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Manual of Surgical Anatomy.

MANUAL

OF

SURGICAL ANATOMY

BY

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PREFACE.

THE task of preparing this small work was undertaken after repeated requests, made by several members of a Class in Surgical Anatomy which I have for some time conducted.

As the time at their disposal is (owing to pressure of hospital and other work) too limited to allow them to study carefully and completely the larger works upon the subject, it was their desire that I should publish the notes utilized by me in the regular routine course of instructing the Class. I have therefore attempted to present, in as concise a manner as possible, consistent with clearness, the more salient points of Anatomy in their special bearing on the practice of Surgery.

The preparation of this work has been, in the main, a process of exclusion; whereby the parts of Anatomy, important from a Surgical point of view, have been separated from those which may be disregarded by candidates for the ordinary Surgical

qualifications. That which has found its way into the book comprises what in a struggle for existence has, to the Author's mind, appeared worthy to survive as fittest.

The subject of Fractures and Dislocations will be found to be dealt with somewhat cursorily, as the aim of the Author has been to include only that amount of Anatomy which, while requisite for the practice of Surgery, is not contained in the works on Surgery usually read by Students.

I trust that the portable and convenient size of the book will encourage Students to study their Surgical Anatomy *in the dissecting-room*—in the presence of skeleton, dissections, and prepared specimens.

In preparing some of the Diagrams, many valuable suggestions have been gathered from a perusal of Professor Macalister's "Text-Book of Anatomy."

ALFRED W. HUGHES.

42 George Square,
Edinburgh, *October 1890.*

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THE UPPER EXTREMITY.

REGION OF THE SHOULDER.

THE clavicle, spine, and acromion process of the scapula may be distinctly felt. Notice that the outer and inner extremities of the clavicle are frequently unduly prominent, and are apt to cause a suspicion of dislocation. The rounded prominence of the shoulder below the acromion is formed by the deltoid, supported by the tuberosities of the humerus, which may be felt through the muscle on rotating the bone. In dislocations of the shoulder joint the deltoid becomes flattened, as it ceases to be supported by the humerus, and the acromion process stands out more prominently. Some flattening occurs also when the deltoid is from any cause atrophied, but in this case the upper extremity of the humerus may be felt occupying its normal position.

Between the deltoid and pectoralis major is a slight groove in which the cephalic vein and the descending branch of the acromio-thoracic artery lie, and in this groove the coracoid process may be felt, the process being overlapped by the inner fibres of the deltoid.

If the above groove be traced upwards it leads to a well-marked depression—the infra-clavicular fossa—

which becomes entirely obliterated, or replaced by an eminence, when the head of the humerus is dislocated below the coracoid or clavicle. This depression lies over the costo-coracoid membrane and the first part of the axillary artery, which may, in this situation, be compressed against the second rib.

The **hollow of the armpit** varies in depth with the position of the arm. It is bounded by the anterior and posterior axillary folds. The anterior fold is formed by the pectoralis major and the posterior fold by the teres major and latissimus dorsi. Between these two folds the axillary fascia extends, forming the floor of the axilla. The head of the humerus may be felt by passing the fingers high up into the axilla with the arm well abducted.

THE AXILLA.

The axilla is bounded *in front* by the two pectoral muscles with the costo-coracoid membrane; *behind*, by the subscapularis, teres major, and latissimus dorsi; *internally*, by the ribs and intercostal muscles and the serratus magnus; *externally*, by the upper end of the humerus, coraco-brachialis, and biceps.

The **floor** of the axilla is formed by the deep or axillary fascia which extends between the anterior and posterior walls.

The **apex** consists of a small triangular space between the clavicle, scapula, and first rib. Through this opening the axillary space is continuous with the posterior triangle of the neck, and through it the vessels and nerves reach the axilla from the lower part of the

neck. Excepting at the apex, the axillary space is closed in all directions by muscles or fascia—a fact which explains the upward course taken by pus, the result of an axillary abscess.

Axillary Vessels.—The axillary vessels pass from the apex to the outer side of the space so as to reach the arm. The axillary vein lies internal to, and overlaps the artery. It is thus more liable to be injured than the artery in operations in the axilla, such as removing enlarged and cancerous glands. In removing glands seated high up in the axilla, wound of the axillary vein is the most likely accident to occur, as a result of which a ligature has to be placed on the wounded wall or the entire vein. Such cases are recorded by Billroth who, on more than one occasion, had to tie the axillary vein. Wound of the axillary vein requires very prompt attention, for not only is the bleeding very free, but moreover, due to its close proximity to the heart, air is liable to be drawn into the vein during inspiration. Bleeding from the axillary vessels is also favoured by the attachment of the sheath of the vessels to the super-imposed costo-coracoid membrane, which tends to prevent the closure of the divided vessel.

Axillary Artery.—The axillary artery extends from the outer border of the first rib to the lower border of the teres major muscle. The *line of the artery* varies with the position of the arm, for with the arm at right angles to the trunk a line from the middle of the clavicle to the inner border of the coraco-brachialis would indicate the direction of the vessel, but with the arm drawn to the side the artery takes a curved course.

It is covered by the two pectoral muscles, but near its termination it lies superficially beneath the skin and fascia. The artery is divided into three parts—viz., above, beneath, and below the pectoralis minor.

The *first part* is covered by the pectoralis major, costo-coracoid membrane, and is crossed by the cephalic vein. The axillary vein is internal to it, the cords of the brachial plexus being to its outer side. It lies on the first intercostal space.

In its *third part* the artery is covered for a short distance by the lower fibres of the pectoralis major, but beyond this it is merely covered by the skin and fasciæ. The internal cutaneous and inner head of the median nerve are superficial to it.

The axillary vein, the ulnar nerve, and nerve of Wrisberg, lie to its inner side.

