

# SURFACE ANATOMY

BY

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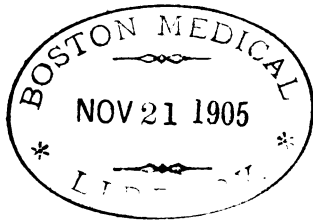
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## P R E F A C E

THIS little book on surface anatomy is written at the request of numerous past and present pupils. It consists for the most part of the course of lectures which I was accustomed to give on the subject when Chief Demonstrator of Anatomy in Trinity College, Dublin, and is very similar to the course which I deliver twice yearly to my private classes. For the facts I am largely indebted to the standard works on anatomy and surgery, but in almost every case, with the exception of some of the cranio-cerebral markings, I have confirmed them by my own observations.

I have tried as far as possible to bring the facts together into a continuous narrative, and to follow an order such as would be adopted by anyone who was studying the subject with a model before him. That a model is necessary need hardly be contended, and as far as the limbs, at any rate, are concerned, the best that the student can employ is himself ; for, if once he becomes thoroughly familiar with his own conformation, no difficulty will be found when dealing with patients. A knowledge of deep anatomy is, of course, essential before the facts of surface anatomy can be appreciated.

My best thanks are due to Dr. E. J. Watson, who very kindly provided me with a series of skiagrams to study, and also made some observations on special points for me ; also to Dr. R. A. Stoney and Dr. R. J. Rowlette, who undertook the revision of the proof-sheets.

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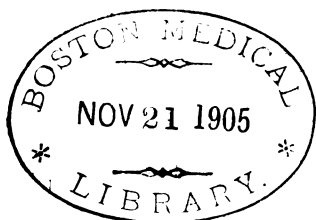
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# SURFACE ANATOMY

## THE HEAD

THE three superficial layers of the scalp—namely, the skin, the subcutaneous fat, and the occipito-frontalis muscle with its aponeurosis—are bound so closely to one another as to form one continuous layer, which is freely movable over the pericranium and bones of the vault of the skull, and is, moreover, so thin as to enable the bony conformation beneath to be felt with ease. Posteriorly the scalp becomes continuous with the neck at the level of the superior curved lines of the occipital bone. Both of these lines can be felt throughout their whole extent, and can be traced outwards on each side to the mastoid process. At the middle line, where they commence, the external occipital protuberance, or inion, constitutes a marked bony projection, which is readily felt, and is immediately above the upper end of the nuchal furrow. Above the inion the convexity formed by the upper part of the occipital bone is situated, and when the finger is drawn along this in the middle line it usually encounters, about  $2\frac{1}{2}$  inches above the inion, a slight depression—the lambda, which corresponds to the position of the posterior fontanelle in the foetal cranium, and which lies at the point of junction of the occipital angle

with the two parietal bones. Beyond this the finger passes in the middle line along the sagittal suture which intervenes between the two parietal bones. This suture may be marked by a slight ridge, but as a rule there is no perceptible evidence of its presence. At its anterior extremity a slight depression may be felt at the place where the two parietal bones join the frontal bone. This point is known as the bregma, and can be determined most readily by bisecting a line drawn vertically across the top of the cranium between the middle points of the two external auditory meatuses. In front of the bregma the finger passes downwards along the middle of the frontal bone on to the forehead, and reaches at the root of the nose the depression known as the nasion, where the frontal bone articulates with the two nasal bones.

In front the scalp region is marked off from the face by the nasion and by the supra-orbital ridges. When the finger is carried along this last-named ridge the following points may be noticed: (1) At its inner part the ridge is blunt and rounded, and affords only very slight protection to the contents of the orbital cavity. (2) Externally the ridge becomes more sharp and projecting, and overhangs the orbit to a considerable extent. (3) At the junction of its inner and middle third a distinct notch or groove can be felt. This is the supra-orbital notch, which lodges the supra-orbital nerve and vessels. (4) The ridge ends externally in the prominent external angular process of the frontal bone which articulates with the frontal process of the malar bone.

When the finger is carried backwards and downwards over the external angular process it reaches the zygoma, which marks the lateral limit of the scalp at its anterior part. The whole of the zygoma, both upper and

lower borders, can be palpated, and the tubercle at its root, immediately in front of the ear, can be felt. Behind the ear the mastoid process is encountered, from which the finger can be carried backwards to again meet the curved lines of the occipital bone.

On each side of the middle line of the scalp, between it and the lateral boundaries of the scalp, the following points can be detected from behind forwards.

1. The convexity formed by the upper portion of the occipital bone. This is bounded in front by the lambdoid suture, which can usually be felt through the scalp tissues in the form of a ridge running from the lambda downwards and outwards towards the mastoid process. This ridge terminates about 2 inches above the tip of the mastoid process at a point called the asterion, where the parietal, mastoid, and occipital bones articulate. Below the asterion the finger can be carried downwards and forwards towards the reflexion of the skin of the ear on to the scalp, across a flat area which is formed by the posterior part of the squamous portion of the temporal bone, and which is thinly covered by the posterior edge of the temporal muscle. The asterion can be conveniently mapped out by taking a point  $1\frac{1}{2}$  inches above and  $1\frac{1}{2}$  inches behind the tip of the mastoid process.

2. The parietal eminence, which overlies at its central point the supramarginal gyrus of the inferior parietal lobule.

3. The superior and inferior temporal ridges. These ridges commence in front at the anterior root of the zygoma, and as the finger is drawn upwards along them from that point the projecting marginal process of the malar bone, which marks the place where the temporal branch of the temporo-malar nerve reaches the surface,

is first encountered. Above this process the fronto-malar articulation is encountered, and then the finger can be carried without interruption along the ridges to their termination behind the ear at the base of the mastoid process. The upper of the two ridges limits the upper attachment of the temporal fascia, while the lower corresponds to the upper margin of the temporal muscle. Below the ridges lies the surface of the temporal muscle, covered over by the tense temporal fascia, which presents a considerable amount of resistance to the examining finger. Immediately behind and above the external angular process of the frontal bone a slight hollow is situated, in the neighbourhood of what is called the orbito-temporal angle. This hollow is a convenient landmark in mapping out some of the cerebral fissures.

4. The frontal eminence, which lies one on each side of the middle line of the forehead, and which is in relation on its deep aspect to the frontal pole of the brain.

5. The supraciliary ridge. This ridge varies widely in extent in different subjects, and is always more marked in men than in women, giving to the former sex the characteristic appearance of the upper part of the face. The ridges overlie the frontal air sinuses, but are not necessarily co-extensive with them, as the latter may extend from the middle line outwards as far as the fronto-malar articulation, and upwards as far as the frontal eminence. The two supraciliary ridges meet in the middle line, their place of junction being indicated by a slight eminence called the glabella, which lies immediately above the hollow caused by the naso-frontal junction.

**Vessels and Nerves of the Scalp**

1. The **supratrochlear** nerve, with its accompanying artery, turns upwards into the scalp round the inner and upper angle of the orbit, immediately above the inner canthus of the eye.

2. The **supra-orbital** nerve and artery enter the scalp through the supra-orbital notch, and from thence pass almost directly upwards and backwards, their terminal twigs reaching in many cases to the posterior margin of the parietal bone.

3. The **temporal** branch of the **temporo-malar** nerve has already been referred to as reaching the surface opposite the marginal process of the malar bone.

4. The **temporal** branches of the **facial** nerve pass vertically upwards into the scalp across the middle of the zygoma.

5. Immediately in front of the external auditory meatus the **superficial temporal** artery can be felt crossing the root of the zygoma, and it is here accompanied by the auriculo-temporal nerve. The artery ascends vertically for a distance of  $1\frac{1}{2}$  inches or more, and then divides, one branch passing forwards towards the frontal eminence, and the other backwards and upwards over the parietal eminence.

6. The **middle temporal** artery ascends vertically from the upper margin of the external auditory meatus, lying deep under cover of the temporal muscle.

7. The **posterior auricular** artery and the corresponding nerve lie deeply sunk at the back of the ear, in the groove between the pinna and the mastoid process.

8. The **small occipital** nerve passes upwards into the scalp along the line of the posterior margin of the

sterno-mastoid muscle, and midway between the inion and the mastoid process.

9. The **great occipital** nerve perforates the deep fascia about half an inch external to and slightly below the level of the external occipital protuberance, and then passes vertically upwards into the scalp along with the occipital artery.

Before commencing the description of the surface relations of the endocranial bloodvessels and of the cerebrum, it is advisable, at the risk of some repetition, to define the following terms :

1. **Nasion**.—This is the middle point of the naso-frontal suture, and is situated at the bottom of the slight depression below the glabella, which separates the forehead from the bridge of the nose.

2. **Bregma**.—This name is applied to the junction of the coronal and sagittal sutures. It is situated on the scalp a little in front of the point of bisection of a line drawn from the middle of one external auditory meatus to the middle of the other.

3. **The Lambda**.—This is the point of junction of the sagittal and lambdoid sutures. It lies about  $2\frac{1}{2}$  inches above the external occipital protuberance, and can usually be felt through the scalp in the form of either an elevation or a depression.

4. **The Inion** is another name applied to the external occipital protuberance.

5. **The Pterion**.—This is the name given to the region in the temporal fossa of the skull where the frontal, parietal, temporal, and sphenoid bones articulate. As a rule, in the European the lines of junction form a suture shaped like the letter **H**. The anterior vertical limb is formed by the coronal and fronto-sphenoidal sutures, the pos-

terior vertical limb by the parieto-temporal and temporo-sphenoidal sutures, and the transverse limb by the spheno-parietal suture. For convenience the term pterion may be limited to the posterior extremity of the horizontal limb. This point is situated about  $1\frac{1}{2}$  inches behind the fronto-malar junction and  $\frac{1}{2}$  inch higher up.

6. **Reid's Base Line** is a line drawn around the skull through the lowest point of the infra-orbital margin and the centre of the external auditory meatus.

7. **The Pre-auricular Point** is situated on Reid's base line immediately in front of the tragus of the ear and at the root of the zygoma.

8. **The Auricular Point** is the centre of the external auditory meatus.

9. **The Asterion** is the point of junction of the lambdoid with the parieto-mastoid and occipito-mastoid sutures. It lies  $1\frac{1}{2}$  inches above and  $1\frac{1}{2}$  inches behind the tip of the mastoid process.

### Cranial Sutures

1. **Coronal Suture.**—This can be mapped out on the scalp by drawing a line across the vertex of the cranium from the front of one pterial region to the front of the other.

2. **The Sagittal Suture** extends in the middle line from the bregma to the lambda.

3. **The Lambdoid Suture** extends on each side from the lambda to the asterion.

4. The highest point of the *squamo-parietal suture* lies about  $1\frac{3}{4}$  inches vertically above the pre-auricular point.

### Relation of Intracranial Bloodvessels to the Surface

1. **Superior Longitudinal Sinus.**—The line which maps out this sinus extends along the middle line of the scalp from the nasion to the inion. In front, the sinus is narrow, and does not much transgress the middle line, but at its posterior part it attains a width of nearly an inch, and extends about half an inch outwards on each side from the middle line. Its extreme posterior part may lie altogether to the right of the middle line, where the sinus descends to join the right lateral sinus.

2. **The Lateral Sinus** extends, in the form of a curve convex upwards, from the inion to a point half an inch above the tip of the mastoid process. Its position is subject to great variation, and, unfortunately, the particular position that it occupies in any given individual cannot be determined beforehand. Birmingham, however, gives the following lines between which he states it is always to be found: (1) A line drawn from a point  $\frac{1}{2}$  inch above the inion to a point  $1\frac{1}{2}$  inches behind and  $1\frac{1}{4}$  inches above the centre of the external auditory meatus. (2) A line drawn from a point  $\frac{1}{2}$  inch below the inion to cut Reid's base line  $1\frac{1}{2}$  inches behind the meatus. These lines represent the extreme upper and lower limits of the sinus, but the average can be more easily mapped out as follows. Draw a guiding line from the inion to the middle of the external auditory meatus. The highest point of the sinus is represented as a rule by a point  $\frac{2}{3}$  inch above the middle of this line, and the posterior part of the sinus can be mapped out by joining that point to the inion. The anterior part of the sinus passes from the same point forwards and slightly downwards to the back of the ear, and then descends vertically along the reflection of the skin of the ear on

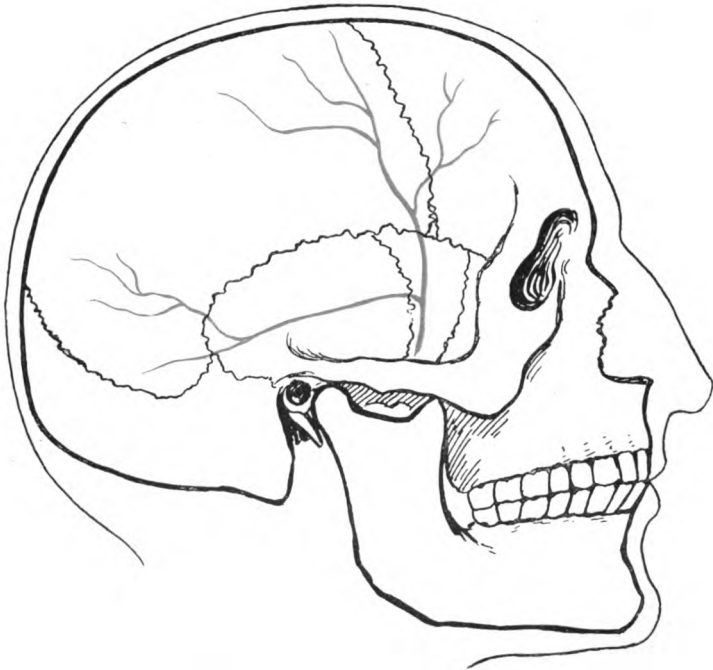


FIG. 1.—DIAGRAM TO ILLUSTRATE THE RELATION OF THE MIDDLE MENINGEAL ARTERY TO THE SKULL AND SURFACE OF THE SCALP.

to the mastoid process to within  $\frac{1}{2}$  inch of the tip of that process. At this level it turns inwards in relation to the deep aspect of the mastoid portion of the temporal bone. (See Fig. 2.)

**Middle Meningeal Artery.**—The main trunk of the middle meningeal artery ascends vertically from the point of junction of the anterior two-fifths with the middle fifth of the zygoma for a distance of about half an inch, and then divides into its posterior and anterior divisions. The posterior division turns backwards on the deep aspect of the squamous portion of the temporal bone, lying, as a rule, under cover of the middle third of the temporal muscle. The larger anterior division turns upwards and forwards on the deep aspect of the anterior inferior angle of the parietal bone. Its further course can be mapped out by determining three points upon it as follows. Draw a line horizontally backwards from the external angular process of the frontal bone, and mark upon it points 1 inch,  $1\frac{1}{2}$  inches, and 2 inches respectively behind that process. At the first point the artery lies 1 inch vertically above the zygoma, at the second point it lies  $1\frac{1}{2}$  inches above the zygoma, and at the third point 2 inches above the zygoma. The direction of the vessel is thus seen to be backwards and upwards under cover of the front portion of the parietal bone.

### Cranio-Cerebral Topography

**Superior Border of Hemisphere.**—The first important step in determining the relation of the brain to the surface of the scalp consists in mapping out the borders of the cerebral hemisphere. The superior or supero-mesial margin is represented by a line drawn along the scalp from the nasion to a point just above the inion. The margin does not quite reach the middle line, in conse-

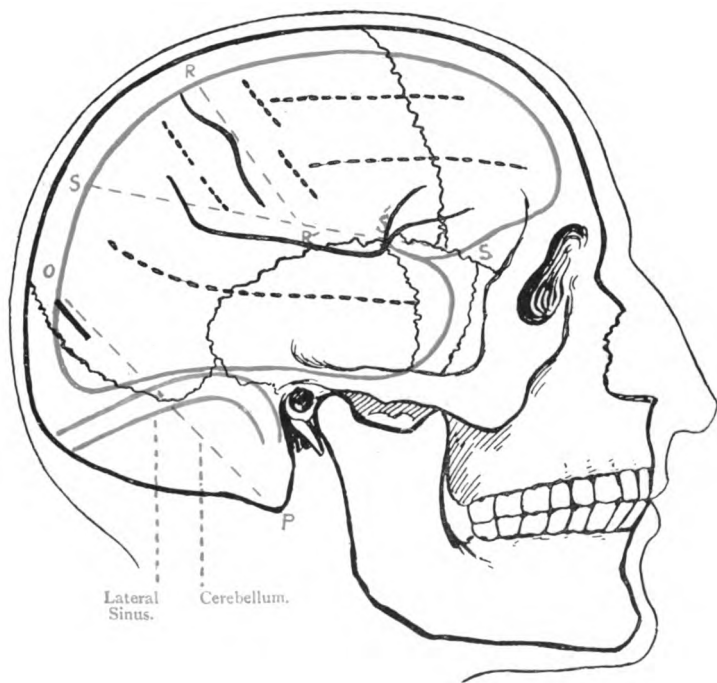


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF CEREBRAL HEMISPHERE AND LATERAL SINUS.

S S, Sylvian line; S', Sylvian point; R R', Rolandic line; O P, Occipito-parietal sulcus and its continuation to the tip of the mastoid process. The heavy black lines represent respectively the various parts of the Sylvian fissure, the Rolandic fissure, and the external parieto-occipital fissure. The dotted black lines represent the intralobar fissures as described in the text.

quence of the presence of the superior longitudinal sinus, but lies in front about  $\frac{1}{5}$  inch from that line, and behind at least  $\frac{1}{2}$  inch from it. Owing to the fact that the sinus usually inclines to the right as it approaches its termination, the right hemisphere is further from the middle line than the left at its posterior part. The actual separation of the hemispheres only involves their extreme upper margins, however, owing to the triangular shape of the sinus in section, and immediately below the level of the sinus the inner surface of the cerebrum reaches the middle line in contact with the falx cerebri.

**Inferior Border of Hemisphere.**—The inferior margin of the hemisphere, where it comes in contact with the outer cranial wall, is composed of the supraciliary margin in front and the infero-lateral margin posteriorly. It can be mapped out on the surface as follows. Commencing at the nasion in front, draw a curved line outwards and convex upwards, about  $\frac{1}{3}$  inch above the supra-orbital ridge, to cut the temporal ridge  $\frac{1}{2}$  inch above the fronto-malar junction. This last-named point is readily felt through the scalp, as it almost exactly corresponds to the orbito-temporal angle. This angle is formed by the meeting of the temporal ridge, the direction of which is upwards and backwards, with the posterior margin of the external angular process of the frontal bone, which passes downwards and backwards to become continuous with the posterior margin of the malar bone. From the orbito-temporal angle the inferior margin of the hemisphere passes almost directly backwards to the pterion, the position of which has already been described. On reaching the pterion, the direction of the margin changes, and it passes downwards and slightly forwards in a curved manner to the middle of the upper margin of the zygoma, circum-

scribing as it does so the temporal pole. This line corresponds closely to the position on the skull of the spheeno-temporal suture. The line then continues backwards along the upper margin of the zygoma and about  $\frac{1}{3}$  inch above the external auditory meatus, to cut the supramastoid crest at or slightly above the level of the asterion. From the asterion the line is then continued backwards along the upper margin of the lateral sinus.

### Cerebral Fissures and Convolution

**The Fissure of Sylvius.**—The place where the stem of the Sylvian fissure reaches the outer surface of the cerebral hemisphere is known as the Sylvian point, and corresponds, according to Victor Horsley, to the pterion as already defined. It is therefore to be marked on the scalp  $1\frac{1}{2}$  inches behind the fronto-malar junction and  $\frac{1}{2}$  inch higher up. From the Sylvian point the three limbs of the fissure radiate in different directions.

The posterior horizontal limb passes from the Sylvian point backwards and somewhat upwards towards the lower part of the parietal eminence for a distance of about  $2\frac{1}{2}$  inches. Its anterior part corresponds in the adult to the squamo-parietal suture, but its posterior part lies above the level of that suture and under cover of the lower half of the parietal bone. According to Thane, this fissure can be mapped out by drawing a line from the fronto-malar junction backwards through the Sylvian point as far as the parietal eminence, and this method is probably the most accurate that has yet been devised. Another and simpler method is that of Chiene, and consists in drawing a line from the fronto-malar junction to a point three-fourths of the way from the glabella, along a line drawn over the scalp from the

glabella to the inion. The portion of the line thus drawn, which lies between the pterion and the parietal boss, overlies the posterior horizontal limb of the Sylvian fissure.

The anterior horizontal limb lies under cover of the speno-parietal suture, and can be mapped out on the surface by drawing a line forwards from the Sylvian point for a distance of an inch, parallel with Reid's base line.

The anterior ascending limb is mapped out by drawing a line an inch in length upwards and slightly forwards from the Sylvian point, so as to make a right angle with the line of the posterior limb. The upper part of this line crosses the coronal suture.

**Fissure of Rolando.**—On account of the localisation of the most important motor functions of the cortex in the neighbourhood of this fissure, it is most necessary that its relation to the surface should be accurately known. Owing to the extreme irregularity of the fissure, however, it is almost impossible to give any measurement that could be adopted clinically, and would delineate the fissure with accuracy upon the scalp. At most, the general direction of the fissure can be indicated, but, fortunately, that is sufficient for all practical purposes. The fissure throughout its entire extent lies under cover of the parietal bone, and is best marked out by determining its superior and inferior extremities upon the surface, and drawing a straight line between these two points. The line thus drawn will then represent rather the central part of the Rolandic area than the Rolandic fissure itself. The superior extremity of the fissure cuts the supero-mesial margin of the hemisphere, and the point corresponding to this on the surface is known as the superior Rolandic point.

