level (Fig. 3). In

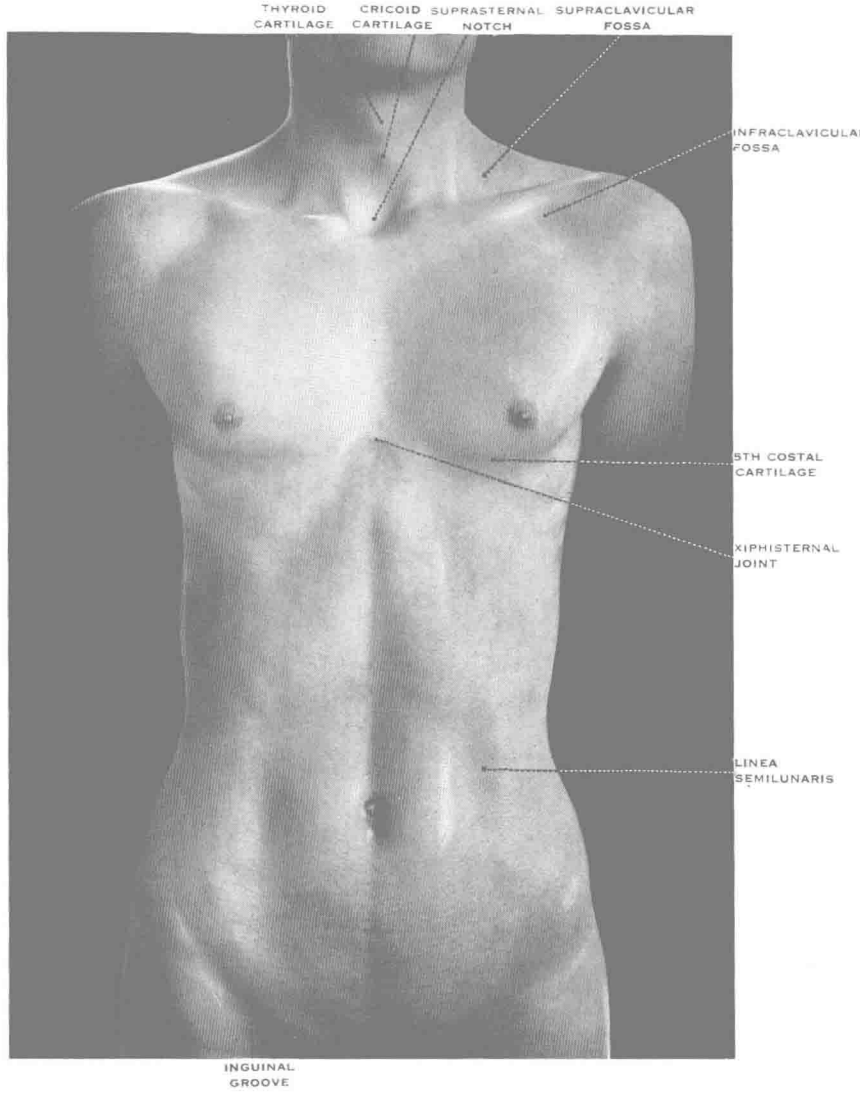

FIG. 4.—Surface features of the trunk of a young male adult. Slender type.

contrast with the slender subject the muscular system of the broad subject tends to be well developed, and for this reason the term hypersthenic has been frequently applied to the pyknic type. In these subjects the heart tends to lie more transversely than in the slender type; the pyloric (distal) part of the stomach tends to be situated at a relatively higher level (Fig. 2) and the stomach is thus generally less elongated in a vertical direction and lies more transversely in the upper part of the abdomen than it does in the subject with a long narrow trunk.

The Slender Trunk. This type of subject tends to have a long lumbar region; the ribs are very obliquely placed; the infrasternal angle is small and the sternum lies at a low level (Fig. 4). This type is frequently described as the hyposthenic or asthenic with reference to the frequency with which a relative weakness or deficiency of tone occurs in the muscular system, resulting in

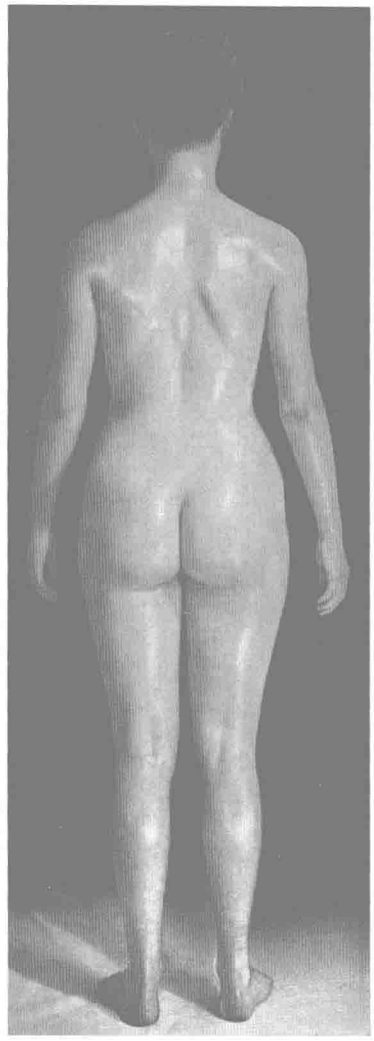

FIG. 5.—Back view of a female figure.