It is situated on the scalp  $\frac{1}{2}$  inch behind the point of bisection of a line drawn over the scalp from the nasion to the inion. This point lies nearly 2 inches behind the bregma, and, of course, a little external to the mesial plane, on account of the presence of the superior longitudinal sinus.

Numerous methods have been described for determining the inferior extremity of the fissure, one of the best being Thane's. This authority states that the fissure of Rolando terminates inferiorly just above the Sylvian line at a point on that line 1 inch behind the Sylvian point. This point is therefore called the inferior Rolandic point, and a line drawn from it to the superior Rolandic point is known as the Rolandic line. An alternative method of determining the inferior Rolandic point is that of Reid. It consists in drawing a line upwards from the pre-auricular point at right angles to Reid's base line. Where this vertical line cuts the Sylvian line is the point required. It must be remembered, however, that the fissure of Rolando really terminates a little above the level of the fissure of Sylvius, and that consequently the lower end of the Rolandic line lies just above the level of the inferior Rolandic point, as determined by both of the above methods.

The angle which the fissure of Rolando makes anteriorly with the middle line of the scalp is called the Rolandic angle. It varies within fairly wide limits in different subjects, but is on an average, according to Cunningham,  $71.7^\circ$ , or, according to Horsley,  $69^\circ$  in British skulls. If the size of this angle be remembered, it will be plain that, as soon as the superior Rolandic point is determined, the fissure of Rolando can be mapped out on the surface by drawing a line from that point downwards

and forwards on the scalp for a distance of about  $3\frac{1}{2}$  inches, making an angle of about  $70^\circ$  with the supero-mesial margin of the hemisphere.

**Parieto-occipital Fissure.**—This fissure lies close to the situation of the lambda, usually, however, being situated a little above that level. It is indicated on the surface by a line, an inch in length, drawn outwards at right angles to the supero-mesial margin of the hemisphere from a point  $\frac{1}{4}$  inch above the lambda. According to Chiene, the exact level at which this fissure cuts the supero-mesial margin of the hemisphere is at a point three-fourths of the distance along the scalp from the glabella to the inion.

**Lobes of the Cerebrum.**—As soon as the method of mapping out the margins of the cerebrum and the three above-described intralobar fissures has been thoroughly mastered, it will be apparent that the different lobes of the brain can be readily marked out on the surface without drawing any new lines. It is, in fact, only necessary to continue the line, which maps out the external parieto-occipital fissure, downwards to the tip of the mastoid process, when all the lobes will appear ready mapped out upon the surface. Thus : (1) The frontal lobe is bounded above by the upper margin of the hemisphere, behind by the fissure of Rolando, and below by a portion of the Sylvian fissure and by the inferior margin of the cerebrum. (2) The parietal lobe is bounded in front by the fissure of Rolando, above by the upper margin of the hemisphere, behind by the parieto-occipital fissure and its continuation downwards, and below by the Sylvian line. (3) The temporal lobe is bounded above by the Sylvian line, behind by the lower part of the line drawn from the parieto-occipital fissure, and below and in front by the

lower margin of the cerebrum. (4) The occipital lobe is bounded in front by the line drawn from the parieto-occipital fissure to the mastoid process, above by the upper margin of the cerebrum, and below by the lateral sinus.

**Intralobar Fissures : Frontal Lobe.**—The superior precentral sulcus lies parallel with and about  $\frac{2}{3}$  inch in front of the upper part of the fissure of Rolando. The inferior precentral sulcus is parallel with and about  $\frac{2}{3}$  inch in front of the inferior part of the Rolandic fissure, and is only separated by a distance of 2 or 3 millimetres from the lower part of the coronal suture. The inferior frontal sulcus lies under cover of the anterior part of the temporal crest, extending forwards from the precentral sulcus. The superior frontal sulcus lies parallel with the inferior frontal, and almost midway between it and the upper margin of the hemisphere.

**Parietal Lobe.**—The two parts of the post-central sulcus lie parallel with and about  $\frac{2}{3}$  inch behind the fissure of Rolando. The horizontal limb of the intra-parietal sulcus lies about midway between the Sylvian line and the supero-mesial margin of the hemisphere. The supramarginal gyrus lies immediately under cover of the most prominent part of the parietal eminence.

**Temporal Lobe.**—The first temporal sulcus lies  $\frac{3}{4}$  inch below and parallel with the Sylvian line.

**The Cerebellum**, situated in the posterior cranial fossa, is in relation to the cranial wall below the level of the lateral sinus, and therefore below the level of the scalp proper. It can be best reached by trephining at a point about  $1\frac{1}{2}$  inches behind and about  $\frac{1}{4}$  inch below the external auditory meatus.

## THE FACE

THE soft structures which cover over the bony framework of the face are for the most part thin and lax, and in consequence most of the osseous projections and ridges of the face are accessible to direct palpation.

Commencing below, the lower margin of the mandible can be felt throughout its entire extent, being covered only by skin and the fibres of the platysma muscle, and it will be noticed to become gradually thicker as the symphysis menti is approached. A slight depression can often be felt upon it at the anterior margin of the masseter muscle, and is formed by the facial artery turning over it at that place. From the angle of the jaw the finger can be carried upwards along the posterior margin of the ramus as far as the condyle, a small portion of the parotid gland alone intervening between the finger and the bone. The condyle lies immediately below the tubercle at the root of the zygoma, and when the jaw is opened and shut it can be felt moving under the finger. Behind it, when the jaw is protracted, the finger slips into a depression which overlies the glenoid fossa, while in front of it a slight fossa is felt on deep pressure, which corresponds to the sigmoid notch. Anterior to this notch lies the coronoid process, from the anterior margin of which the finger can be carried down along the front of the ramus to the body of the jaw. The outer aspect of the ramus itself is covered by the masseter

muscle, the margins of which are rendered very distinct by clenching the jaw. The outer aspect of the body of the mandible presents in the middle line in front a vertical ridge, which terminates inferiorly in the prominence of the chin. The latter is often marked by a couple of bony tubercles, one on each side of the middle line. External to the chin the depression known as the incisive fossa can be felt, and also the oblique line which bounds this fossa externally.

The position of the mental foramen can often be made out by the pain caused by pressure over the mental nerve as it emerges from the bone. It lies below the interval between the bicuspid teeth, and, in the adult, midway between the upper and lower margins of the body of the jaw.

In the superior maxilla the incisive crest and the anterior nasal spine, to which the septum of the nose is attached, can be felt in the middle line, and laterally the incisive and canine fossæ, separated from one another by the canine eminence, can be felt. External to the canine fossa lies the malar crest of the superior maxilla and the malar bone itself. The whole of the anterior surface and the borders of the latter bone are practically subcutaneous. The malar bone varies in prominence in different individuals, thereby giving one of the most important characteristics to the face.

The osseous boundaries of the anterior nares are all distinctly palpable. They are formed on each side by the superior maxilla and its nasal process, and above by the inferior margin of the nasal bones. The lateral nasal cartilages and the cartilages of the nasal aperture, which are attached to these boundaries, are freely movable upon them. The aperture of the nostril is directed downwards, and is usually oval in shape, with

its long axis directed forwards. It is important to remember that its orifice is situated a little above the level of the floor of the nasal chambers. Immediately within the orifice are placed a number of stiff hairs, or vibrissæ, and as a rule the lower part of the septum nasi and the anterior extremity of the inferior turbinated bone are visible. By the aid of a speculum, a more complete view of the inferior turbinated and of part of the middle turbinated bones can be obtained, and the posterior pharyngeal wall can be made out. The spur formed at the articulation of the vomer with the perpendicular plate of the ethmoid forms a prominent object in all nasal examinations.

The bridge of the nose is formed by the nasal bones, which articulate by their outer margins with the nasal processes of the superior maxillæ. Between the nasal bones in the middle line a faint groove can be felt, which corresponds to the interval between them. Above this the naso-frontal suture lies at the bottom of the small depression below the glabella, and separates the nose from the forehead.

The bony margins of the orbit can be easily felt. Above is the supra-orbital ridge of the frontal bone, which terminates on each side in the internal and external angular processes respectively. Externally, lies the malar bone; below, lie the malar and superior maxillary bones, and internally, the nasal process of the superior maxilla. The boundary as a whole is much more prominent externally than internally. By pressing the finger against the superior border about the junction of its inner and middle thirds, the supra-orbital notch can be detected, and a little internal to this may be felt the prominence to which the pulley of the superior oblique muscle of the eye is attached. At the inferior

internal angle of the orbit the upper opening of the lachrymal canal can be appreciated by firm pressure backwards, and immediately above this lies the internal tarsal ligament, which can be felt in the form of a rounded cord, rendered tense when the eyelids are closed. This ligament passes transversely across the front of the nasal duct, and forms an important guide to its position.

Separating each eyelid from the margins of the orbit is a curved sulcus. That which intervenes between the upper eyelid and the supra-orbital ridge is called the *superior palpebral sulcus*, and is very much deeper than the *inferior palpebral sulcus*, which separates the lower lid from the inferior margin of the orbit. Below this last-named sulcus a broad, shallow groove, called the *palpebro-malar sulcus*, is seen extending from the root of the nose outwards towards the malar bone. The place where the eyelids meet externally is called the outer canthus of the eye, and extending outwards from this a faint transverse groove in the skin, to which the term *external palpebral sulcus* is applied, can be seen, especially when the eyelids are tightly closed. The eyelids meet internally at the internal canthus, and here a faint *internal palpebral sulcus* is sometimes visible.

Within the substance of each eyelid the tarsal plate can be felt, and both plates can be traced internally to the point where they become continuous with the internal tarsal ligament. On everting the eyelid the palpebral conjunctiva is rendered visible, and the Meibomian glands appear as faint yellowish streaks lying on the deep aspect of the tarsal plate. The free margin of each eyelid is somewhat thickened and rounded. Externally the margins meet at a definite angle, but when traced inwards they are found to become

parallel for a short part of their course, and to bound a small quadrilateral area called the *lacus lachrymalis*. The floor of this area is of a reddish-yellow colour, and is somewhat raised owing to the presence of a collection of small mucous glands. On the margin of the eyelid, at the place where the curved portion joins the horizontal part, a small elevation can be seen, to which the term *papilla lachrymalis* is applied. Close inspection shows this papilla to be perforated on its summit by a small orifice, the *punctum lachrymale*, which leads into the lachrymal canaliculus, and thence to the nasal duct.

A considerable portion of the eyeball itself is visible when the eyelids are opened, and it will be noticed that the conjunctiva is only loosely attached to its substance. The places of reflection of the conjunctiva above and below on to the eyelids are known as the *superior* and the *inferior conjunctival fornices*. The upper fornix is deep, and is rather difficult to inspect, but the inferior one is shallow, and is readily seen by depressing the lower eyelid. Under cover of the conjunctiva, at the upper and outer angle of the orbit, a small portion of the lachrymal gland may be visible.

Below the palpebro-malar sulcus lies the cheek, which is traversed by a distinct groove called the *nasolabial furrow*. This furrow commences just above the ala of the nose, and extends from thence downwards and outwards to the angle of the mouth. It is formed in part, at any rate, by the pull of the zygomatic muscles. The general mass of the cheek is composed of the facial muscles, and of the integuments above, while, lower down, in front of the masseter muscle, there is a large pad of fat, the buccal pad, lying on the surface of the buccinator muscle. This pad of fat gives the characteristically rounded appearance to the face of the child, while, in

old age, its atrophy in part accounts for the falling in of the cheeks that then takes place. The principal muscle of the lips is the orbicularis oris, with which, however, are blended the fibres of many of the other facial muscles. In the middle of the upper lip there exists in front a deep vertical groove, the philtrum, which recalls the mode of development of this portion of the face.

Within the cavity of the mouth the inner aspect of the lips and cheeks can be examined, and numerous irregularities of their surface will be noticed, caused by the presence beneath the mucous membrane of collections of glands. The fræna of both the upper and lower lips will also be noticed, and on the inside of the cheek, at the level of the second molar tooth of the upper jaw, a small papilla can be seen, on the summit of which opens the duct of the parotid gland. All the teeth can be studied, and also the alveolar aspect of both the jaws. That portion of the mouth which lies in front of the teeth will be seen to communicate with the posterior part of the oral cavity behind the last molar teeth when the jaws are closed.

In the posterior portion of the mouth the inner aspect of almost the whole of the lower jaw can be palpated, with the exception of a portion of the ascending ramus, and the lingual nerve can sometimes be rolled under the finger, where it lies in contact with the bone below the last molar tooth. On the dorsum of the tongue the filiform and fungiform papillæ are evident, while further back the row of circumvallate papillæ is seen. Behind these latter the smooth mucous membrane of the back of the tongue may be inspected when that organ is protruded, and occasionally even the tip of the epiglottis comes into view. On the under aspect of the tongue, in

the middle line, the frænulum is seen attaching it to the posterior aspect of the mandible, and as a rule the orifices of Wharton's ducts, and rarely the openings of the ducts of the sublingual gland, are seen on each side of this fold. More externally the large ranine veins are perceptible, and the pulsation of the lingual artery may be felt. The sublingual gland lies on each side of the frænulum of the tongue, forming an elongated swelling on the floor of the mouth. This gland is merely covered above by mucous membrane, the latter being reflected off it on to the inner aspect of the jaw.

The roof of the mouth is formed by the hard and soft palate. The former of these is formed by the palatal processes of the superior maxillary and of the palate bones. It presents along its middle line a distinct ridge or raphe, which terminates in front in a small elevation termed the *incisive pad*, and posteriorly is prolonged along the soft palate as far as the uvula. The incisive pad overlies the anterior palatine fossa. From the anterior part of the median raphe a few transverse folds of mucous membrane pass outwards on each side. At the posterior part of the hard palate the hamular process can easily be felt on each side, and the tense pterygo-palatine ligament can be traced downwards from it to the lower jaw. Immediately in front of the hamular process lies the posterior palatine foramen, through which passes the anterior palatine nerve and artery. Both nerve and artery pass forwards from this point in contact with the alveolar margin of the jaw as far as the incisive pad. The soft palate is attached to the posterior margin of the hard, and forms a movable curtain which bounds the isthmus faucium superiorly. Its posterior margin is free, and from its centre there hangs downwards a conical projection, the uvula.

From the anterior and posterior margins of the base of the uvula prominent folds of mucous membrane arise on each side, and pass downwards and outwards, forming what are called the anterior and posterior pillars of the fauces. The anterior pillar blends with the posterior part of the side of the tongue, and contains within its substance the palato-glossus muscle, while the posterior pillar passes downwards and backwards in the lateral pharyngeal wall, containing within its substance the palato-pharyngeus muscle. Between these two folds, and situated at the side of the base of the tongue, is the tonsil, on the buccal aspect of which numerous small depressions or crypts can be seen. Externally the tonsil lies about the level of the angle of the lower jaw.

Behind the posterior margin of the ramus of the lower jaw externally, between it and the mastoid process, is situated the parotid gland. The lower margin of the gland can be marked out by a line drawn from the tip of the mastoid process to the angle of the jaw, while above the gland extends as high up as the zygoma. Behind, it comes in contact with the external auditory meatus, and sends a process into the posterior portion of the glenoid fossa. The gland is not limited to the region behind the lower jaw, but extends forwards upon the surface of the masseter muscle for a considerable distance, and from this anterior margin the duct of the gland (*Steno's duct*) takes origin. The duct extends forwards, lying about  $\frac{3}{4}$  inch below the zygoma, and sinks deeply, in front of the masseter muscle, to reach the buccinator. The point of bisection of a line drawn from the lower margin of the lobule of the ear to the lower margin of the ala nasi lies just below the middle of Steno's duct. The course of the duct can be

mapped out with considerable accuracy by drawing a line from the auricular point forwards to bisect a line drawn from the margin of the nostril to the angle of the mouth. Only about the middle third of this line, of course, overlies the duct. As already mentioned, the papilla, on the summit of which the duct opens into the mouth, can be felt on the inner aspect of the cheek.

Behind the parotid region is situated the pinna, or external ear, which is attached to the margins of the external auditory meatus of the temporal bone. Different names are applied to the various parts of the pinna. The *helix* is the outer curved margin of the ear; it commences in the fossa, or *concha*, which leads into the external auditory meatus, and terminates below in the soft dependent *lobule*. Behind the concha is situated a ridge which is called the *antihelix*; this bifurcates superiorly, so as to form two fossæ—an anterior *triangular* and a posterior *scaphoid*. Projecting backwards over the entrance of the meatus is a small prominence, to which the name *tragus* is applied; while a somewhat similar process posteriorly is termed the *antitragus*. The notch between these two processes is termed the *incisura intertragica*. The external auditory meatus is about an inch in length, and leads from the bottom of the concha inwards and somewhat forwards. Its outer third is cartilaginous, and its inner two-thirds bony. It is terminated internally by the membrana tympani, which is placed obliquely across the passage, and, embedded in the substance of which, the processus gracilis and the handle of the malleus can be seen by the aid of a speculum. The margins of bone bounding the bony external auditory meatus can only be felt in part, but above and posteriorly, immediately below the supramastoid crest and in front of the mastoid

process, a small triangle can readily be made out. This triangle is termed the suprameatal triangle, and is an important guide to the position of the mastoid antrum, which lies about half an inch immediately deep to it.

### Bloodvessels of the Face

1. The **facial artery** enters the face by crossing the mandible at the anterior margin of the masseter muscle, and from thence passes upwards and inwards in a rather sinuous course just behind the angle of the mouth to the inner canthus of the eye. The vessel can be felt pulsating throughout the lower portion of its course. As it passes upwards it gives off the inferior and superior coronary arteries, which can be felt pulsating beneath the mucous membrane of the upper and lower lip respectively; and also the lateral nasal twig, which supplies the side of the nose. The facial vein lies posterior to the artery on the face, but it leaves the face at the same point—namely, the anterior margin of the masseter muscle.

2. The **transverse facial artery** arises from the superficial temporal, and passes transversely forwards on to the face about half an inch below the zygoma and just above Steno's duct. The other bloodvessels of the face accompany the nerves, and will be referred to in connection with these.

### Nerves of the Face

1. **Motor Nerves.**—The main trunk of the facial nerve can be mapped out by drawing a line from the root of the mastoid process forwards to the middle of the posterior margin of the ramus of the lower jaw. In the face and scalp its main branches are distributed as

follows : (1) The temporal branches turn vertically upwards over the middle of the zygoma into the scalp ; (2) the malar branches pass directly inwards across the convexity of the malar bone ; (3) the infra-orbital branch passes inwards towards the ala of the nose ; (4) the buccal branch passes towards the angle of the mouth ; (5) the supra-mandibular branch runs inwards about the middle of the lower jaw ; (6) the inframandibular branch emerges from the parotid gland near the angle of the jaw, and passes forwards and downwards into the neck.

2. **Sensory Nerves.**—Most of these are derived from the three divisions of the trigeminal nerve. From the ophthalmic division come the supra-orbital and supra-trochlear, the surface marking of which has already been described ; the infratrochlear, which lies just above the inner canthus of the eye ; the nasal, which is distributed on the outer aspect of the lower part of the nose ; and the palpebral, which emerges on the face just above the outer canthus. Accompanying each of these nerves is a small arterial twig derived from the ophthalmic artery.

From the superior maxillary division are derived : (1) The infra-orbital, which enters the face about  $\frac{1}{4}$  inch vertically below the mid-point of the infra-orbital margin, and then divides into branches which radiate to the lower eyelid, to the side of the nose, and to the upper lip. Deep pressure over the site of the infra-orbital foramen usually gives rise to pain due to pressure upon the trunk of this nerve. Accompanying the nerve is the infra-orbital artery, which is a branch of the internal maxillary. (2) The malar branch of the temporo-malar, which enters the face at the point of maximum convexity of the malar bone.

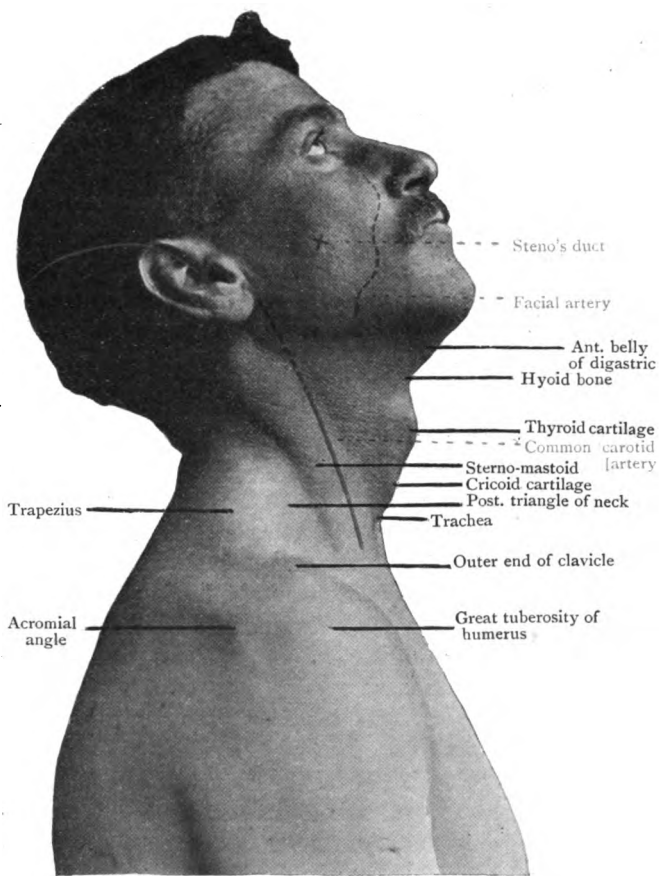
From the inferior maxillary division are derived :

- (1) The mental nerve, which, with its accompanying artery, enters the face through the mental foramen. This foramen is situated vertically below the interval between the two bicuspid teeth of the lower jaw, and usually about midway between the upper and lower margin of the jaw in the adult. Pressure over the site of this foramen gives rise to a distinct sense of pain.
- (2) The buccal nerve, which, entering the face at the middle of the anterior margin of the masseter muscle, passes from thence forwards towards the angle of the mouth.

## THE NECK

THE region of the neck is limited below and in front by the upper margin of the sternum, and by the clavicle on each side, while, behind, there is no sharp line of demarcation between it and the back. Above it is bounded by the lower margin of the mandible, by lines drawn from the angle of the jaw on each side to the root of the mastoid process, and by the superior curved lines of the occipital bone.

The neck region is divided into well-defined anterior and posterior areas by the two sterno-mastoid muscles. These muscles lie close together at their origin below, but diverge widely when traced up towards their insertion into the mastoid processes and into the superior curved lines of the occipital bone. Below, the clavicular and sternal heads of the muscle are distinct from one another, and are separated by a small depression which extends upwards for an inch or more above the clavicle. Higher up, however, they completely fuse into a single belly, the anterior fibres of which are derived from the sternal head, and the posterior of which principally represent the clavicular head. The anterior area of the neck lies in front of these muscles, and is triangular in shape, with the apex below at the suprasternal notch, and the base above extending from one mastoid process to the other. The posterior region behind these two muscles is also triangular in shape, with a



**FIG. 3.—SIDE OF HEAD AND NECK.**

The upper dotted part of the red line in the Neck indicates the position of the External Carotid Artery.

blunted apex above at the occipital bone, and with its base below where the neck and back become continuous with one another.

**Posterior Region.**—That portion of the posterior area which lies behind the anterior margin of the trapezius muscles will be described in connection with the back, and it is only necessary now to consider the surface anatomy of that portion of it which is included between the anterior margin of the trapezius muscle and the posterior margin of the sterno-mastoid. This region presents itself as an elongated furrow, narrow above at its commencement at the occipital bone, and wider and deeper below, above the middle of the clavicle. It winds spirally round the neck, following the border of the trapezius muscle, and corresponds to what is known as the posterior triangle of the neck. In emaciated subjects it can often be seen to be divided into an upper and a lower part by the posterior belly of the omo-hyoid muscle, which crosses it obliquely from below upwards and inwards about half an inch above the level of the clavicle. The floor of the upper part of this triangle is formed by the splenius and levator anguli scapulæ muscles, and by deep pressure against these the posterior aspect of the transverse processes of the upper cervical vertebræ can be distinguished. At the extreme apex of the triangle the occipital artery can sometimes be felt pulsating, and along the posterior margin of the sterno-mastoid a row of lymphatic glands can readily be palpated when at all enlarged. Emerging into this triangle from under cover of the sterno-mastoid are several nerves, most of which are derived from the cervical plexus, which latter lies under cover of the upper portion of that muscle. They can all be mapped out by a series of lines com-

mencing at the mid-point of the posterior margin of the sterno-mastoid, and are as follows :

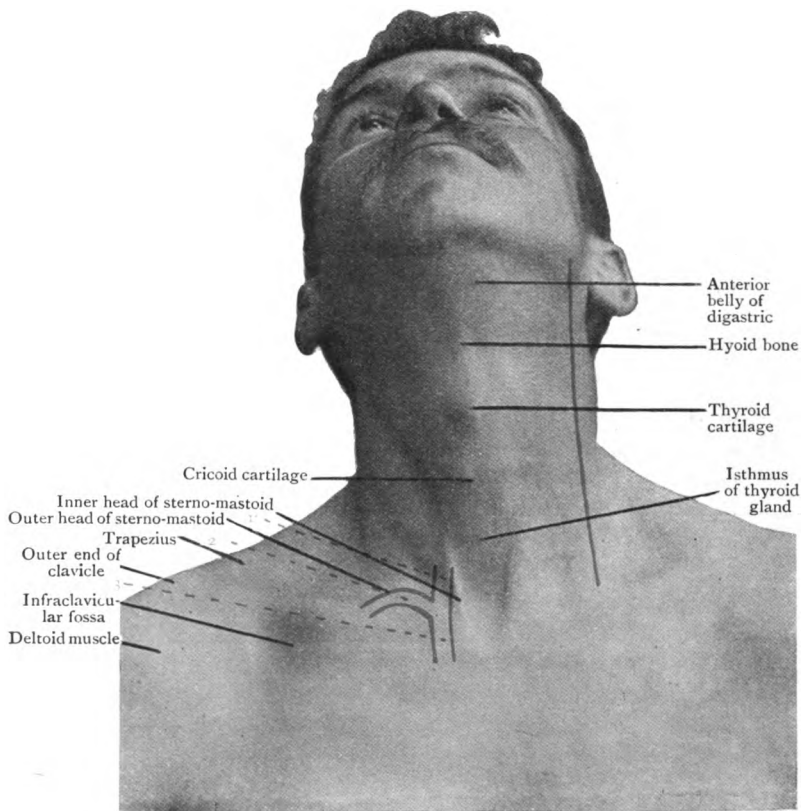
1. The great auricular, extending upwards and forwards towards the lobule of the ear.
2. The small occipital, passing upwards and backwards along the posterior margin of the sterno-mastoid muscle.
3. The spinal accessory, passing downwards and backwards towards the trapezius, in company with some muscular branches of the cervical plexus.
4. The descending group of superficial cervical nerves, which radiate downwards over the clavicle and acromion process to the upper part of the arm and chest.
5. The superficial cervical nerve, which passes horizontally inwards across the sterno-mastoid muscle to spread out over the anterior region of the neck.

In the lower or supraclavicular portion of the posterior triangle lie the third stage of the subclavian artery, and some of the branches of that vessel. These will be referred to subsequently, and also the external jugular vein, which traverses the region in a vertical direction. The main trunks of the brachial plexus, emerging from between the scalene muscles, above the level of the omo-hyoid, pass downwards and outwards under cover of that muscle to reach the apex of the axilla, and are sometimes distinctly visible in thin subjects.

**Anterior Region.**—The anterior neck region may be conveniently divided into a portion lying above the hyoid bone (*suprahyoid*) and a portion beneath that bone (*infrahyoid*). The hyoid bone itself is situated at the level of the lower margin of the mandible, opposite the fourth cervical vertebra, and both its body and its greater and lesser cornua can be readily palpated. Immediately above its body in the middle line is situated the floor of the mouth, formed by the

mylo-hyoid muscles, and when the finger is pressed into this area it is found to be triangular in shape, with the apex at the chin, and the base formed by the body of the hyoid bone. Bounding the triangle on each side can be felt the anterior belly of the digastric muscle, and as a rule a couple of small lymphatic glands can be found lying on its floor. Outside the anterior belly of the digastric lies the submaxillary gland, containing within its substance the facial artery, while a little further back a part of the posterior belly of the digastric may be felt, and also, on deep pressure, the resistance caused by the stylo-maxillary ligament. Finally, the anterior border of the sterno-mastoid is reached, under cover of which, and immediately beneath the mastoid process, the transverse process of the atlas can be felt.

Below the hyoid bone, in the middle line of the neck, lies the thyro-hyoid membrane, covered on each side by the thyro-hyoid muscle. Along the upper border of this membrane runs the small hyoid artery, and the membrane is pierced about its middle on each side by the internal laryngeal nerve and artery. A knife driven backwards through this membrane would pierce the base of the epiglottis and the root of the tongue. Below the membrane comes the thyroid cartilage, or *pomum Adami*, the general form of which, including the central notch along its upper border, can be felt. The middle of its anterior border marks the position of the glottis. Below the thyroid cartilage comes the crico-thyroid membrane, crossed by the crico-thyroid artery, and then the cricoid cartilage itself is encountered. This last-named cartilage is situated opposite the sixth cervical vertebra, and marks the level at which the pharynx becomes continuous with



**FIG. 4.—ANTERIOR ASPECT OF NECK. THE BLUE LINE ON THE LEFT SIDE OVERLIES THE EXTERNAL JUGULAR VEIN.**

**1, Common carotid artery; 2, Subclavian artery; 3, Innominate artery.**

the œsophagus. When the finger is pressed deeply into the neck at this level, and just internal to the sterno-mastoid muscle, the prominent anterior tubercle of the transverse process of the sixth cervical vertebra is easily detected. This tubercle marks the place where the carotid artery is crossed by the omohyoid muscle, and also the place of entrance of the vertebral artery into its canal. A line drawn upwards from it to the body of the hyoid bone will indicate the position of the anterior belly of the omohyoid muscle. Below the cricoid cartilage the examining finger passes on to the anterior aspect of the trachea, the rings of which, as a rule, can only be felt with difficulty, in consequence of their being covered in front by the isthmus of the thyroid body and by the inferior thyroid veins, together with the infrahyoid muscles and a variable quantity of fat. The length of trachea which is present in the neck varies in different subjects from 2 to 3 inches. As it descends it recedes from the surface, and at the upper margin of the sternum it lies at a depth of nearly  $1\frac{1}{2}$  inches, at the bottom of the suprasternal fossa. The finger, when placed in this fossa, can occasionally feel the beating of the innominate artery, and a slight prominence caused by a persistent thymus may be visible. When dilated, the cross branch between the anterior jugular veins is also readily seen. Sometimes the isthmus of the thyroid gland is visible in the form of a slight rounded swelling a little below the cricoid cartilage, especially in females. As a rule the lateral lobes of the thyroid gland cannot be distinguished.

**Bloodvessels of the Neck**

The **Innominate Artery** terminates on the right side at the upper margin of the sterno-clavicular articulation, immediately deep to the interval between the two heads of the sterno-mastoid, and on the left side the **Common Carotid Artery** enters the neck at the same level. From thence the common carotid artery on both sides passes upwards immediately under cover of the anterior margin of the sterno-mastoid muscle, and terminates above at the level of the upper margin of the thyroid cartilage. It can be mapped out by a line drawn from the upper margin of the sterno-clavicular articulation to bisect a line drawn from the angle of the jaw to the tip of the mastoid process. The portion of this line that extends above the thyroid cartilage overlies the internal carotid artery. The place where the common carotid artery is crossed by the omo-hyoid is marked by the transverse process of the sixth cervical vertebra, and the same process marks the place where the inferior thyroid vessel and the middle ganglion of the cervical sympathetic lie deep to the common carotid trunk. The internal jugular vein pursues the same course as the common and internal carotid artery, but lies a little further out.

The **External Carotid Artery** can be mapped out by a line drawn from in front of the sterno-mastoid muscle at the level of the upper margin of the thyroid cartilage to a point immediately below the lobule of the ear. At this latter point it terminates by dividing into the superficial temporal and the internal maxillary vessels. The former of these passes upwards over the

root of the zygoma on to the scalp, and the latter passes forwards, lying deep to the lower jaw.

The **Superior Thyroid Artery** arises just below the greater cornu of the hyoid bone, and passes downwards and forwards to the thyroid gland. The **Lingual Artery** arises opposite the greater cornu of the hyoid bone, and passes at first inwards along the upper margin of that bone, till, reaching a point about  $\frac{3}{4}$  inch from the middle line of the neck, it commences its ascending stage. The **Facial Artery** arises at almost the same point as the lingual, and passes at first upwards and then forwards horizontally within the submaxillary gland, to reach the anterior margin of the masseter muscle, at which point it turns upwards on to the face. The **Occipital Artery** takes origin at the same level as the lingual and facial, and turns backwards along a line drawn from the tip of the greater cornu of the hyoid bone to the root of the mastoid process.

The **Subclavian Artery** takes an arched course at the root of the neck, lying at first in front of the cervical dome of pleura. Its upper margin can be mapped out by a curved line, convex upwards, drawn from the upper margin of the sterno-clavicular articulation to the middle of the clavicle, and lying at its highest point about half an inch above the level of that bone. The terminal part of the artery can be felt pulsating in the supraclavicular fossa, and may be compressed here against the upper surface of the first rib. The supra-scapular and transversalis colli vessels pass outwards transversely, just above the level of the clavicle. The subclavian vein lies below and in front of the subclavian artery, and is under cover of the clavicle throughout its whole extent.

The **External Jugular Vein** is formed in the neighbour-

hood of the angle of the lower jaw by the union of the temporo-maxillary with the posterior auricular vein. From its point of origin it passes vertically downwards across the sterno-mastoid muscle to terminate above the middle of the clavicle by joining the subclavian vein.

The **Anterior Jugular Vein** runs vertically downwards on each side of the neck, about half an inch from the middle line, till, reaching the upper margin of the clavicle, it turns transversely outwards under cover of the origin of the sterno-mastoid. The cross branch between the two anterior jugular veins at the upper margin of the sternum has already been referred to.

In addition to the above-mentioned veins a communicating branch from the facial vein may frequently be seen joining the anterior jugular vein about the middle of the neck, and lying along the anterior margin of the sterno-mastoid muscle. The **Facial Vein** itself lies comparatively superficial. Entering the neck at the anterior margin of the masseter muscle, it passes downwards and backwards across the submaxillary gland to join the internal jugular vein opposite the middle of the thyro-hyoid space.

### Nerves of the Neck

The surface marking of most of the nerves of the neck has already been described, but the following additional facts may be stated. (1) The spinal accessory nerve in the beginning of its course lies in the anterior region of the neck, and passes from in front of the mastoid process downwards and backwards to enter the anterior margin of the sterno-mastoid muscle, about an inch below the tip of the mastoid process. It then traverses that muscle, and emerges at the middle of its

posterior border, as already described. (2) The loop of the hypoglossal nerve crosses the carotid vessels about the level of the hyoid bone, and from that point down to the omohyoid muscle the descendens hypoglossi nerve lies anterior to the common carotid artery. (3) The vagus nerve and the cervical sympathetic pass vertically downwards in the neck along the same course as the internal and common carotid vessels, but on a deeper plane.

## THE THORAX

THE thorax, when viewed in the dissected subject after the upper limbs have been removed from the trunk, presents a conical appearance, with the apex above and the base below, and is distinctly flattened from before backwards, its antero-posterior diameter being only a little more than two-thirds of its transverse. During life, however, its shape is considerably disguised by the attachments of the shoulder-girdles, in consequence of which the chest appears widest above immediately below the clavicles, is slightly contracted just below the axillæ, and then expands again towards its base. In all physical examinations of the chest it is most important to bear in mind the real shape of the thoracic cage, and to endeavour to see with a true anatomical eye the lateral walls sloping upwards and inwards under cover of the axillary muscles to the thoracic inlet. In front, indeed, it is often comparatively easy to palpate the lateral portions of the upper ribs by deep pressure upon the relaxed pectoralis major muscle just internal to the head of the humerus. At the back, on the other hand, the position of the scapula and the muscles related to it render any such method of mapping out quite impossible, and, unless the student has accustomed himself to the shape of the thorax as viewed from the back in the dissecting-room, he will find considerable difficulty in appreciating the normal outer

limit of the thorax above the level of the axilla, when examining clinically the posterior aspect of the chest. The study of the chest by means of X-rays, making use both of the screen and actual photographs, will prove of great value in overcoming this difficulty, and is, indeed, one of the most valuable methods at present at our command for clinically estimating the extent of variations in shape from the normal.

When viewed from the front the chest is seen to be convex from side to side, and is often slightly asymmetrical, the right side in the majority of persons being larger than the left. This difference is chiefly due to the greater size of the muscles on the right side in right-handed persons, but is also partially to be accounted for by the greater size of the right lung.

Above, the chest is bounded in the middle line by the upper margin of the sternum, and on each side of this by the prominent clavicles. In possessing this definite upper limit, the anterior aspect of the chest contrasts with the posterior, where there is no distinct line of demarcation between the chest and neck, and where these parts in consequence are directly continuous with one another. Below, the lower margin of the chest corresponds to the outlet of the thorax, and is bounded by the costal arches, from the seventh to the twelfth.

If the finger be placed in the depression above the sternum, between the projecting inner ends of the clavicles (*suprasternal notch*), and from that carried downwards along the middle line of the sternum to its lowest part, it is felt to traverse a distinct groove or furrow (*sternal groove*), which corresponds to the interval between the origins of the pectoralis major muscles, and is distinctly visible. The level of the upper margin of the sternum is situated opposite the lower

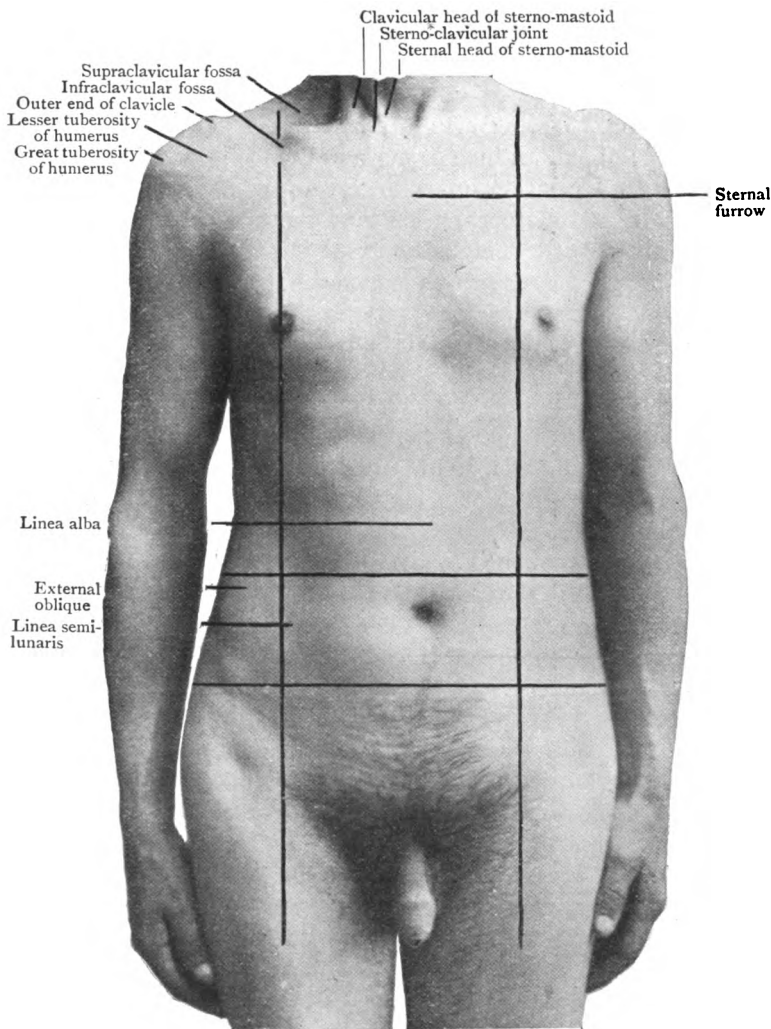


FIG. 5.—ANTERIOR ASPECT OF TRUNK.

The horizontal lines on the abdomen represent the subcostal and inter-tubercular planes respectively, and the vertical lines the mid-Poupart planes. Both mid-Poupart lines cut the middle of the clavicle above. Owing to slight asymmetry of the model, the nipple lies outside the mid-Poupart line on the left side, and the umbilicus is nearer the left than the right side.

vertical lines are drawn from the centre of Poupart's ligament on each side, and are usually continuous superiorly with the mid-clavicular lines. The lower of the two horizontal lines is named the intertubercular, because it is drawn between the projecting tubercles on the outer aspect of the iliac crests. This line, when projected upon the posterior abdominal wall, cuts the body of the fifth lumbar vertebra. The upper horizontal line is drawn between the lowest points of the tenth costal arches, and when projected backwards cuts the upper margin of the third lumbar vertebra. The abdominal compartments thus mapped out are called from above downwards : (1) The *epigastric*, on each side of which lies the *right* and *left hypochondriac* ; (2) the *umbilical*, on each side of which lies the *right* and *left lumbar* ; and (3) the *hypogastric*, flanked by the *right* and *left iliac* regions respectively.

### The Abdominal Viscera

**The Stomach.**—Only two points of the stomach can be regarded as in any way fixed—namely, the cardiac and the pyloric ends, and the latter of these has a considerable range of movement. The cardiac end lies deep to a point on the seventh left costal cartilage, 1 inch from its place of junction with the sternum, and is nearly 4 inches from the surface. At the back it corresponds to the level of the tenth dorsal spine. The pyloric end is situated at or near the middle line of the abdomen, and is more superficial. In vertical level it usually lies from  $2\frac{1}{2}$  to 3 inches above the umbilicus, or, at the point of bisection of a line drawn from the upper margin of the sternum to the upper margin of the symphysis (see Fig: 6). This last-named point is, in

consequence, called the transpyloric point, and usually lies about half an inch above the subcostal plane. The pyloric end of the stomach, as already stated, has, however, a considerable range of movement, and, as the stomach distends, it passes over two or three inches to the right of the middle line, and comes closely into relation with the gall-bladder. Posteriorly, the twelfth dorsal spine marks the position of the pylorus. Between the cardiac and pyloric ends the lesser curvature describes a gentle curve, with the convexity forwards and to the left. The fundus of the stomach lies at a higher level than the cardiac end, projecting upwards in the mid-Poupart plane to the level of the fifth costal cartilage. The greater part of the body of the stomach lies under cover of the left costal arch, but as the viscus distends a considerable portion of it comes to lie directly in contact with the anterior abdominal wall below the level of the costal margin. It is only under abnormal conditions that the lower margin of the stomach sinks below the subcostal plane.