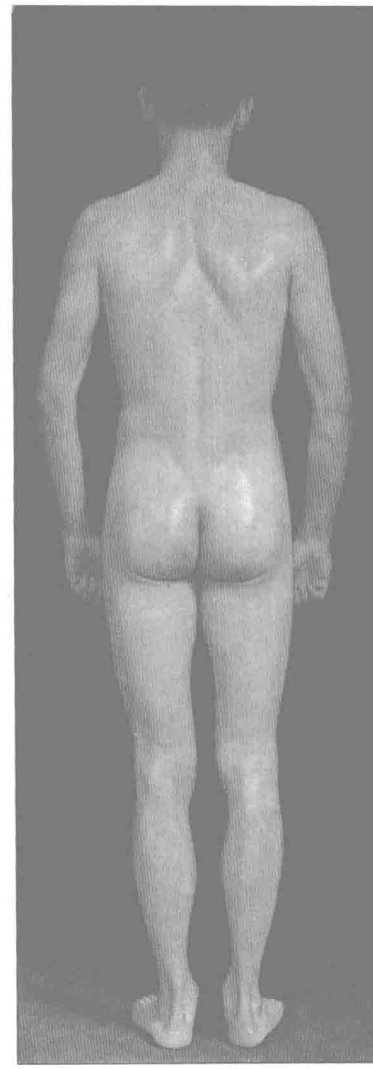

FIG. 6.—Back view of a male figure.

"round" shoulders and a sagging abdominal wall (Fig. 1). The heart is narrow and long, in a vertical direction, and is situated at a lower level than in the broad type (cf. Figs. 159 and 160). The pyloric part of the stomach tends to lie at a relatively low level, and the stomach is thus elongated in a vertical direction.

(B) ASYMMETRY

A slight asymmetry affects both the proportions and the movements of the body. Thus one limb may be 1 cm. shorter than its fellow, and breathing movements may be more extensive on one side than on the other. Such asymmetries commonly show a relationship to the right- or left-handedness of the individual. In the right-handed person the thoracic part of the vertebral column may show a slight convexity to the right (with rotation of the vertebrae), and the right

clavicle tends to be shorter, stouter and more horizontally placed than the left one. In consequence of the associated rotation of the vertebrae the ribs may be more sharply curved posteriorly on the right, whilst the left side of the chest may be more prominent anteriorly. The converse asymmetry is usual in the left-handed. Muscular development also often shows marked asymmetry even though limb lengths may be similar; manual workers (carpenters) and sportsmen (tennis players) often show marked variation between left and right side.

(C) SEX DIFFERENCES

There are physical differences between the male and female form which are independent of race and civilization and are, in the main, due to secondary sexual characteristics. Some differentiation is, however, apparent at a very early age. In the pelvic region, for example, certain of these characteristics are present during early foetal life.

At birth and for several years there is little difference between the male and female child. Until the age of puberty the main differences are those of weight and height; there are periods of special **height-increase,** "stretching out," and **weight-increase,** "filling in," which have different distributions in the sexes during growth. Over a period of a few years, centred round puberty, girls are on the average taller and heavier than boys of the same age.

In general the bony prominences and the superficial muscles are more clearly defined in the adult male than in the female. Owing to the presence of an abundance of subcutaneous fat in women the general contours of the body are more rounded; in particular we may notice the distinctive curves of the breasts, hips and thighs (Figs. 5, 6 and 120). Bony landmarks of the skull, e.g., the glabella and superciliary ridges, are more conspicuous in men than in women. The facial skeleton is smaller in proportion and the jaws are narrower and less prominent in the female than in the male. Notwithstanding these differences it is not possible to determine with certainty the sex of an individual from the size or shape of the skull.

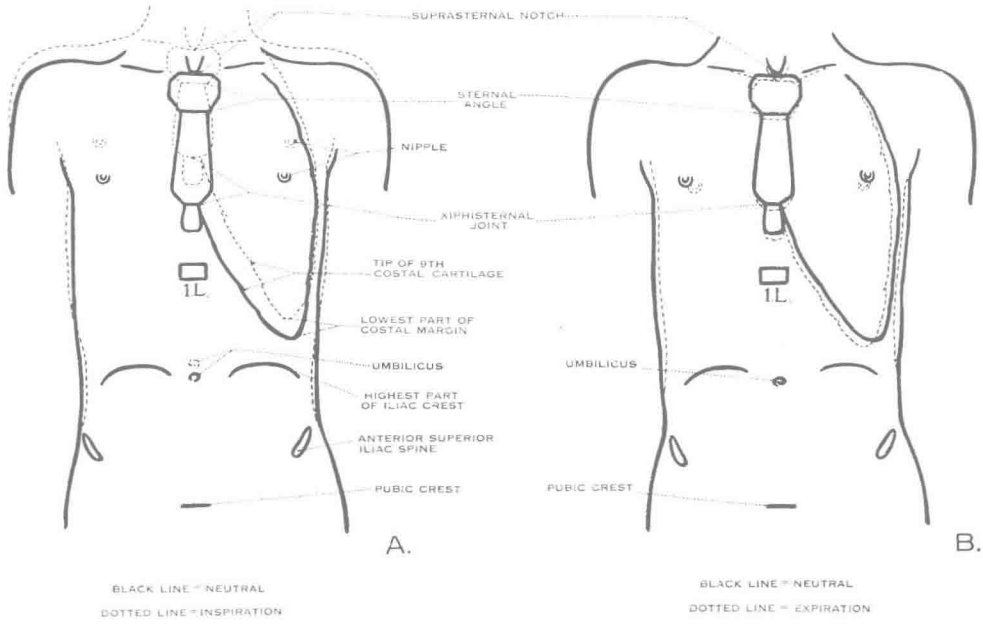

FIG. 7.—Outlines illustrating the respective ranges of movement of the chest and abdominal wall, in full inspiration in **A,** and in full expiration in **B** (from photographs, broad type of individual). The displacements of the umbilicus and nipples are shown.