The various parts of the **small intestine**, with the exception of the duodenum and the terminal part of the ileum, are so mobile that it is impossible to lay down any rules as to where any particular portion of the gut is situated; but it may be stated in general that more of the intestine lies to the left than to the right of the middle line of the body, and that the coils collectively lie in relation to the anterior abdominal wall below the level of the transverse colon, and covered over by the great omentum. The transverse portion of the third stage of the duodenum crosses the middle line a little above the level of the umbilicus, the extreme lowest point of its curve being, according to Addison, at the level of the highest point of the iliac

crest. The duodeno-jejunal flexure lies slightly to the left of the middle line of the abdomen, about 3 inches above the level of the umbilicus and opposite the second lumbar spine (see Fig. 6).

The **ileo-cæcal junction** lies in the right lumbar region, and is more or less fixed. It may be indicated on the surface by a point on the intertubercular line 2 inches internal to the anterior superior iliac spine, and usually about 1 inch higher up. This point closely corresponds to the place at which this line is intersected by the right mid-Poupart line. The **cæcum** is situated in the right iliac region, lying below the intertubercular line and external to the right mid-Poupart line. Its lowest point comes in contact with the outer portion of Poupart's ligament. The **Appendix** is very variable in position, and often lies immediately deep to the cæcum. The opening of the appendix into the cæcum is situated about 1 inch below, and usually slightly internal to the ileo-cæcal junction; or, according to McBurney, this opening may be marked on the surface one-third of the way from the anterior superior iliac spine, along a line drawn from that spine to the umbilicus (see Fig. 10).

The **Ascending Colon** lies in the right lumbar region, ascending vertically through it till it reaches the under surface of the liver. At its commencement it lies in the iliac fossa, but after crossing the iliac crest it comes into relation with the quadratus lumborum muscle and the right kidney. The **Transverse Colon** varies much in position, according to the degree of distension of the stomach. When that viscus is moderately full the transverse colon extends from the hepatic flexure, which is situated in the right hypochondrium, downwards, forwards, and to the left, in contact with the

abdominal wall till it reaches the level of the umbilicus. It then commences to ascend gradually to the splenic flexure, which lies deep within the abdomen in the left hypochondriac region, somewhat behind the stomach.

The **Descending Colon** passes almost vertically downwards through the left lumbar region, somewhat external to the left mid-Poupart line, and is continuous below with the iliac colon, which lies in the left iliac fossa (see Fig. 10).

**The Liver.**—The anatomical outlines of the liver as projected upon the surface do not correspond with those mapped out clinically, owing to the fact that when the chest and abdomen are percussed a resonant note is obtained from the lung and from the colon beyond the actual limits of those viscera. The clinical outlines will therefore vary much, according to the state of the lungs and intestines, and it is consequently of considerable importance to know accurately the true anatomical outlines of the liver, in order that the clinical impressions may be corrected.

The extreme limit of its upper margin can be mapped out by a slightly curved line, the convexity of which is directed upwards, and extending from a point half an inch below the right nipple to a point an inch below the left. This crosses the fifth rib in the mammary line on the right side, and ends at the sixth rib or fifth intercostal space in the mammary line on the left side. It crosses over the sternum about the level of the xiphisternal articulation, this point representing the lowest part of the line, and then slopes upwards again to its extreme left point, which lies from  $2\frac{1}{2}$  to 3 inches to the left of the mesial plane. A projection of this line backwards through the trunk represents the upper limit of the liver at the back, but, in consequence of the

thickness of the bases of the lung, pulmonary resonance at the back extends downwards to a much lower level.

The lower margin of the liver extends to the lower edge of the costal arch on the right side, or sometimes to a slightly lower level, till the lowest margin of the ninth costal cartilage is reached. At this point the edge of the liver passes below the costal margin and extends across the middle line of the body along a line drawn from the ninth costal cartilage on the right side to the tip of the eighth on the left side, and then continues upwards behind the left costal arch to a point an inch below the level of the left nipple. The lower margin can usually be palpated at the place where it extends across the middle line, but elsewhere it is difficult to feel. Posteriorly, the lower edge of the liver is prevented from coming in contact with the abdominal wall, except in the neighbourhood of the middle line, by the right kidney, which lies sunken within its substance. In the middle line it lies in contact with the posterior abdominal wall at the level of the eleventh dorsal spine (see Fig. 10).

The fundus of the **Gall-bladder** lies in contact with the anterior abdominal wall at the lower margin of the ninth right costal cartilage. This point is almost identical with the point where the right mid-Poupart plane and the right linea semilunaris cut the lower margin of the costal arch.

**The Kidneys.**—The exact relation of the kidneys to the anterior abdominal wall is not a matter of great importance, as it is only in rare instances that they can even partially be made out during life. It is, however, important to know the limits to which the inferior pole may extend, and for this reason the following brief account of the surface anatomy of these organs

from in front is given. For further information see Surface Anatomy of the Back.

The left kidney usually lies from  $\frac{1}{2}$  to 1 inch higher than the right, and the upper portion of both lies under cover of the costal cartilages, reaching up to a point on the seventh costal cartilage 2 inches away from the middle line in front. The lower pole of the right kidney extends somewhat below the subcostal plane, and lies about half an inch above the level of the umbilicus at a distance of  $2\frac{1}{2}$  inches from the middle line. The lower pole of the left kidney lies half an inch higher up, barely reaching the subcostal plane, and is, moreover, slightly nearer to the middle line of the abdomen. The upper pole of the right kidney lies opposite the middle of the body of the twelfth dorsal vertebra, and the upper pole of the left lies opposite the disc between the eleventh and twelfth dorsal vertebrae. The hilum of each kidney lies about  $1\frac{1}{2}$  inches from the middle line, and is opposite the first lumbar vertebra. The outer border of each kidney extends for a short distance beyond the mid-Poupart plane, but nearly four-fifths of the entire organ on each side lies internal to this plane. In order to place the finger over the kidney from in front, a point on the abdominal wall should be chosen about  $2\frac{1}{2}$  inches above and outside the umbilicus.

The **Ureter** passes downwards and slightly inwards from the position of the hilum of the kidney along a line parallel to and about  $1\frac{1}{2}$  inches external to the mesial plane, and crosses the common iliac arteries about the level of the intertubercular plane.

**The Spleen.**—The outlines of the spleen as mapped out on the surface anatomically differ widely from those which are determined clinically by percussion,

owing to the fact that a considerable portion of the upper part of the organ is overlapped by the thick basal part of the left lung. In consequence of this it is only the lower and anterior part which can clinically be distinctly defined. The lower and posterior part also comes close to the surface, and a dull note is obtained over it by percussion; but as this dull note merges below into that of the left kidney, it cannot be accurately defined. The spleen lies under cover of the ninth, tenth, and eleventh ribs, its long axis corresponding to the tenth rib, and its lower border to the eleventh. Its posterior or vertebral angle is situated on the eleventh rib opposite the tenth dorsal spine, about  $1\frac{1}{2}$  inches from the middle line, while its inferior angle is situated on the same rib about  $3\frac{1}{2}$  inches from the middle line and opposite the first lumbar spine. Its anterior basal angle reaches the mid-axillary line opposite the tenth costal arch, and its anterior border can be marked out by a line joining this point with the inferior angle on the eleventh rib. The upper border is mapped out by a curved line convex upwards, extending between the posterior and anterior angles, and reaching in the scapular line to the ninth rib (see Fig. 8).

**Abdominal Vessels.**—The arteries in the abdominal wall itself may be divided into three groups—namely, those that enter the wall from below, those that enter it from above, and those that enter it from behind.

1. *Inferior Group.*—(1) The superficial epigastric artery is mapped out by a line drawn upwards and inwards from the femoral point\* towards the umbilicus. (2) The deep epigastric artery is mapped out by the same line as that for the superficial epigastric. (3) The

\* The femoral point is the point of bisection of a line drawn from the anterior superior iliac spine to the symphysis pubis.

superficial pudic artery passes from the femoral point inwards across the spermatic cord towards the symphysis pubis. (4) The superficial circumflex iliac and the deep circumflex iliac vessels run along a line drawn outwards from the femoral point to the anterior superior iliac spine. The deep vessel then continues along the course of the iliac crest to about its mid-point.

2. *Superior Group*.—(1) The superior epigastric artery descends vertically in the abdominal wall from the seventh costal cartilage about an inch from the middle line. (2) The musculo-phrenic winds round the lower margin of the costal cartilages from about the eighth to the tenth rib.

3. *Posterior Group*.—This group of arteries is accompanied by the lower intercostal nerves, and is composed of the lower aortic intercostal vessels and the lumbar arteries. They wind from behind downwards and forwards into the abdominal wall along lines which correspond to the forward continuation of the intercostal spaces and lines parallel to these.

Accompanying the arteries in the abdominal wall are corresponding veins. These for the most part are invisible, but when distended they may become more evident. Frequently a long vein is seen passing along the lateral aspect of the abdomen from the femoral vein below upwards into the axilla. It is called the lateral thoracico-epigastric vein, and is of importance from a clinical standpoint.

**Intra-abdominal Vessels**.—1. The abdominal aorta is mapped out by a line drawn from a point in the middle line 2 inches above the subcostal plane downwards and slightly to the left, to terminate half an inch below the umbilicus on a level with the highest point of the iliac crest. The inferior vena cava lies to the right of

the aorta, and almost in the middle line of the body throughout its entire length.

2. The common and external iliac arteries lie along a line drawn from the point which marks the bifurcation of the aorta downwards and outwards on each side to the femoral point. The upper third of this line overlies the common iliac, and the lower two-thirds the external iliac vessels.

3. The exact level of the origin of the other branches of the aorta is comparatively unimportant. The cœliac axis arises about 4 inches above the umbilicus, at the level of the twelfth dorsal spine, the renal vessels about an inch lower down, and the superior mesenteric midway between the cœliac axis and renal. The inferior mesenteric artery arises about an inch above the umbilicus.

## THE BACK

IN the middle line of the back there is a distinct inter-muscular furrow extending along its whole length, and varying in depth at different levels. In the neck it is shallow, and is called the nuchal furrow, while in the remainder of the back it is termed the spinal furrow. It reaches its greatest depth in the lower dorsal and lumbar regions. The furrow commences above at the external occipital protuberance, and if the finger be carried down along it from that point the external occipital crest is first felt, and then the prominent spinous process of the axis is encountered, separated from the occipital bone by an interval, which corresponds to the position of the atlas. Below this the spines of the third, fourth, and fifth cervical vertebræ cannot be felt, but the resistance caused by them, and by the ligamentum nuchæ, which lies posterior to them, is easily appreciated. A prominence is next encountered, which is formed by the spinous processes of the sixth and seventh cervical vertebræ and of the first dorsal vertebra. Of these three vertebræ the spine of the first dorsal is, as a rule, the most prominent, and marks the interval between the nuchal and spinal furrows. In the spinal furrow proper the spines of the dorsal and lumbar vertebræ can be made out, and it will be noticed that some slight deviation in their position from the middle line is normal. The spines of the mid-dorsal vertebræ

are hard to feel when the erect position is maintained, but they become more easily palpable on bending forward. The spinal furrow terminates below at the spine of the second sacral vertebra, where, after passing over the rounded prominence formed by this part of the sacrum, it becomes continuous with the cleft of the nates. In counting the vertebræ it is convenient to commence from above, where the prominence of the lower cervical and first dorsal spines form suitable landmarks, and in cases of difficulty it is well to remember that the second sacral spine lies opposite the posterior superior iliac spine, the fourth lumbar spine opposite the highest point of the crest of the ilium, the third lumbar spine opposite the umbilicus, and, that the inferior and superior angles of the scapula lie opposite the seventh and second dorsal spines respectively when the arm is hanging by the side.

Bounding the spinal furrow on each side are found in the neck region the complexus muscle and the trapezius, both of which are limited above by the superior curved line of the occipital bone. It is the trapezius muscle on each side which gives the triangular shape to the posterior aspect of the neck, while the rounded mass felt by palpation on each side of the middle line is caused by the presence of the complexus and semi-spinalis muscles lying under cover of the trapezius. In the dorsal and lumbar regions lie the masses of the erector spinæ muscle, which extends outwards from the spinal furrow as far as the angles of the ribs.

The form of the two superficial muscles of the back—namely, the trapezius and the latissimus dorsi—can usually be made out. The upper border of the former can be seen extending from the occipital bone downwards, outwards, and forwards, in a curved manner

towards the clavicle, while its inferior border extends from the spine of the twelfth dorsal vertebra upwards to the root of the spine of the scapula. When the muscle is thrown into contraction a depression is usually seen on each side of the middle line in the lower cervical and upper dorsal regions which corresponds to its non-contractile tendinous portion. A similar depression exists at the root of the spine of the scapula over the tendon of insertion of the muscle. The portion of the trapezius which overlies the upper border of the scapula renders palpation of that part of the bone difficult, while the part that lies in the interscapular region covers over the rhomboid muscles and the levator anguli scapulæ. Below the lower border of the trapezius, and just behind the vertebral border of the scapula, a triangular interval can sometimes be made out above the latissimus dorsi. The floor of this triangle is formed externally by the lower fibres of the rhomboideus major muscle, and internally by the intercostal muscles of the sixth intercostal space.

The upper border of the latissimus dorsi is marked out by a line drawn from the sixth dorsal spine transversely outwards across the inferior angle of the scapula, and its inferior border can be seen extending from the posterior part of the iliac crest upwards and outwards into the posterior fold of the axilla. This border is best marked when the arm is raised from the side and the muscle is contracted. The tendinous origin of the lower part of the latissimus dorsi from the lumbar fascia remains as a diamond-shaped depressed area above the sacrum when the muscle is contracted, and gives the characteristic appearance to this portion of the back. Immediately in front of the lower border of the latissimus and above the iliac crest a small tri-

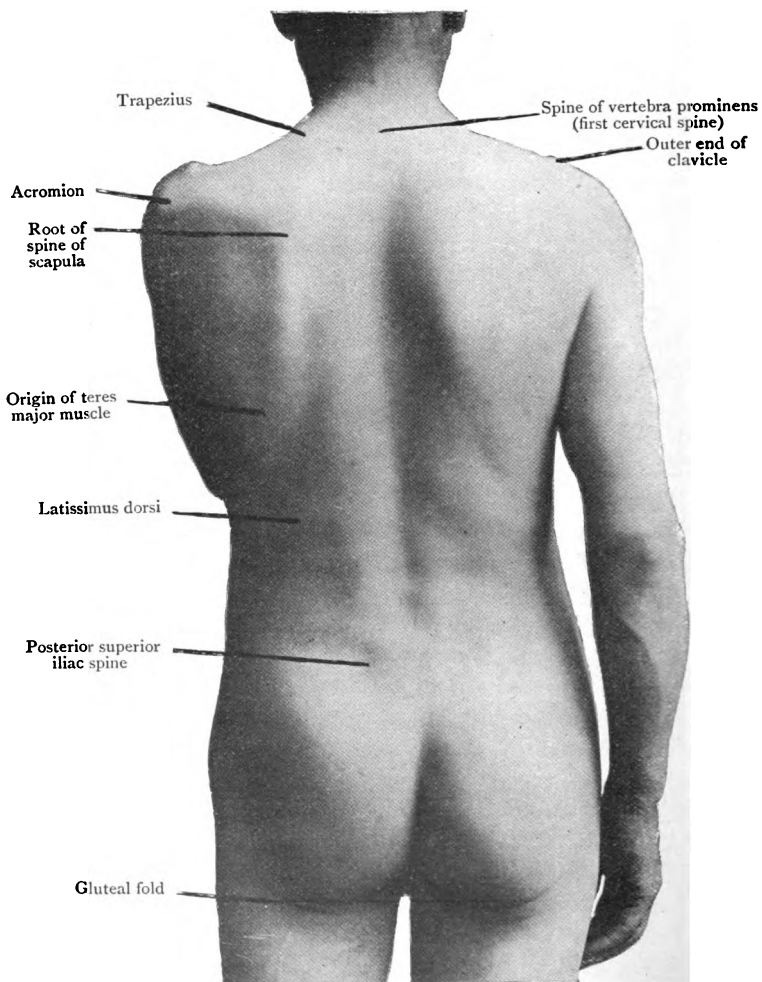


FIG. II.—POSTERIOR ASPECT OF TRUNK.

angular interval, called the triangle of Petit, exists posterior to the external oblique muscle. This triangle cannot, as a rule, be either seen or felt from the surface, but it is of importance to be aware of its position, in consequence of the occasional occurrence of hernial protrusions through its floor, which is formed by the internal oblique muscle.

Owing to the thickness of the erector spinæ muscles, the posterior parts of the ribs internal to their angles cannot be felt, and the upper ribs are still further obscured by the presence of the scapula and the muscles in relation to it. The lower two or three are, however, distinctly felt through the latissimus dorsi muscle. The interval between the last rib and the crest of the ilium varies much in depth in different individuals, but, as a rule, does not exceed a couple of inches at its narrowest part. Owing to the great obliquity of the spines of the middle dorsal vertebræ, the head of each of the middle ribs is situated opposite the tip of the spine of the vertebra immediately above it in number.

The relations of the scapula will be discussed later in connection with the surface anatomy of the upper limb, but it may here be added that when the arm is at the side the bone usually extends from the second rib above to the seventh below, and that the root of its spine is situated at the level of the third dorsal spine.

**Lung, Trachea, etc.**—The relations of the lung and pleural sac to the back have been already described. The trachea and œsophagus commence in the middle line at the level of the sixth cervical spine. From that point the trachea is directed vertically downwards in the middle line to the spine of the fourth dorsal vertebra, opposite which it bifurcates, this point corresponding

on the front of the body to the manubrio-gladiolar articulation. The roots of the lungs lie between the spines of the third and fifth dorsal vertebræ, and are situated about an inch from the middle line. The œsophagus deviates from its origin slightly to the left of the middle line, but again assumes a mesial position opposite the fourth dorsal spine. It then again turns slightly to the left, and reaches the stomach at the level of the ninth dorsal spine, about an inch from the mesial plane.

The descending **aorta** commences above, a little to the left of the middle line opposite the fourth dorsal spine, and terminates below almost in the mesial plane of the body at the level of the fourth lumbar spine. Throughout the greater part of its course it is either mesial in position or situated about half an inch to the left of the middle line. It perforates the diaphragm at the level of the twelfth dorsal spine.

**The Kidneys.**—The upper pole of the right kidney is situated about  $1\frac{1}{2}$  inches from the middle line opposite the eleventh dorsal spine, reaching in this position the middle of the eleventh intercostal space or the lower border of the eleventh rib. Its inferior pole lies opposite the third lumbar spine, and is about 1 inch above the crest of the ilium. The left kidney is situated at a somewhat higher level. Its upper pole reaches the upper margin of the eleventh rib, and lies opposite the tenth dorsal spine, and its lower pole lies from 1 to  $1\frac{1}{2}$  inches above the iliac crest, opposite the interval between the second and third lumbar spines (Fig. 8).

The inner border of each kidney may be represented by a line drawn parallel to the mesial plane at a distance of an inch from it, and lying between the levels of the superior and inferior poles. The hilum of each kidney lies on, or slightly external to, this line, at the level of

the first lumbar spine. The outer border is curved, and its extreme outer limit lies 2 inches directly external to the point which marks the hilum.

**The Spleen.**—The relation of the spleen to the surface has been described with the surface anatomy of the abdomen, and need not be further referred to here.

**The Liver.**—The extreme upper limit of the liver and the highest point of the right dome of the diaphragm lie about the level of the inferior angle of the scapula, opposite the seventh dorsal spine, during expiration. From this point the upper border descends slightly, to reach the middle line of the body at the level of the eighth dorsal spine. The upper border of the extreme left point of the liver and the highest point of the left dome of the diaphragm lie opposite the lower margin of the seventh dorsal spine. The lower margin of the liver is obscured at the back by the presence of the kidney, but in the middle line it reaches the surface at the inferior extremity of the eleventh dorsal spine.

**The Stomach and Intestines.**—As already stated, the cardiac opening of the stomach lies an inch to the left of the mesial plane, opposite the ninth dorsal spine. The pyloric opening is situated in the mesial plane, opposite the twelfth dorsal spine when the stomach is empty. Between these two points the lesser curvature describes a gentle curve, lying to the left of the vertebral column, and the greater curvature describes the arc of a circle, which above is co-extensive with the diaphragmatic dome and below passes almost transversely inwards across the line of the eleventh and twelfth ribs to the pylorus.

The ascending and descending colon pass vertically through the costo-iliac space, lying external to the erector spinæ muscle on each side respectively, and internal

to a line drawn vertically upwards from the central point of the crest of the ilium.

**The Pancreas** crosses the middle line opposite the twelfth dorsal and first lumbar spines, and the third stage of the duodenum lies immediately below it.

**The Spinal Cord and Nerves.**—The spinal cord terminates in the adult immediately below the tip of the first lumbar spine, but the dura mater and arachnoid descend along with the cauda equina as low as the third sacral spine. The cervical swelling extends from the fourth to the seventh cervical spines, and the lumbar swelling lies opposite the last three dorsal spines. The nerves before they emerge from the spinal canal take a very oblique course, and consequently their place of emergence from the spinal canal does not correspond with their origin from the spinal cord. The following table, which is principally taken from Quain's 'Anatomy,' indicates, however, their place of origin with sufficient accuracy, and, in conjunction with Head's diagrams, should prove of value in localizing the level of spinal cord lesions.

1. The first cervical nerve arises from the cord between the axis and the occiput.

2. The second cervical nerve arises opposite the neural arch of the atlas.

3. The third cervical arises opposite the spine of the axis.

4. The fourth cervical arises opposite the third cervical spine.

5. The fifth, sixth, seventh, and eighth cervical nerves arise respectively opposite the third, fourth, fifth, and sixth cervical spines.

6. The first, second, third, fourth, fifth, and sixth dorsal nerves arise opposite the sixth and seventh

cervical, the first, second, and third dorsal, spines respectively.

7. The seventh, eighth, ninth, tenth, eleventh, and twelfth dorsal nerves arise opposite the third, fourth, fifth, sixth, seventh, and eighth dorsal spines respectively.

8. The lumbar nerves arise opposite the tenth and eleventh dorsal spines.

9. The sacral nerves arise between the twelfth dorsal and first lumbar spines.

## THE PERINEUM

**The Perineum** is the diamond-shaped space which is circumscribed by the structures forming the pelvic outlet. It extends from the subpubic arch anteriorly to the tip of the coccyx posteriorly, and in a lateral direction from one tuber ischii to the other. Its boundaries are all accessible to palpation. From the subpubic angle in front the finger can be carried along the rami of the pubis and ischium to the tuber ischii, over which point the skin is specially thickened in order to enable it to resist the pressure exerted upon it during sitting. Posteriorly, the tip of the coccyx is prominent, and by pressing under the edge of the gluteus maximus muscle on each side between the coccyx and the tuber ischii, the resistance caused by the lower edge of the great sacro-sciatic ligament can be made out.

For purposes of descriptive anatomy the region is usually divided into two triangles by a line drawn transversely immediately in front of the anus. The anterior triangle is called the uro-genital, and the posterior the rectal.

Within the rectal triangle, midway between the tubera ischii, is situated the anal orifice, the skin around it being puckered, and arranged in the form of radiating lines, which are produced by the contraction of the sphincter ani. On each side of the anus is situated a surface, which corresponds to the base of the ischio-rectal

fossa. When the parts are relaxed the finger can be sunk for some little distance into this fossa, and in thin subjects the inner surface of the ischium can be palpated. Posterior to the anus, and intervening between it and the tip of the coccyx, is situated a firm mass of fibrous tissue—the ano-coccygeal body—which presents itself as a hard, resisting structure to the examining finger. The skin over this mass is marked by a central raphe.

Within the uro-genital triangle are contained the external genital organs. Traversing this area from the anus forwards is seen a central ridge of skin—the median raphe—which is prolonged along the scrotum and under surface of the penis. A point on this raphe, about an inch in front of the anus, overlies the central point of the perineum, and in front of that lies the bulb of the penis, which often causes a rounded central elevation. On each side of this elevation the resistance caused by the triangular ligament and other structures of the perineum can be felt. The skin of the scrotum is pigmented and corrugated, the latter condition being produced by the contraction of the fibres of the dartos muscle. Within the fold of the scrotum the testis is readily palpated, and its various parts can be made out. On its posterior aspect lies the epididymis from which the spermatic cord can be traced upwards to the inguinal canal. On the dorsum of the penis the dorsal vein can usually be seen, and the dorsal arteries may be felt pulsating. The skin covering the penis is remarkably delicate, and is freely movable over the organ.

By internal examination of the rectum, and in the female of the vagina, much information may be obtained concerning the position and condition of the pelvic viscera. These points are, however, best discussed in

a book dealing with surgical anatomy, and it is sufficient to state here that when the finger is introduced into the rectum the sacrum, coccyx, and ano-coccygeal body can be palpated posteriorly, and that in the male the prostate forms anteriorly an easily detected prominence lying just above the level of the anal canal. In the female the os uteri can be felt through the anterior rectal wall as a distinct button-like elevation.

## THE UPPER EXTREMITY

**Shoulder Region and Axilla.**—The clavicle is practically subcutaneous throughout its whole extent, and the various parts of it can be readily palpated, and in thin subjects seen. Its inner extremity is very prominent in the macerated state, from the fact that its articular facet is much larger than, and projects above, the corresponding facet on the sternum. During life, however, it is somewhat obscured by the sternal head of origin of the sterno-mastoid muscle which passes upwards internal to it. As a rule it projects forwards slightly anterior to the front of the manubrium sterni. In some cases when the bone is grasped between the finger and thumb a slight degree of movement backwards and forwards can be made out at this articulation. Arising from the upper aspect of the inner end of the bone is seen the clavicular head of the sterno-mastoid, and below and in front of this the clavicular portion of the pectoralis major muscle takes origin. Further out, the anterior convexity of the bone in most subjects stands out prominently, and is immediately succeeded by the anterior concavity. The latter is bounded above by the supraclavicular fossa, which lies between the sterno-mastoid and trapezius muscles, and below by the infraclavicular fossa. The outer flattened part of the clavicle is also palpable, and the insertion of the trapezius muscle into its posterior border can be seen. From its

anterior border the innermost fibres of the deltoid muscle arise, and pressure here enables one to feel the deltoid tubercle when that bony prominence is present.

The outer end of the clavicle lies usually at a slightly higher level than the inner end. At the place where it articulates with the acromion process of the scapula a distinct bony tubercle is usually present. This is most commonly developed on the upper portion of the clavicle itself, more rarely upon the acromion process. If the finger be placed just beyond this tubercle and the arm moved backwards and forwards, the acromio-clavicular joint can usually be detected. The line of the articulation is directed from behind forwards, and is sometimes difficult to feel. It is indicated fairly accurately by a line drawn upwards along the middle of the front of the arm and continued over the shoulder.

The whole of the acromion process and the posterior border of the spine of the scapula lie superficially, and can be palpated; and when the finger is carried along the anterior border of the acromion a distinct angle—the acromial angle—can be made out at the place where it joins the spine. This angle derives its importance from the fact that it is commonly employed as a landmark in making measurements of the upper limb. In emaciated individuals the spine forms a distinct projection beneath the skin, but in those of strong muscular development it lies at the bottom of a groove between the prominent supraspinatus and infraspinatus muscles, when those muscles are contracted. The triangular root of the spine can always be felt where it joins the vertebral border of the bone, and from it the finger can be passed up and down along the vertebral border to the superior and inferior angles. The muscles attached to this border

are covered by the trapezius, and cannot be separately distinguished. They form a broad, flat elevation when the arm is raised from the side, but when it is pressed backwards and inwards they form a rounded prominence. When the arm is hanging loosely the vertebral border of the scapula is almost vertical, and parallel with the vertebral column.

Crossing the inferior angle of the scapula the latissimus dorsi muscle can be seen, forming a prominent fold when the arm is abducted, and above this the axillary border of the scapula, and also the teres major muscle arising from it can be distinctly felt. At the upper extremity of this border arises the long head of the triceps muscle, which tends to obscure the glenoid cavity. When this muscle is contracted and the arm is raised from the side a prominent fold formed by it can be seen passing downwards into the arm. The upper border of the scapula is less easily felt than the other parts, owing to its being covered over by the fibres of the trapezius muscle, but its position can always be determined by deep pressure. As already mentioned, the coracoid process is felt from in front by placing the finger in the outer part of the infraclavicular fossa. Immediately above and outside this process the resistance caused by the coraco-acromial ligament as it passes upwards under the clavicle can be felt, while below and internal to it lie the brachial nerves and the first stage of the axillary artery. In extent the scapula reaches from about the second rib above to the eighth rib below when the arm is hanging by the side.

**The Axilla** presents an irregular pyramidal shape when the arm is raised from the side, the various boundaries of which can be readily recognised.

In front, lie the pectoralis major and minor muscles,

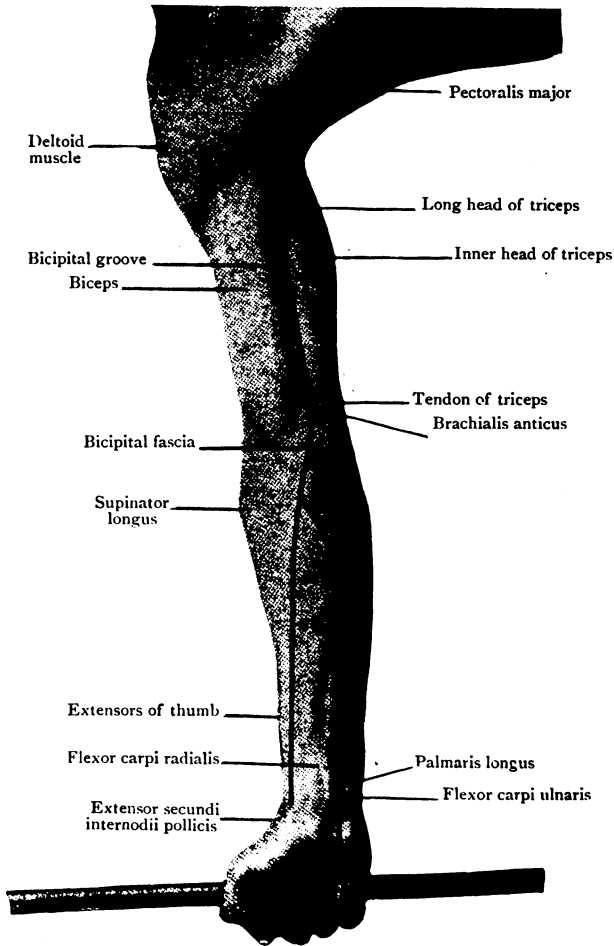


FIG. 12.—INNER SIDE OF ARM AND FRONT OF FOREARM.

The black lines indicate the position of the brachial, radial, and ulnar arteries.

the former of which can be traced outwards to its insertion into the humerus at a point on a level with the middle of the deltoid muscle. The lower border of this muscle forms the anterior fold of the axilla, and leaves the chest along the line of the fifth rib. As a general rule a distinct interval can be seen between its clavicular and sternal parts. The pectoralis minor lies almost entirely under cover of the pectoralis major, but sometimes its lower border can be seen below the level of that muscle when the arm is raised above the level of the shoulder. The upper and lower borders of the pectoralis minor can be mapped out by lines drawn from the coracoid process to the third and fifth ribs respectively at their place of junction with the costal cartilages.

Behind, lies the latissimus dorsi, the tendon of which can be distinctly felt winding around the lower border of the teres major, while, higher up, the venter scapulæ, covered by the subscapularis muscle, can be felt. The posterior boundary, it will be noticed, extends lower down than the anterior.

Internally, lie the upper ribs, covered by the digitations of the serratus magnus muscle, and, in the female, by the outer part of the mammary gland. Pressure against the outer wall enables one to feel the pulsations of the axillary artery, and in front of this the large nerve-trunks of the brachial plexus can be rolled under the finger, while still more anteriorly, and just under cover of the insertion of the pectoralis major muscle, lies the conjoined tendon of the coraco-brachialis and biceps muscles. The posterior portion of this tendon can be followed down to a distinct prominence situated midway between the axillary folds at the outlet of the axilla, and formed by the insertion of the coraco-brachialis.

The anterior part, on the other hand, passes downwards and forwards, and blends with the eminence formed by the biceps muscle on the front of the arm.

The skin at the apex of the axilla is covered with hair, the central tuft of which overlies a group of lymphatic glands. Upward pressure in this position enables one to feel the rounded head of the humerus and the edge of the glenoid cavity of the scapula. When the arm is rotated in an inward and outward direction, the head of the humerus can be felt to roll under the fingers, and when it is raised above the shoulder the head of that bone may be felt to slip partly over the edge of the glenoid cavity, and to form a slight convexity within the axilla. Normally the head of the humerus looks in the same direction as the internal condyle.

The smooth and rounded contour of the shoulder is produced by the presence of the deltoid muscle, covered over by a considerable amount of fatty tissue, which renders the skin of this region freely movable over the deeper parts. The V-shaped origin of the muscle from the front of the clavicle and from the outer margin of the acromion process and lower border of the spine of the scapula can be made out throughout its whole extent, and the fibres traced downwards from there to their insertion into the humerus. The point of insertion is marked by a distinct hollow on the outer aspect of the arm, about its middle. This depression is continuous below with the groove formed by the attachment of the investing fascia of the arm to the external supracondyloid ridge of the humerus, and known as the *external bicipital furrow*. When the muscle is thrown into action vertically directed depressions corresponding in situation to its tendinous intersections become visible. Under cover of the upper portion of the

deltoid lies the great tuberosity of the humerus, which forms the most external part of the shoulder, and in front of this the lesser tuberosity can also be distinguished lying under cover of the anterior border of the muscle, and just below the acromio-clavicular joint. Between the two tuberosities firm pressure may enable the long tendon of the biceps to be rolled under the fingers within the bicipital groove.

### The Arm

On the anterior aspect of the arm the fleshy belly of the biceps muscle forms an elongated elevation, which becomes rounded and bulging when the arm is forcibly flexed. On passing the finger upwards along the middle of this elevation, it is found to sink into a slight depression just below and in front of the anterior margin of the deltoid muscle. This depression corresponds to the interval between the two heads of the biceps. Below, the tendon of the biceps can be followed beyond the bend of the elbow towards its insertion into the upper part of the radius.

On each side of the main portion of the muscle there are distinct longitudinal furrows, known as the *external* and *internal bicipital furrows* respectively. They correspond to the lines along which the investing fascia of the arm sends in septa to become attached to the shaft of the humerus. The external furrow is the shallower of the two. Above, it commences below the insertion of the deltoid, and when traced downwards it is found to turn inwards around the lower part of the biceps muscle, and to terminate in the antecubital fossa. Pressure in the upper part of this groove enables one to feel the shaft of the humerus, but in the lower part the

bone is obscured by the projection of the outer edge of the brachialis anticus muscle, which helps to round off the arm in this region. Posterior to this last-named muscle, and just above the elbow-joint, the external supracondyloid ridge of the humerus can be distinctly felt, and the origins from it of the supinator longus and extensor carpi radialis longior muscles of the forearm made out.

The internal bicipital furrow is well marked throughout its whole extent. It commences above at the level of the insertion of the coraco-brachialis, which point is almost opposite the insertion of the deltoid, and corresponds to the centre of the shaft of the humerus. Inferiorly it turns slightly outwards in the vicinity of the elbow-joint, and then terminates somewhat abruptly, being limited below by a slight elevation passing downwards and inwards into the forearm from the inner margin of the biceps tendon, and formed by the bicipital fascia. Contained within this groove are several important vessels and nerves, to which reference will be made subsequently. In its lower part the inner edge of the brachialis anticus muscle can usually be felt, and posterior to this the tense internal intermuscular septum which is attached to the prominent internal supracondyloid ridge of the humerus.

The posterior aspect of the arm is entirely occupied by the triceps muscle, the three heads of which can be individually distinguished when the muscle is thrown into a state of contraction. Thus, just below and behind the posterior margin of the deltoid is a prominent and somewhat sinuously curved elevation, formed by the external head. Immediately below and internal to this as the finger is passed round the arm a distinct groove can be felt, which overlies the musculo-spiral groove,

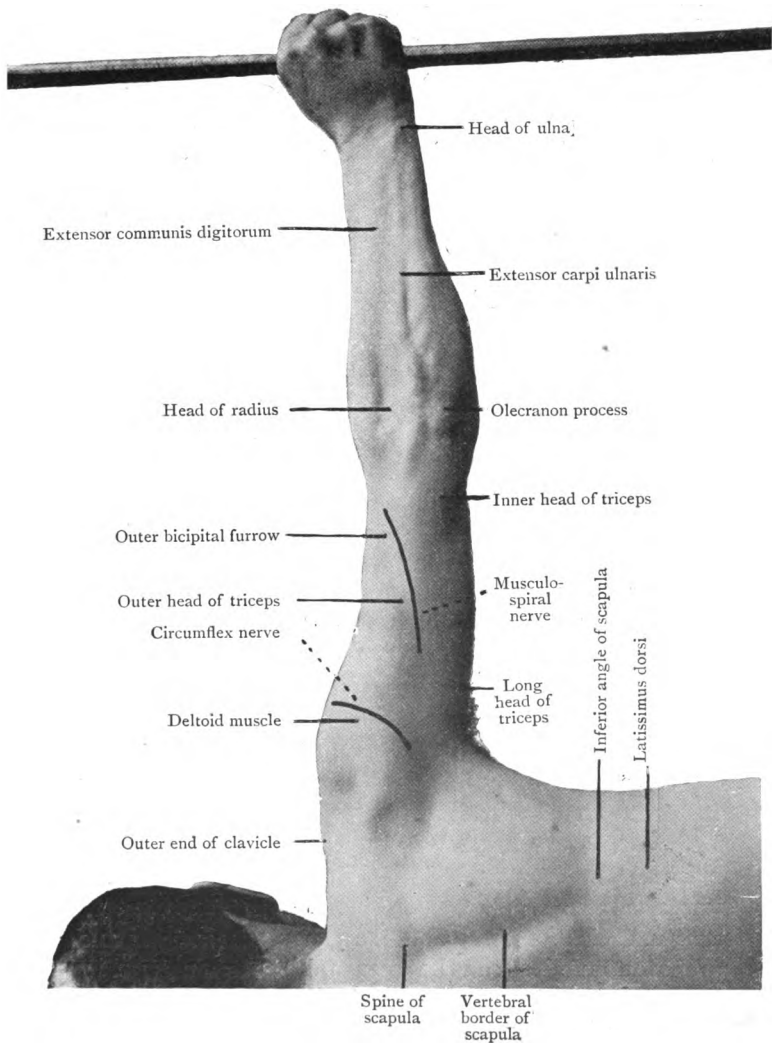


FIG. 13.—BACK OF ARM AND FOREARM.

and which is bounded internally by a broad, flattened elevation extending over the whole breadth of the back of the arm above the elbow-joint. This latter elevation is principally composed of the internal head of the muscle, and passing downwards into it from the axillary border of the scapula can be seen the long head, which forms a prominent longitudinal ridge. The tendon of the whole muscle can be traced to its insertion into the olecranon process of the ulna.

**Elbow Region.**—In the neighbourhood of the elbow numerous important bony points can be made out beneath the skin, and it is of great importance to have an accurate knowledge of their relative positions. Such a knowledge can be best obtained by a combined study of the macerated bones and of the undissected arm.

When the external and internal supracondyloid ridges of the humerus are traced downwards they are found to terminate in the external and internal epicondyles, which are situated about the same level in the arm. Crossing between the epicondyles on the anterior aspect of the limb is a distinct transverse depression, which is called the fold of the elbow, and which lies more than half an inch above the level of the articulation.

The internal epicondyle is the more prominent of the two, and can be readily grasped between the fingers. Its direction corresponds with accuracy to that of the head of the humerus. When the arm is extended it forms a rounded elevation intervening between the arm and the forearm, and the group of extensor and pronator muscles can be seen taking origin from its lower border. When the arm is semi-flexed it appears more prominent and pointed, but in complete flexion it is less evident, although still distinctly visible. On its posterior aspect a deep groove exists, which is bounded

externally by the trochlear surface of the humerus and by the olecranon process, and within which the ulnar nerve lies. The edge of the trochlear surface is very prominent, and lies at a lower level in the arm than the capitellum.

The external epicondyle is blunter and shorter than the internal, and is directed outwards. In front it is completely obscured by the supinator longus and long radial extensor muscles of the forearm, which pass downwards anterior to it. Posteriorly it can be felt, in the position of extension, at the outer part of a depression situated just external to the mid-point of the back of the joint. In the inner portion of the same fossa, the capitellum of the humerus and the head of the radius can be felt. The depression is bounded internally by the anconeus, and externally by the extensor group of muscles of the forearm. When the finger is placed within it a distinct gap can be felt between the humerus and radius, and the head of the latter can be felt rolling under the fingers when the forearm is pronated and supinated. As the arm passes from the position of extension to that of semi-flexion the depression gradually disappears, and both the external condyle and capitellum become more prominent. In full flexion the capitellum forms the outer part of the projection which is known as the point of the elbow, and the external condyle again becomes somewhat obscured by the contraction of the muscles which arise from it. Sometimes the tuberosity of the radius can be detected below the head of that bone when the arm is fully pronated.

The olecranon process of the ulna is very evident in all positions of the joint. When the arm is extended its upper border lies on a level with a line drawn across

between the tips of the two condyles, but as the arm is flexed it passes below that line, and becoming much more prominent, constitutes the summit of the point of the elbow. The subcutaneous triangle on its posterior aspect is readily felt, and the skin can be made to move over it, on account of the presence of an intervening bursa.

On the anterior aspect of the joint very few bony landmarks can be made out, on account of the thick muscles which overlie it. Deep pressure at the inner aspect just below the bend of the elbow enables one, however, to feel the resistance of the coronoid process of the ulna, and similar pressure in a backward direction between the tendon of the biceps and the supinator longus usually enables one to feel the head of the radius, but no portion of the humerus can be detected.

### **The Forearm**

On the front of the forearm the outlines of the antecubital fossa are visible in the form of a faint depression below the fold of the elbow, into which the external and internal bicipital furrows pass from above. The fossa itself is triangular in shape. The internal boundary of the fossa, the pronator radii teres muscle, can be made out extending from just above the internal condyle of the humerus downwards and outwards towards the radius. Externally the boundary is formed by the prominent mass of muscles which give to the forearm in this position its characteristic shape. These muscles are, in front, the supinator longus and the extensor carpi radialis longior, and, behind, the group of extensor muscles which arise from the external condyle of the humerus. The former two muscles can be followed

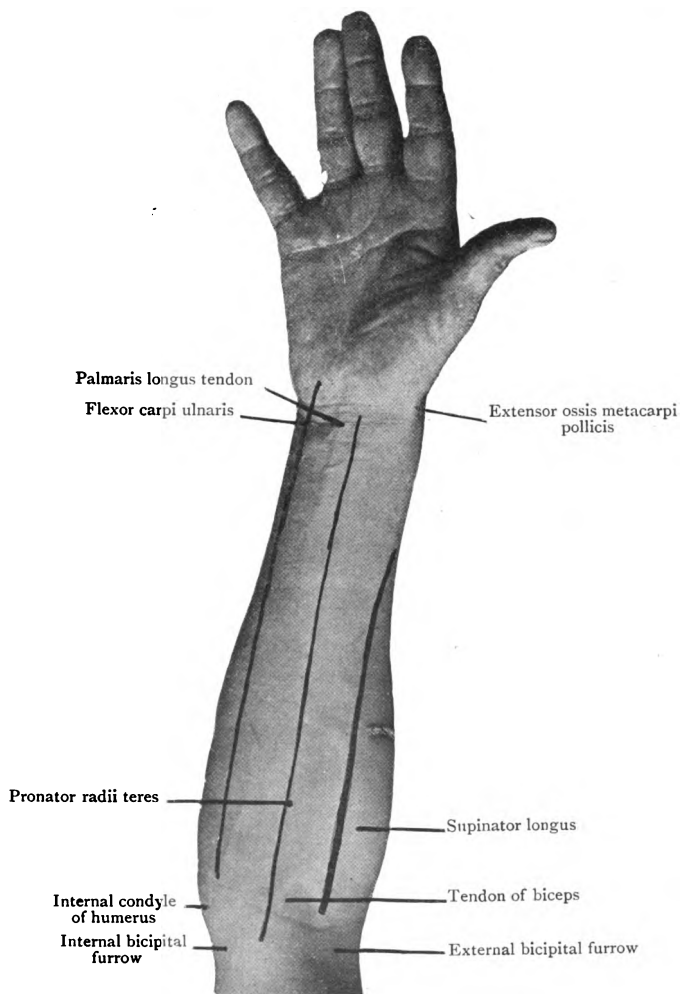


FIG. 14.—FRONT OF THE FOREARM AND HAND.

The three lines represent the radial, median, and ulnar nerves respectively.

down almost to the wrist-joint, but in the middle of the arm their outline is obscured by the approximation to them of the flexor group. The base of the antecubital fossa is formed by the fold of the elbow. In the middle of the fossa the tendon of the biceps can be distinctly felt, and also the resistance caused by the bicipital fascia, which arises from its inner aspect and passes downwards and inwards towards the pronator teres. The pulsations of the brachial artery are also to be felt in this position. The fossa contains numerous other vessels and nerves, the surface-marking of which will be referred to subsequently.

Below the pronator radii teres, the muscles which constitute the bulk of the front of the forearm can rarely be individually distinguished till just above the wrist-joint, but, occasionally, when they are contracted, in thin subjects, the bellies of the flexor carpi radialis and flexor carpi ulnaris muscles can be felt throughout almost their whole extent, and followed down to their tendons ; while, intervening between these two, the bellies of the flexor sublimis digitorum and palmaris longus muscles form a rounded elevation. On the front of the arm the shaft of the radius can be indistinctly felt in its lower two-thirds in thin subjects, and the lower third of the ulna can also, but less distinctly, be palpated.

On the back of the forearm the subcutaneous border of the ulna can be followed down, throughout its whole length, from the olecranon process to the styloid process and head. Outside this border lies the general mass of extensor muscles, the principal bulk of which is formed by the extensor communis digitorum. This muscle can often be seen standing out prominently when the hand is pronated and the fingers alternately

flexed and extended, while internal to it and running along the whole length of the ulna the extensor carpi ulnaris may be seen in thin subjects. Lower down, an oblique prominence, formed by the extensors of the metacarpal bone and first phalanx of the thumb, can be seen extending from below the middle of the forearm downwards and outwards to wind round the lower part of the radius. The outer border and back of the radius can be indistinctly palpated in its lower two-thirds, but in its upper third this bone is too thickly covered to be felt.

### The Wrist and Hand

On each side of the wrist the prominences formed by the lower ends of the radius and ulna respectively can be felt. The lower end of the radius is the more massive of the two, and descends to a lower level. On its anterior aspect, about half an inch above its lowest point, the supinator tubercle, into which the supinator longus muscle is inserted, can be distinguished, and on its posterior aspect a prominent tubercle can also, as a rule, be felt, bounding externally the groove in which the extensor secundi internodii pollicis tendon runs. When the hand is supine the head and styloid process of the ulna can be distinctly felt on the inner side of the wrist, and also the grooves that intervene between them. The groove is more easily palpated on the anterior than on the posterior aspect, owing to the fact that the posterior one lodges the extensor carpi ulnaris tendon. As already stated, the tip of the ulnar styloid process lies normally at a higher level in the arm than the tip of the styloid process of the radius. The former corresponds fairly accurately to the line of the wrist-joint, while the tip of

the radial styloid lies below the line of the articulation. When the hand is pronated the styloid process of the ulna can only be felt with difficulty, and the prominence then seen at the back of the wrist is formed by the head of the bone. On grasping the wrist firmly with the thumb in front and the fingers posteriorly, the interval between the radius and ulna can usually be made out.

Below the ulna, at the inner side of the wrist, the pisiform bone forms a distinct anterior prominence, and can be freely moved from side to side when the hand is flexed; immediately below it the hook of the unciform can be felt by deep backward pressure against the muscles of the hypothenar eminence; while posteriorly the pyramidal bone and the internal lateral ligament of the wrist-joint can be distinguished. Outside the pisiform bone the finger sinks into the carpal depression in which lie the flexor tendons of the fingers. This is bounded externally by the scaphoid and trapezium bones, the former of which can be distinctly felt through the skin. The latter bone is covered over by the muscles of the thenar eminence, and can only be indistinctly felt in front. When the hand is forcibly extended the tubercle of the scaphoid becomes very prominent, and can be easily recognised both by sight and touch. On the outer side of the wrist the external lateral ligament can be made out, and below it the outer aspect of the scaphoid and trapezium bones, and sometimes the interval between them. On the back of the wrist the individual carpal bones cannot, as a rule, be made out, but sometimes the head of the os magnum forms a rounded elevation, which may be distinctly visible when the hand is forcibly flexed. The tendons of the various muscles which descend from the forearm into the hand can all be easily felt around the wrist-joint. Commencing in front on the

outer side, the first tendon encountered is that of the supinator longus, and proceeding from that inwards the following are met with in the order named: (1) The tendon of the flexor carpi radialis, separated from that of the supinator longus by the radial artery. (2) The tendons of the flexor sublimis digitorum muscles, which overlie those of the deep flexor of the fingers. On the surface of the former group of tendons lies the palmaris longus tendon, which is rendered very prominent by opposing the thumb and flexing the hand. This tendon is situated very close to the place where the median nerve becomes superficial between the flexor carpi radialis and flexor sublimis digitorum. (3) The flexor carpi ulnaris, which can be followed down to its insertion into the pisiform bone. Intervening between this tendon and those of the flexors of the fingers lie the ulnar artery and nerve, and immediately internal to it can be felt the lower end of the ulna. (4) Continuing to carry the finger around the back of the wrist from within outwards, the extensor carpi ulnaris is next met with, and then, (5) intervening between the radius and ulna, the tendon of the extensor minimi digiti, which is rendered more evident by flexing and extending the little finger. (6) The tendons of the extensor communis digitorum, descending in a wide groove at the back of the radius, and accompanied by the tendon of the special extensor of the index lying external to them, are next encountered, and can be followed along the back of the hand. (7) External to the last-named group of tendons lie the extensor of the second phalanx of the thumb and the tubercle which bounds it externally. When the thumb is forcibly extended this tendon can be seen passing obliquely downwards and outwards to its insertion. (8) Immediately beyond this the finger

sinks into a distinct depression intervening between the tip of the radius and the scaphoid bone. This depression is traversed longitudinally by the extensor carpi radialis longior and brevior tendons, which cannot, however, be separately distinguished. (9) Immediately outside them lies the extensor primi internodii pollicis tendon, beyond which, (10) at the extreme outer aspect of the wrist-joint, the extensor ossis metacarpi can be seen. Along the back of the hand the tendons of the extensors of the fingers and of the thumb can be followed down to their insertions, and the depressions between the metacarpal bones, which contain the dorsal interossei muscles, can be made out. As a rule the tendons of the extensor indicis and extensor minimi digiti can be seen to join the tendons of the extensor communis digitorum which go to those fingers.

Each of the metacarpal bones themselves can be palpated throughout their entire extent, and, in addition to the first, the fourth and fifth are found to be movable. The last-named admits of fairly free movement in an antero-posterior direction, and also to a less extent laterally, while the fourth only moves slightly from before backwards. Occasionally a distinct prominence can be seen at the upper part of the back of the hand, caused by the styloid process of the third metacarpal bone. The heads of the metacarpal bones project prominently, as the knuckles, when the fingers are flexed.

**The Palm of the Hand** is well marked off from the wrist superiorly by the commencement of the thenar and hypothenar eminences, and by grooves in the skin which cross the wrist transversely at the place of separation. These grooves are three in number and are caused by the frequent movements of flexion at the

articulation. They are best marked in thin subjects. The middle one corresponds fairly closely with the line of the wrist-joint.

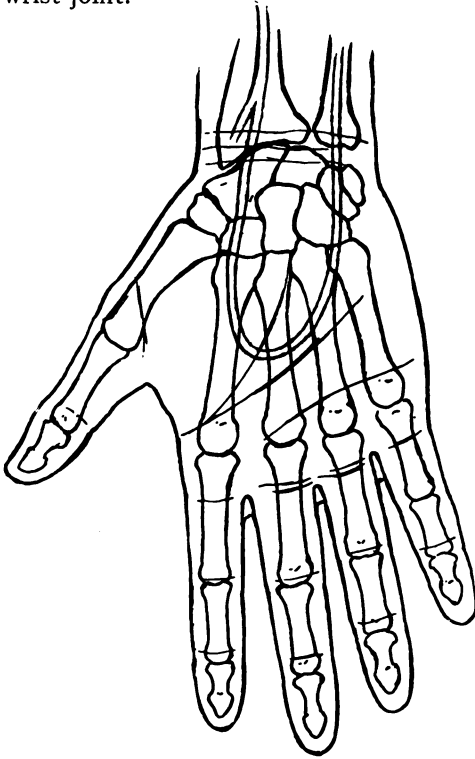


FIG. 15.—DRAWING OF HAND FROM X-RAY PHOTOGRAPH BY  
DR. E. G. WATSON.

The palmar arch is represented semi-diagrammatically. Note the position of the lines of the hand and fingers in relation to the bones.

On the outer side of the palm of the hand the intrinsic muscles of the thumb form the elevation

known as the thenar eminence. This is continuous inferiorly with the fold of skin which passes from the metacarpal bone of the index-finger to the inner side of the thumb, and which is known as the web of the thumb. The fold is supported by the adductor transversus pollicis and abductor indicis muscles. On the inner side of the hand an eminence called the hypothenar eminence, similar to, but smaller and more elongated than, the thenar eminence, is formed by the intrinsic muscles of the little finger. When the palmaris brevis muscle is well developed the skin can usually be wrinkled over this elevation by its contraction. Between the thenar and hypothenar eminences lies the central hollow of the palm of the hand. This is triangular in shape, with the apex above and the base below. It is limited above by a slight elevation connecting the thenar and hypothenar eminences, beneath which lies the anterior annular ligament. Pressure against this elevation enables the resistance caused by the ligament to be felt, while the bones to which it is attached can be palpated on each side. Below, the hollow of the hand is limited by a series of slight elevations placed opposite the roots of the fingers, and separated from one another by intervening depressions which lead into the interdigital spaces. The hollow itself presents a varying degree of firmness, dependent upon the degree of development of the underlying palmar fascia. It is traversed by a series of lines which correspond to the places where flexures of the palm occur during the various movements of the hand. The most constant of these lines are as follows: (1) A line circumscribing the thenar eminence on its inner aspect. This commences above at the wrist, and passes downwards and outwards to cut the radial side of the palm about its middle, and on a level with the lower margin

of the web of the thumb. The upper part of this line lies over the middle of the os magnum, and its lower part crosses the second metacarpal bone at the junction of the shaft with the head. (2) A line which crosses the palm of the hand obliquely. Starting about the middle of the hypothenar eminence, it passes outwards, and usually terminates by joining the lower end of the first-described line. (3) A curved line, which commences at the inner side of the palm at the junction of its upper three-fourths with its lower fourth, and passes from thence downwards and outwards, to end opposite the interval between the index and middle fingers. The inner part of this line crosses the fifth and fourth metacarpal bones just above the junction of the shaft with the head.

The palm of the hand is separated from the fingers by distinct transverse lines which lie immediately below the eminences at the roots of the fingers already referred to, and limit those eminences inferiorly. As a rule, only a single line is present at the base of the index and little fingers, while two are seen at the base of the middle and ring fingers. These lines do not correspond to the metacarpo-phalangeal joints, but lie about three-quarters of an inch below them. Similar transverse lines cross the fingers in the regions of the interphalangeal joints. As a rule, two lines lie in relation to the proximal interphalangeal articulation, and the distal one of these corresponds with considerable accuracy to the line of the joint. One line only is found in relation to the distal interphalangeal joint, and this lies somewhat above the line of the articulation. At the root of the thumb, just external to the thenar eminence, two or three transverse lines may be seen, the most distant of which, as a rule, lies, in the middle of its course, opposite the metacarpo-phalangeal joint.

**Bloodvessels of the Arm**

**Arteries.**—When the arm is abducted, supinated, and extended, the course of the **axillary artery** may be mapped out on the surface by a line drawn from the centre of the clavicle to the mid-point of the axilla, opposite the lower margin of the teres major muscle. The terminal point is easily determined, as it lies immediately internal and posterior to the slight elevation formed by the insertion of the coraco-brachialis muscle. In its lower part the artery can be felt pulsating immediately under the skin, and by pressure upwards into the axilla a considerable portion of the second stage of the vessel can also be felt. Deep pressure backwards and downwards in the infraclavicular fossa may also enable its commencement, or the termination of the subclavian artery, to be palpated. The intervals between the various stages of the artery can be determined by drawing the lines corresponding to the upper and lower margins of the pectoralis minor muscle. Where the upper of these lines crosses the artery corresponds to the origin of the thoracic axis artery. The long thoracic artery runs along the lower margin of the pectoralis major muscle, and the subscapular along the axillary border of the scapula. The posterior circumflex accompanies the circumflex nerve, and the anterior circumflex lies with the tendon of the biceps in the bicipital groove.

The **brachial artery** extends from the termination of the axillary downwards and outwards along the inner margin of the biceps, within the internal bicipital groove. It terminates in the antecubital fossa in the middle line of the arm, about a finger's breadth below the fold of the elbow. A straight line drawn on the skin between the point of commencement and point of termination

will indicate its position. The artery can be felt pulsating throughout its entire extent, and at its termination it lies immediately internal to the prominence formed by the tendon of the biceps. The superior profunda and inferior profunda branches of the brachial artery accompany the musculo-spiral and ulnar nerves respectively, and have the same markings in the upper arm. The nutrient artery enters the humerus about the middle of its shaft, and the anastomotica passes inwards about an inch above the fold of the elbow.

The course of the **radial artery** may be marked out in the forearm by drawing a line from the middle of the antecubital fossa downwards and outwards to the anterior margin of the tip of the styloid process of the radius. Throughout its entire course it lies superficially, but can only be felt distinctly in the lower part of its course when the muscles between which it lies have become tendinous. From the tip of the styloid process of the radius the vessel passes obliquely across the outer side of the wrist to the superior part of the first interosseous space. As it does so it passes across the hollow which intervenes between the tendons of the extensors of the thumb, and gives off the two small arteriæ dorsales pollicis, which run downwards on each side of the dorsal aspect of the thumb, and also the arteria dorsalis indicis, which passes along the back of the radial aspect of the index-finger. The deep palmar arch lies within the hand a little below the lower margin of the anterior annular ligament, and about half an inch superior to the superficial palmar arch. The only other branch of the radial artery which requires mention is the radial recurrent, which runs upwards along the outer boundary of the antecubital fossa, accompanying the lower part of the musculo-spiral nerve.

The **ulnar artery** commences at the middle line in the antecubital fossa, and runs from thence obliquely inwards along a line drawn from its place of commence-

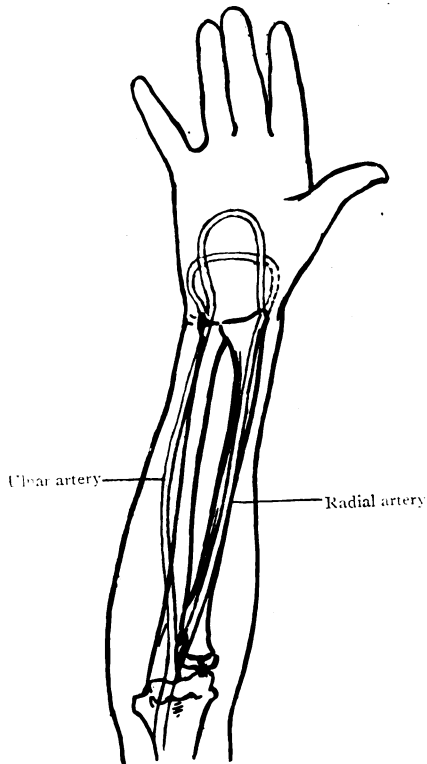


FIG. 16.—DIAGRAM TO REPRESENT THE RADIAL AND ULNAR ARTERIES, AND THE PALMAR ARCHES.

ment, across the flexor pronator group of muscles, to the inner aspect of the arm at the junction of its upper and middle thirds. It then turns downwards along the lower

portion of a line drawn from the back of the internal condyle of the humerus to the outer side of the pisiform bone, and forms within the palm the superficial palmar arch. The lowest portion of the curve of this arch corresponds in level with the middle of the second line crossing the palm of the hand, and lies opposite the lower margin of the outstretched thumb. The first digital artery given off by the arch crosses the lower part of the hypothenar eminence on its way to the inner side of the little finger. The three other digital arteries run downwards from the arch to the interval between the fingers, and then bifurcate within the upper part of the webs of the fingers into the lateral digital arteries. The anterior recurrent branch of the ulnar artery runs upwards along the inner margin of the pronator radii teres muscle, while the posterior recurrent branch lies with the ulnar nerve at the back of the internal condyle of the humerus.

**Veins.**—On the dorsum of the hand a large venous plexus exists, from which the principal superficial veins of the forearm take origin. These are four in number, and can all be seen distinctly when they are rendered full by pressure upon the upper arm. Almost in the middle line of the front of the forearm lies the median vein, which terminates a little distance below the elbow by dividing into the median cephalic and the median basilic veins. The former of these passes upwards and outwards, and receives as tributary the radial vein which has ascended along the outer border of the forearm. The combined trunk, which is now called the cephalic vein, runs upward in the external bicipital furrow and in the interval between the deltoid and pectoralis major muscles, to finally cross the outer part of the infraclavicular fossa, and disappear into the axilla. The median basilic crosses the tendon of the biceps as

it passes upwards and inwards, and after receiving the two superficial ulnar veins continues its upward course as the basilic vein in the internal bicipital furrow, to ultimately form the axillary vein, which pursues a course identical with that of the axillary artery.

### Nerves of the Arm and Forearm

1. **Superficial Nerves.**—These nerves are very numerous, and are best considered seriatim. (1) A group of nerves derived from the cervical plexus (supra-acromial and supraclavicular) stream vertically downwards across the clavicle, and spread out over the pectoral and deltoid regions. (2) The superficial branch of the circumflex nerve winds round the deltoid muscle midway between its origin and insertion. (3) The two external superficial branches of the musculo-spiral nerve descend along the outer aspect of the arm from about the level of the lower margin of the deltoid to the elbow. (4) On the inner side of the arm four nerves descend vertically from the axilla towards the elbow. They are, from before backwards, (*a*) a branch from the internal cutaneous which overlies the biceps muscle; (*b*) the lesser internal cutaneous nerve; (*c*) the intercosto-humeral nerve; (*d*) the internal cutaneous branch of the musculo-spiral nerve. (5) On the outer side of the forearm lie two branches of the musculo-cutaneous nerve—one anterior and the other posterior to the radial border. (6) On the inner side of the forearm two branches of the internal cutaneous nerve descend as far as the wrist—one lying in front and the other behind the ulnar border.

**Deep Nerves.**—(1) The deep branch of the circumflex lies in close contact with the humerus, and is represented by a line drawn around the deltoid muscle a little above the mid-point between its origin and inser-

tion. (2) The musculo-spiral nerve passes obliquely across the back of the arm along a line drawn from the lower margin of the posterior axillary fold, where it meets the arm, to the upper part of the external condyle of the humerus. It crosses the middle of the back of the humerus at the level of the insertion of the deltoid, and its terminal part lies under cover of the supinator longus muscle in the antecubital fossa. (3) The posterior interosseous nerve winds round the outer aspect of the radius two fingers' breadth below the bend of the elbow. (4) The radial nerve accompanies the radial artery to within two inches of the end of the radius, and then winds round the outer aspect of the forearm, to be distributed on the back of the hand. (5) The musculo-cutaneous nerve passes obliquely across the front of the arm along a line drawn from the lower margin of the anterior axillary fold to the external condyle of the humerus. Its further cutaneous course has already been dealt with. (6) The median nerve within the upper arm closely follows the course of the brachial artery, and in the antecubital fossa it lies immediately internal to that vessel. It then descends vertically along the middle of the front of the forearm, and becomes superficial just above the wrist between the flexor carpi radialis and flexor sublimis digitorum tendons. Its digital branches within the hand accompany the digital arteries. (7) The ulnar nerve lies to the inner side of the axillary and brachial vessels as far as the insertion of the coracobrachialis, and then descends to the back of the internal condyle of the humerus, where it can easily be felt and rolled under the finger. From this point it descends vertically to the outer side of the pisiform bone, lying in the lower part of its course on the inner aspect of the ulnar artery. Its digital branches within the palm of the hand accompany the digital arteries.

## THE LOWER EXTREMITY

**The Gluteal Region.** — The gluteal region is limited by the iliac crest superiorly and by the fold of the nates below. The iliac crest is subcutaneous throughout its entire extent, and, when the abdominal and gluteal muscles are contracted, is usually visible on the surface as a faint groove. In thin subjects, however, and especially in females, it may exist in the form of a well-marked projection. In front it commences at the anterior superior iliac spine, to which Poupart's ligament is attached, and as the finger is carried round it from in front backwards a distinct tubercle is detected situated on its outer aspect 2 inches behind its anterior extremity. This tubercle has already been referred to in connection with the lines used to map out the abdominal cavity into areas; some distance behind it the highest point of the crest is reached. It lies at about the level of the umbilicus, opposite the fifth lumbar vertebra. From this point the crest descends gradually to the posterior superior iliac spine, which is situated at the bottom of a slight depression or dimple at the level of the spine of the second sacral vertebra, and overlying the centre of the sacro-iliac articulation. The posterior inferior iliac spine is somewhat obscured by the fibres of origin of the gluteus maximus, but can usually be felt lying about an inch vertically below the above-mentioned depression.

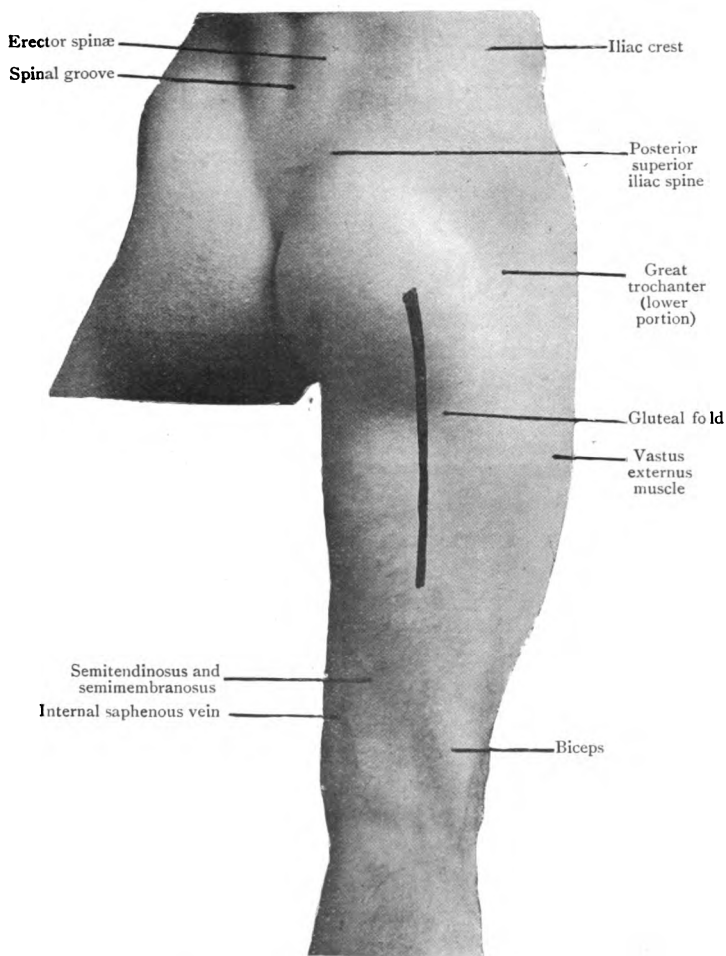


FIG. 17.—POSTERIOR ASPECT OF THIGH.  
 The black line indicates the position of the great sciatic nerve.

The greater part of the mass of the buttock is formed by the gluteus maximus muscle, covered over by a thick layer of adipose tissue, but at its upper and outer part the tensor fasciæ femoris muscle is situated, and forms a prominent elongated swelling on the outer aspect of this region.

A distinct interval can usually be made out between the tensor fasciæ femoris and the gluteus maximus. This is filled in by the gluteus medius, covered by the strong gluteal fascia. Between the inner margins of the gluteus maximus muscles lies a deep cleft—the cleft of the nates—at the bottom of which the spines of the lower pieces of the sacrum and the pieces of the coccyx can be felt, the latter, as a rule, being movable. By pressure against the outer margins of this cleft the sacro-sciatic ligaments and the tubera ischii can also be felt. Below, the cleft passes outwards on each side to become continuous with the fold of the nates—a deep transverse groove in the skin which limits the buttock inferiorly, and which crosses over the lower oblique margin of the gluteus maximus muscle. This fold is caused by the dimpling in of the skin below the level of the tuber ischii. Immediately deep to this line at its inner part lie the hamstring muscles, where they emerge from under cover of the gluteus maximus, while the tendon of the gluteus maximus itself may be felt, when contracted, as a firm line crossing under its outer portion.

When the gluteal muscles are all contracted and the individual standing erect, a deep depression is seen on the outer aspect of the region, caused by the attachment of the muscles to the great trochanter of the femur. At the anterior part of this depression the great trochanter itself can be felt, and its outline made out. Its summit

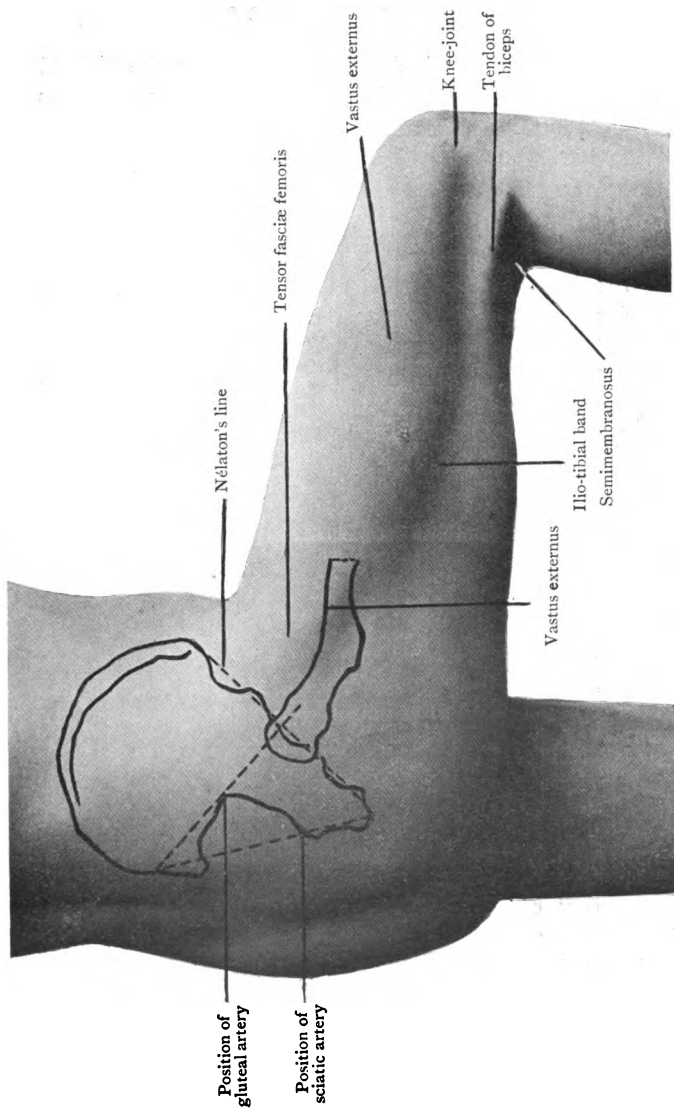


FIG. 18.—OUTER ASPECT OF BUTTOCK AND THIGH.

is situated about five inches vertically below the highest point of the iliac crest, and is at the same level as the hip-joint. An exact knowledge of its position in relation to the ilium is of importance, and for this purpose certain guiding lines may be drawn, the best known of which are those of Nélaton and Bryant.

1. *Nélaton's Line*.—This line is drawn over the buttock from the tip of the tuber ischii to the anterior superior iliac spine. It passes immediately across the top of the great trochanter of the femur, and the point at which it touches the trochanter is opposite the centre of the acetabulum.

2. *Bryant's Line* is determined as follows. Draw a line horizontally around the abdomen at the level of the anterior superior iliac spines. A line dropped vertically upon this from the summit of the great trochanter is known as Bryant's line. Bryant's triangle is completed by joining the tip of the great trochanter and the anterior superior iliac spine.

### The Thigh

The thigh is marked off from the abdomen above by Poupart's ligament and the upper margin of the body of the pubis. It is widest above and gradually tapers downwards towards the knee, having, when viewed from the front, a somewhat triangular appearance, the base of which is formed by Poupart's ligament and the apex by the upper margin of the patella. On the inner side the thigh is separated from the perineum by the symphysis pubis itself, and by the boundaries of the pubic arch, along which the finger can be drawn as far as the tuber ischii. Externally, the only line of demarcation between the thigh and the gluteal region

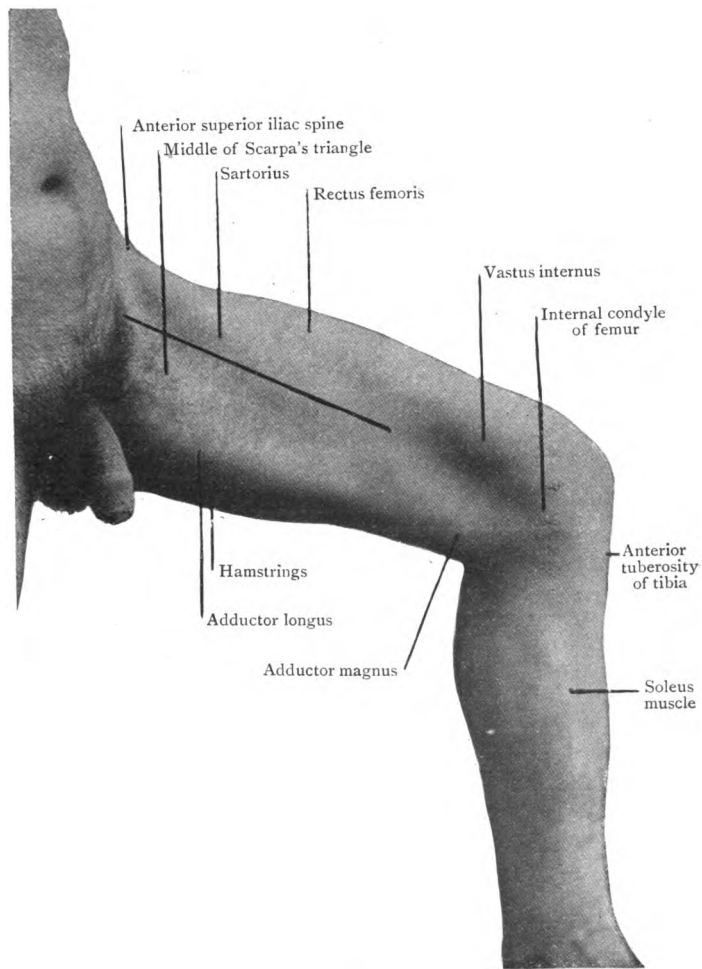


FIG. 19.—INTERNAL AND ANTERIOR ASPECT OF THIGH.  
 The dark line indicates the position of the femoral artery.

is the upper part of the deep longitudinal depression which extends vertically downwards from the front of the iliac crest towards the knee, and is caused by the ilio-tibial band of fascia lata.

On the front of the thigh immediately below Poupart's ligament a triangular depression can be seen in well-developed subjects, the apex of which extends downwards and inwards. This depression corresponds to Scarpa's triangle, and the tendon of the adductor longus, which forms its inner boundary, can be palpated throughout the greater part of its length, and followed upwards to its origin from the os pubis. The outer boundary is formed by the sartorius. This muscle is rendered especially evident throughout its whole length, when the thigh is flexed, abducted, and everted. Its lower part overlies and serves as a marking for Hunter's canal. Within the triangle itself, a row of lymphatic glands can be felt at its base, and a second row can sometimes be palpated, extending vertically downwards about its middle. Pressure against the floor of the triangle enables the obliquely placed adductor longus muscle to be felt, and very firm pressure immediately external to this enables the femur, which is here thickly coated with muscles, to be felt rolling under the fingers when the limb is moved inwards and outwards. The head of the femur lies immediately deep to the centre of Poupart's ligament. Below and outside the sartorius muscle on the front of the thigh, a very marked prominence, caused by the fleshy belly of the rectus femoris muscle, can be both seen and felt when that muscle is thrown into contraction, but the other parts of the quadriceps extensor cannot be individually distinguished except below, where the fibres of the vastus externus and vastus internus respectively contribute to

the rounded appearance of the front of the thigh just above the knee. The fibres of the vastus internus descend a little lower than those of the externus, and therefore the inner side of the knee appears fuller and more rounded than the outer. On the inner side of the thigh, below the adductor longus, the tendon of the adductor magnus can be felt, and can be traced downwards to the adductor tubercle of the femur. It is one of the most easily recognised of all the muscles of the thigh. On the outer aspect of the thigh a distinct vertical groove can be seen, which overlies the vastus externus, and which separates the anterior and posterior convexities of the thigh. This groove, as already stated, is formed by the ilio-tibial band of fascia lata, and at its upper part lodges the tensor fasciæ femoris muscle. Below, it can be followed as far down as the head of the fibula. Its posterior part corresponds to the situation of the external inter-muscular septum.

On the back of the thigh the hamstring muscles cannot be separately distinguished above its middle, but lower down the short head of the biceps and also the long head, fusing with it, can be felt externally. On the inner side also, the tendons of the semitendinosus and semimembranosus muscles can be felt lying immediately posterior to the tendon of the adductor magnus. As a rule, the broad flat tendon of the gracilis cannot be made out, except just above the level of the knee, where it lies internal to the semimembranosus.

Throughout the greater part of its length the shaft of the femur is thickly covered with muscles, and cannot be distinctly felt. At its lowest part, however, its lateral aspects can often be distinguished at the place where the bone widens out into the condyles.

### The Knee

The most prominent portion of the front of the knee in all positions of the joint is formed by the patella, the skin over which is thickened, and freely movable on the underlying bone. When the leg is extended and the quadriceps extensor muscle relaxed, the patella is freely movable, both laterally and from above downwards. Into its upper margin the extensor quadriceps tendon can be traced, and from its lower margin the ligamentum patellæ can be followed downwards to the anterior tuberosity of the tibia. When the bone is displaced laterally the margins of the trochlear surface of the femur can be made out, especially the prominent outer edge, and a portion of that surface itself can be palpated. Both condyles of the femur are quite accessible to touch, and when the leg is forcibly flexed the lower articular portions of them can be seen, especially in thin subjects, projecting under the skin on each side of the patella. On the outer aspect of the external condyle the external tuberosity can be felt, and the cord-like external lateral ligament can be traced down from it to the head of the fibula, lying at first in front of the tendon of the biceps. Sometimes the tendon of the popliteus can be rolled under the finger, where it lies under cover of the upper portion of this ligament. Below the external condyle a faint interval between it and the tibia can be made out, and this is more marked in front when the leg is flexed. On extension, however, the pad of fat that lies under cover of the ligamentum patellæ is pressed out on each side and obscures the line of articulation. On the internal condyle the prominent adductor tubercle

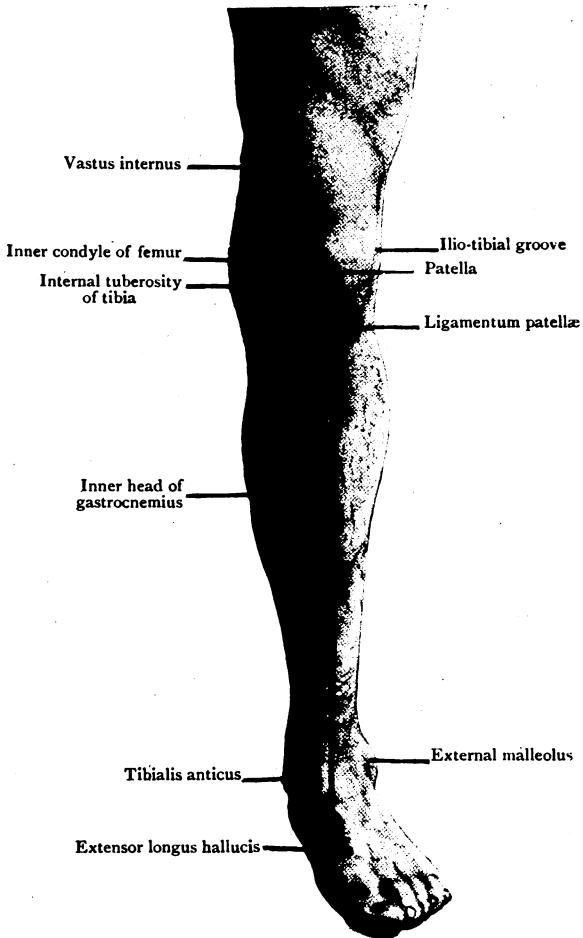


FIG. 20.—FRONT OF LEG AND KNEE.

The black line indicates the position of the anterior tibial nerve and artery.

can be felt, and the adductor magnus tendon which is inserted into it. The upper margin of this tubercle corresponds to the level of the epiphyseal line in the young bone. On the inner aspect, also, the interval between the femur and the tibia can readily be felt.

Below the femur the three tuberosities of the tibia can be made out, the presence of the external and internal ones giving the characteristic appearance to this part of the articulation when viewed from the front. Under cover of the ligamentum patellæ the flat area which leads down to the anterior tuberosity is also palpable. Immediately below the hinder part of the external tuberosity the head of the fibula can be seen lying at the bottom of a slight depression between the biceps and the peronei muscles when the limb is extended. When the limb is flexed it becomes more prominent, and it is then easy to follow the tendon of the biceps and the external lateral ligament downwards towards it.

At the back of the knee is situated the region of the ham, which forms a deep hollow when the leg is flexed, but which becomes prominent on extension. This area is separated from the region of the calf below by a transverse fold called the fold of the knee, which lies somewhat above the interval between the articulating bones. Owing to the presence of the tense popliteal fascia, it is difficult to feel the popliteal vessels and nerves, but the upper boundaries of the space can be made out. Thus, externally is felt the biceps, along the inner margin of which runs the external popliteal nerve, and internally, the tendons of the semitendinosus, semimembranosus, and gracilis muscles.

### The Leg

In dealing with the surface anatomy of the leg, it is convenient to discuss it under the various areas into which it is anatomically divided.

1. **Tibial Region.**—This region corresponds to the inner subcutaneous area of the tibia, which can be palpated throughout its whole extent, and which is bounded posteriorly by the inner border of the tibia, and in front by the shin. The shin or crest of the tibia can be traced from the anterior tuberosity above downwards to the ankle. At its lower part it is less prominent than above, and, becoming rounded, turns inwards to become continuous with the anterior margin of the internal malleolus. Into the upper portion of the inner surface of the tibia the tendons of the sartorius, gracilis, and semitendinosus muscles are inserted, along with the internal lateral ligament of the knee, and give rise to a soft, rounded prominence in this situation. The only other soft structure in relation to this tibial area is the internal saphenous vein, which, when distended, may be seen crossing obliquely its lower part.

2. **Anterior Tibio-fibular Region.**—This region is limited internally by the crest of the tibia, and externally by a faint depression which corresponds to the site of the anterior peroneal septum. Below, it is directly continuous with the dorsum of the foot. It usually presents a full and rounded appearance, which is largely produced by the prominent tibialis anticus muscle. At the upper part of the space a slight interval can be felt outside this muscle between it and the extensor longus digitorum, when both muscles are contracted, and lower down the tendons of the tibialis anticus, extensor longus hallucis, extensor longus digitorum,

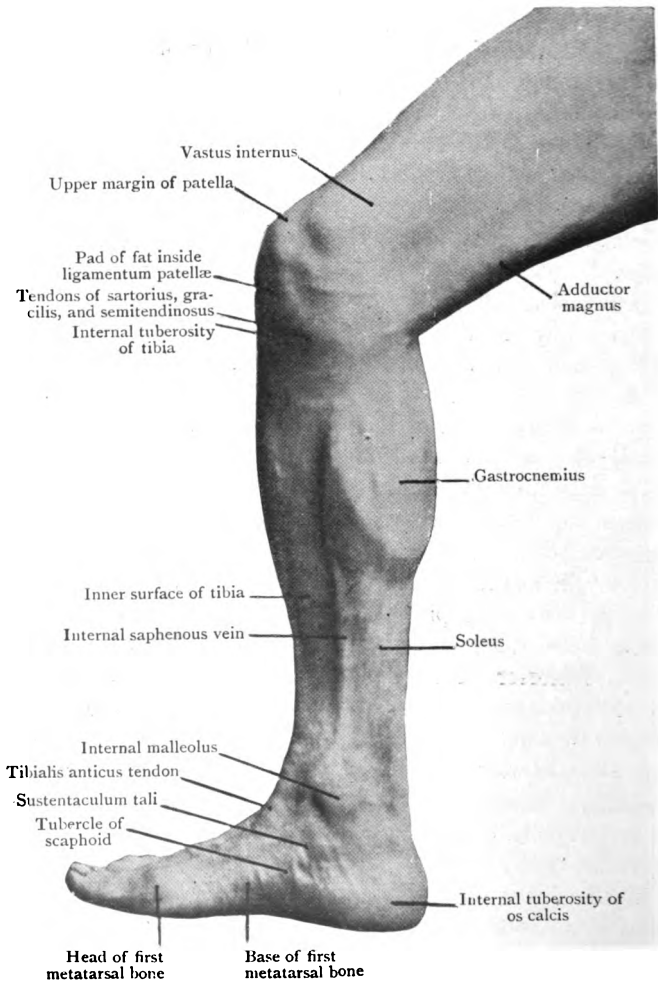


FIG. 21.—INNER ASPECT OF LEG AND FOOT.

and peroneus tertius, can be felt in this order from within outwards as they approach the front of the ankle-joint.

3. **Peroneal Region.**—This region corresponds to the outer surface of the fibula, but, except at its upper and lower extremities, the bone itself cannot be felt, as it is covered by the peronei muscles. The region is limited in front and behind by slight vertical furrows, which are caused by the anterior and posterior peroneal septa. Running down throughout the region a third furrow is also, as a rule, visible when the leg is held tense. This corresponds to the interval between the peroneus brevis and the peroneus longus muscles. Both of these muscles can be distinctly seen, forming slightly rounded prominences, which can be followed by the eye downwards as far as the foot. Above, the head and neck of the fibula are subcutaneous, and the external popliteal nerve can be rolled under the finger as it crosses over the neck of the bone. At the lower end of the region the subcutaneous triangle of the fibula, which lies immediately above the external malleolus, can be felt.

4. **Posterior Tibio-fibular Region.**—This region constitutes the calf of the leg. It extends from the fold of the knee to the heel, and is limited laterally by the groove corresponding to the posterior peroneal septum, and by the internal border of the tibia. In its upper part it is rounded and prominent, but rapidly tapers inferiorly. The upper prominent part is formed principally by the gastrocnemius muscle, the two heads of which can be felt, and the interval between them made out. The inner head will be noticed to be longer and more prominent than the external. On each side of the gastrocnemius above, a prominence is formed by

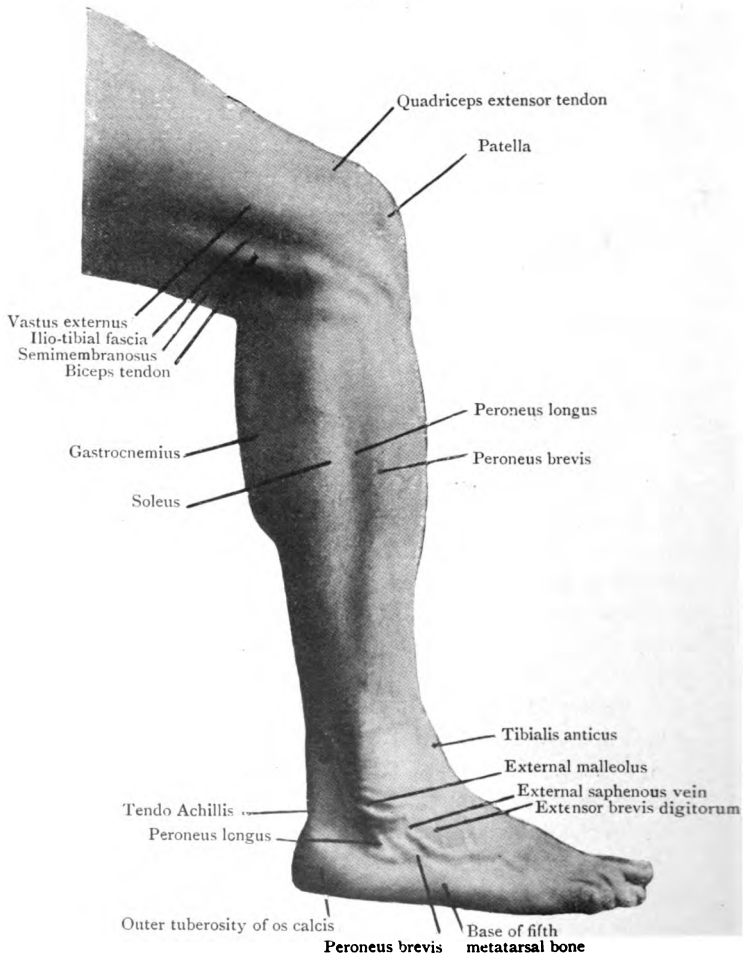


FIG. 22.—OUTER ASPECT OF LEG AND FOOT.

Note especially the tendons of peroneus longus and brevis muscles. The cuboid bone lies immediately behind the base of the fifth metatarsal bone.

the edges of the soleus muscle, and these prominences are continuous below with the triangular elevation formed by that part of the muscle which extends below the level of the gastrocnemius. Inferiorly, the tendo Achillis stands out prominently, and on each side of it a depression is seen which overlies a small pad of fat.

### **The Ankle and the Foot**

On the outer side of the ankle the external malleolus forms a very prominent projection, which is quite subcutaneous. Around its posterior and under border the tendons of the peronei muscles can be traced. The outer surface of this malleolus is continuous with the triangular subcutaneous area of the lower part of the fibula. The external malleolus is less prominent than the internal, but it extends further down and further back. The various parts of the external lateral ligament which extend from it are, with the exception of the middle vertical portion, difficult to feel. The middle part can, however, be distinctly felt, extending downwards to the os calcis. On the inner side of the ankle the lower end of the tibia forms a larger and more prominent elevation, which does not extend down to so low a level as the external malleolus. On the posterior aspect of this prominence a distinct groove can be felt, in which lies the tendon of the tibialis posticus, while from its tip the internal lateral ligament of the joint can be felt passing downwards towards the os calcis. The line of the articulation itself lies about half an inch above the tip of the internal malleolus, and nearly an inch above that of the external malleolus. On the posterior aspect of the joint is placed the tendo Achillis, in front of which lies a pad of fat. By pressing

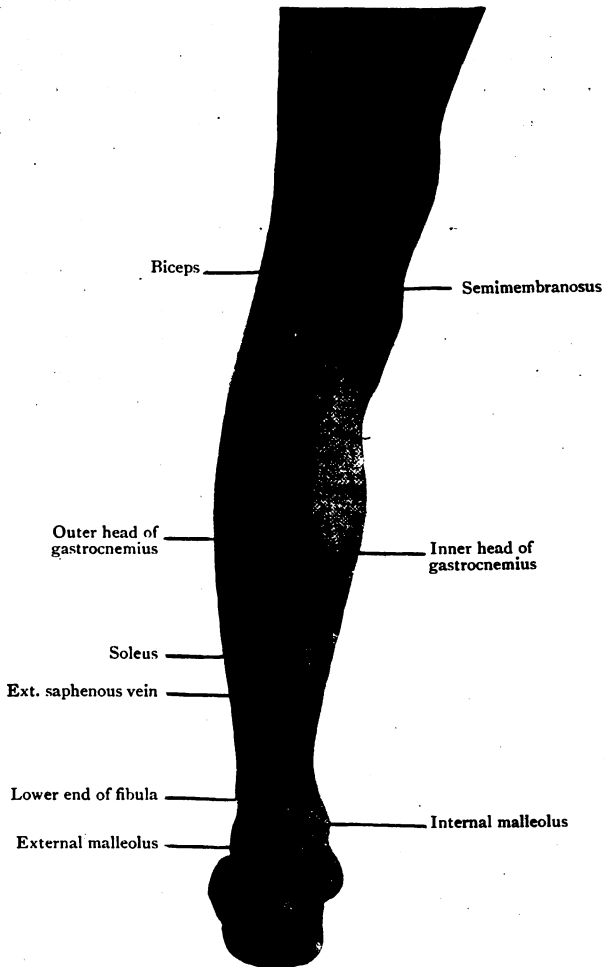


FIG. 23.—BACK OF LEG AND KNEE.

The dark line indicates the position of the posterior tibial artery and nerve.

deeply under this tendon from the inner side, the posterior surface of the astragalus can usually be felt, and the os trigonum made out, but the tendons of the flexor longus hallucis and flexor longus digitorum are too deep to be felt.

In front of the joint a number of tendons are situated, all of which can be traced to their insertion. From within outwards they are as follows. (1) Tibialis anticus—this is rendered very prominent by extending and inverting the foot, and can be followed down to the base of the first metatarsal and the internal cuneiform bones; (2) extensor longus hallucis—this is seen extending downwards and inwards towards the ungual phalanx of the great-toe; (3) the extensor longus digitorum, the various tendons of which can be followed to their insertions into the four outer toes; (4) the peroneus tertius, which extends downwards to the base of the fifth metatarsal bone. The presence of these tendons obscures, to some extent, the outline of the joint, but, as a rule, the interval between the tibia and fibula above and the astragalus below can be made out, by the examining finger, especially on the inner side.

The astragalus also is obscured in front, but when the foot is forcibly extended the head of that bone may often be seen forming a slight rounded swelling at the front and inner aspect of the dorsum of the foot. External to it on the dorsum is seen in all positions of the foot a soft rounded swelling, caused by the presence of the extensor brevis digitorum muscle. The portion of the os calcis from which this arises can be made out lying immediately below and in front of the external malleolus. Beyond the astragalus the upper convex surface of the foot is formed by the scaphoid, cuneiform, and cuboid bones, but these cannot be separately dis-

tinguished. The upper surface of all the metatarsal bones can be distinctly felt, and also, between them, the intervals which lodge the interossei muscles. The webs of the toes are situated nearly half an inch below the metatarso-phalangeal joints. These articulations can themselves be made out when the toes are alternately flexed and extended.

On the inner side of the foot the internal tuberosity of the os calcis can be distinguished posteriorly, and intervening between it and the internal malleolus there is a deep hollow. This hollow lodges the posterior tibial vessels and nerves and the flexor tendons which are passing to the sole of the foot, the order of the tendons being, from above downwards, the tibialis posticus, the flexor longus digitorum, and the flexor longus hallucis. Immediately below the tip of the internal malleolus the sustentaculum tali of the os calcis can be felt, and in front of the latter the prominence caused by the tubercle of the scaphoid. Behind this tubercle a slight interval can be felt intervening between it and the lesser process of the calcaneum, which corresponds to the situation of the medio-tarsal joint. Immediately in front of the scaphoid tubercle is situated the articulation between the scaphoid and the internal cuneiform bone, but no distinct interval can be felt to mark it. Anterior to the scaphoid the broad internal surface of the internal cuneiform bone can be felt, bounded in front by the base of the first metatarsal bone. This last bone can be felt throughout its whole extent, its head being especially prominent, with the sesamoid bones on its under aspect.

On the outer side of the foot the external tuberosity of the os calcis is felt posteriorly, and immediately in front of it, and vertically below the external malleolus,

the peroneal tubercle can be palpated. The whole of the outer surface of the os calcis can, indeed, be felt, and also the tendons of the peroneus brevis and longus muscles in relation to it. The former of these can be followed to the base of the fifth metatarsal bone when the foot is inverted, and the latter can be traced forwards beneath the peroneal tubercle to the cuboid bone, where it disappears into the sole of the foot. The exact outlines of the cuboid are hard to determine, but its position can be made out lying in front of the os calcis and behind the very prominent base of the fifth metatarsal bone. The whole of this latter bone can be palpated on its outer aspect, and also the interval between it and the first phalanx of the toe.

The sole of the foot is so thickly covered with muscles that, with the exception of the posterior part of the os calcis and the heads of the metatarsal bones, it is impossible to make out the surfaces of the bones which form it. The general shape of the sole is somewhat triangular, with the apex over the heel and the base anteriorly at the roots of the toes. The weight of the body is principally supported by the heel and the heads of the metatarsal bones, and in these regions the skin is specially thickened. The skin is also thick along the outer border of the foot, which comes in contact with the ground in walking, but on the inner aspect it is very delicate over an area, which leads superiorly into the hollow on the inner side of the ankle between the internal malleolus and internal tuberosity of the os calcis. The abductor hallucis muscle lies under cover of this inner portion, while the abductor minimi digiti lies in relation to the outer part of the foot. Between the two is placed the flexor brevis digitorum muscle. At the roots of the toes in front there are accumulations of

adipose tissue similar to those seen on the palm of the hand. These are separated from one another by faint depressions which lead down into the interdigital spaces. By pressure against these fatty pads the heads of the metatarsal bones and the metatarso-phalangeal joints can be made out, especially that of the first metatarsal bone. Under the head of this bone the two sesamoid cartilages which play against it can be felt and often moved slightly. The interdigital clefts commence nearly an inch in front of the metatarso-phalangeal joints.

### Bloodvessels of the Lower Limb

**Arteries.** — The **femoral artery** enters the thigh behind Poupart's ligament at a point midway between the anterior superior iliac spine and the symphysis pubis. This point may for convenience be termed the femoral point. In the upper part of its course it lies superficially within Scarpa's triangle for a distance of from 2 to 4 inches, and its pulsation can be felt here in the living. In the lower part of its course, however, it is covered by the sartorius muscle, as it lies within Hunter's canal. Its course can be mapped out on the surface when the limb is slightly abducted and everted by a line drawn from the femoral point to the adductor tubercle of the femur. Only the upper two-thirds or less of this line overlies the artery, as the vessel turns backward through the opening in the adductor magnus at the lower part of the thigh. The **profunda femoris** artery may be indicated by the same line as that for the femoral artery, but occupies a deeper position within the thigh.

The **external circumflex** artery turns horizontally outwards about  $1\frac{1}{2}$  inches below Poupart's ligament, and after a course of a couple of inches divides into its three

branches, one of which descends along the surface of the vastus externus towards the knee, another continues to pass circularly around the thigh, and the third ascends towards the anterior superior iliac spine.

The small **superficial inguinal** vessels arise from the main femoral trunk less than an inch below Poupart's ligament, and from thence radiate in different directions: the superficial pudic inwards towards the symphysis pubis, the superficial epigastric upwards in the abdominal wall towards the umbilicus, and the superficial circumflex iliac outwards towards the spine of the ilium.

No definite markings can be given for the perforating branches of the profunda femoris artery, or for its internal circumflex branch.

The **popliteal** artery descends through the ham, and beyond the bend of the knee, to terminate in the middle line of the leg, about 3 inches below the level of the knee-joint. Its upper part passes obliquely from the level of the opening in the adductor magnus downwards and outwards to the upper part of the intercondyloid notch of the femur, while the lower part of the vessel can be mapped out by a line drawn vertically, and bisecting the lower part of the popliteal space. In the upper part of its extent the vessel is overlapped by the hamstring muscles, but about its middle it can sometimes be felt by deep pressure. Its lower part also lies deeply, under cover of the gastrocnemius and soleus muscles.

The sural branches of the popliteal are distributed to the muscles of the calf, and one of the largest of them lies in the interval between the two heads of the gastrocnemius. The superior articular branches pass inwards and outwards respectively above each condyle of the femur.

The **posterior tibial** artery can be mapped out by a line drawn from the middle point of the leg 3 inches below the bend of the knee downwards to the point of bisection of a line drawn on the inner side of the ankle from the tip of the internal malleolus to the internal tuberosity of the os calcis. Above, the artery lies very deep, but in the lower half of the leg it is only covered by skin and fasciæ, and can be felt pulsating on the inner side of the tendo Achillis. At the inner side of the ankle it lies between the tendons of the flexor longus digitorum and flexor longus hallucis muscles.

The **peroneal** artery may be indicated by a line drawn from the point of commencement of the posterior tibial artery downwards to the back of the external malleolus.

The **external plantar** artery is indicated by a line drawn from a point on the inner side of the ankle midway between the internal malleolus and internal tuberosity of the os calcis outwards across the sole of the foot to the prominent base of the fifth metatarsal bone. It then turns transversely inwards as far as the base of the first metatarsal bone, where, by joining with the dorsalis pedis artery, it forms the plantar arch.

The **internal plantar** artery commences at the same point as the external plantar, and passes almost straight forwards to the under aspect of the metatarso-phalangeal joint of the great-toe.

The **anterior tibial** artery can be mapped out by a line drawn from a point midway between the head of the fibula and the external tuberosity of the tibia downwards to the mid-point of the ankle-joint. In the upper part of its course it lies deeply, but approaching the ankle it becomes superficial between the tendons of the extensor longus hallucis and extensor longus digitorum muscles.

A continuation of the above-described line to the posterior part of the first interosseous space overlies the **dorsalis pedis** artery. This vessel can be felt pulsating throughout the greater part of its extent.

**Gluteal Vessels.**—In the gluteal region it is of importance to be able to indicate the place of emergence from the pelvis of the gluteal and sciatic arteries. This can be done as follows: Draw a line from the posterior superior iliac spine to the summit of the great trochanter. This line crosses the ilium immediately above the great sciatic notch at the junction of its inner and middle thirds, and therefore at this point overlies the **gluteal** artery. To map out the **sciatic** artery, draw a line from the posterior superior iliac spine to the tuber ischii. This line overlies the posterior inferior iliac spine, and also the spine of the ischium, and crosses the sciatic artery at the junction of its middle and lower third, about 2 inches above the tuber ischii (Fig. 19).

**Veins.**—On the dorsum of the foot a venous arch, formed by the junction of the digital veins, is visible, and from it the **external** and **internal saphenous** veins can be traced. The former is seen to pass upwards behind the external malleolus towards the back of the leg. It ascends in the middle line of the calf to the upper part of the popliteal space, where it terminates by sinking through the popliteal fascia and joining the popliteal vein. The internal saphenous vein passes upwards in front of the internal malleolus, and ascends on the inner side of the leg to a little above the knee. It then turns somewhat outwards on the inner aspect of the front of the thigh, and terminates at the saphenous opening. It is joined above the middle of the thigh by a vein from the outer aspect of the thigh, which is sometimes visible under the skin in thin persons.

The **saphenous opening** is situated just external to the pubic spine, and its upper margin lies about half an inch below Poupart's ligament. Its lower margin is more than an inch lower down, and is situated in the same vertical plane. The prominent fold of fascia which bounds this opening superiorly, and is known as Hey's ligament, can easily be felt below the inner portion of Poupart's ligament.

The femoral and other veins of the leg correspond in their surface marking to the arteries that they accompany.

### Nerves

**Cutaneous.**—In the gluteal region the iliac branch of the last dorsal nerve descends over the iliac crest a little in front of the tubercle on its outer margin, and just behind this, and close to the tubercle, lies the iliac branch of the ilio-hypogastric. A little further back, about  $1\frac{1}{2}$  inches behind the highest point of the crest, the three descending lumbar nerves are found. The small sciatic nerve descends vertically in the middle line at the back of the limb from the lower margin of the gluteus maximus as far as the popliteal space. Below this, and also in the middle line of the leg, lies the nervus communicans tibialis, which joins the communicans fibularis on the outer side of the tendo Achillis, and then is continued as the external saphenous nerve along the outer side of the ankle and foot.

On the front of the limb the external cutaneous nerve descends vertically from the anterior superior iliac spine as far as the knee, sending also a branch backwards over the lower part of the gluteal region. In the middle of the thigh lies the crural branch of the

genito-crural nerve, just external to the femoral artery, and immediately below Poupart's ligament, while lower down the two branches of the middle cutaneous nerve descend as far as the knee. The internal cutaneous nerve pierces the deep fascia on the inner side of the thigh in its lower third, and then descends vertically towards the knee.

The long saphenous nerve accompanies the femoral artery in Hunter's canal, and becoming cutaneous on the inner side of the knee posterior to the sartorius muscle, descends behind the inner border of the tibia along the inner aspect of the leg as far as the foot. The musculo-cutaneous nerve pierces the investing aponeurosis of the leg about its middle, and close to the anterior peroneal septum, and from thence descends to its distribution on the dorsum of the foot.

**Deep Nerves.**—The **anterior crural** nerve emerges from under Poupart's ligament half an inch external to the femoral point. Its cutaneous branches have already been referred to. The branch which it gives to the vastus internus accompanies the femoral artery closely in its upper two-thirds.

The **obturator** nerve emerges from the pelvis about  $1\frac{3}{4}$  inches external to the symphysis pubis, and then descends vertically among the adductor muscles.

The **great sciatic** nerve emerges from the great sacro-sciatic foramen, and passes slightly outwards and downwards till it reaches a point midway between the tuber ischii and the great trochanter. From this point it descends vertically to about the middle of the thigh under cover of the gluteus maximus and the hamstrings, and then divides into the internal and external popliteal nerves. The former of these nerves continues the downward course of the great sciatic to the lower margin of

the popliteus muscle, and then becomes the posterior tibial nerve which accompanies the posterior tibial artery and has the same surface marking. It divides into the internal and external plantar nerves, which take the same course as the corresponding vessels (Fig. 17).

The **external popliteal** nerve runs outwards along the inner edge of the biceps muscle, and reaching the head of the fibula, turns round the neck of that bone, where it can be rolled under the finger. It then divides into the anterior tibial and musculo-cutaneous nerves. The former of these accompanies the anterior tibial artery, and has the same surface marking, and the latter has already been described with the cutaneous nerves.

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