The coraco-brachialis with the median and musculo-cutaneous nerves lie to its outer side, and it rests on the subscapularis, teres major, and latissimus dorsi, being separated from those muscles by the circumflex and musculo-spiral nerves.

This artery is occasionally the seat of aneurism, due chiefly to its close proximity to the shoulder joint, which causes it to be subjected to frequent and extensive movements. Statistics show that axillary aneurism is most commonly met with on the right side and amongst men, and of thirty-seven cases cited by Erichsen only three occurred in women. The axillary artery may be injured by falls on the outstretched hand, and many cases have been recorded of rupture of the artery by the forcible reduction of old-standing dislocations of the shoulder, the artery in these cases had probably contracted adhesions to the joint.

Ligature of the Axillary Artery.—The artery may be tied in its first or third parts.

When tied *in its first part*, a curved incision is made from the coracoid process to the lower border of the inner end of the clavicle. The pectoralis major, costo-coracoid membrane, together with branches of the acromio-thoracic vessels, are divided. The axillary vein is next exposed, frequently overlapping the artery, the vein is drawn inwards and the needle passed from the inner side, care being taken not to include the inner cord of the brachial plexus which lies external to the artery.

This part of the artery is so deeply placed, and in such close relation to the vein and nerves, that ligature of the third part of the subclavian artery is more easily performed and more successful in its results.

Ligature of the Third Part.—The artery is reached by an incision in the floor of the axilla. If the space between the anterior and posterior axillary folds be divided into thirds, the junction of the anterior and middle thirds will mark the line of the artery. Upon dividing the skin and fascia the axillary vein comes into view; the vein must be drawn aside with a blunt hook, when the artery will be exposed, closely surrounded by the branches of the brachial plexus. The needle is passed from the inner side.

A simpler method is that of Malgaigne who recommends that the incision should be made on the inner side of the coraco-brachialis muscle; the median nerve is then taken as a guide to the artery, and the vein is not exposed.

Lymphatic Glands.—There are three groups of lymphatic glands in the axilla.

One set lies close to the axillary vessels, and receives the lymphatics of the upper extremity; these are liable to become enlarged and inflamed by septic absorption from wounds of the upper extremity.

Another set lies close to the lower border of the pectoralis minor and receives the lymphatics from the breast and chest wall; these become enlarged in diseases of the chest wall, and in scirrhus of the breast may be felt as an indurated knotted cord.

The third set are unimportant. These lie along the subscapular artery, and receive the lymphatics of the back.

Axillary Abscess.—This abscess may occur either superficial to, or beneath, the axillary fascia. When superficial, it is usually small and circumscribed.

The deep-seated axillary abscess usually originates in an inflamed gland, and shows a marked tendency to burrow upwards, being prevented from reaching the surface by the strong axillary fascia already mentioned. These abscesses sometimes reach the lower part of the neck through the apex of the axilla; such a course being explained by the arrangement of the fasciæ, for the axillary fascia is not only continuous posteriorly with the fascia of the posterior wall, but in front it is continuous with the fascia of the pectoral muscles; this in turn being continuous with the costo-coracoid membrane, which is attached above to the clavicle.

In affording vent to the pus in an axillary abscess, the incision should be made in the middle of the space and towards the inner wall, for near the outer wall the axillary vessels lie, the subscapular artery lies close to the posterior wall, and beneath the anterior wall the long thoracic artery passes to the side of the chest.

THE CLAVICLE.

The clavicle is superficial throughout, and may be traced beneath the skin in its whole extent. Superficial to the bone are the skin, fascia, and platysma, and crossing the bone are the descending branches of the cervical plexus; these nerves may be involved in callus after fracture of the bone, and be the source of great pain. Beneath the clavicle are several important structures, of which may be mentioned the subclavian and supra-scapular arteries, the subclavian, external jugular, and innominate veins, and the nervous cords of the brachial plexus. Any of these structures may be injured or compressed by broken fragments of the bone. The vessel most exposed to injury is the subclavian vein, as it lies in the small angular interval between the inner end of the clavicle and the first rib.

The close proximity of these important structures renders partial or complete re-section of the bone very difficult. Excepting the radius, the clavicle is more commonly the seat of fracture than any other bone in the body. This is due to its exposed position, to its being very slender, and being the only osseous connection between the upper extremity and the trunk; it therefore receives a part of all shocks given to the upper extremity by falls on the hand, elbow, or shoulder. The curved form of the clavicle tends to diminish any shock and thus to add to the strength of the bone. In spite of its exposed position, the clavicle is not very commonly fractured by *direct violence.* When such a fracture occurs, it may take place at any part of the bone.

In fractures from *indirect violence* the break most commonly occurs at the outer end of the middle third of the bone, because here the two curves of the bone meet, this is the thinnest part of the bone, and, moreover, the outer third or fixed portion here joins a more moveable portion of the bone.

In this fracture, which is usually very oblique, the outer fragment is displaced :—

1. *Downwards*, due to the weight of the arm which has now lost its only osseous support.

2. *Inwards*, partly due to the action of the muscles which pass from the chest to the shoulder and arm, and also because the clavicle normally keeps the shoulder away from the chest, acting like an outrigger.

3. *Forwards*, due partly to the greater action of the pectoral muscles, and also because the scapula now falls forwards on the chest wall, thus tilting the shoulder forwards, whereas the axillary portion of the scapula is normally kept away from the chest wall by the clavicle.

The clavicle is occasionally fractured by *muscular action*, the fracture then occurs at the middle of the bone, and is usually caused by the swing of the arm as in a back-handed blow. (Erichsen).

THE SCAPULA.

The inferior angle of the scapula is normally covered by the latissimus dorsi. This muscle occasionally slips away from the bone and becomes hooked beneath it, an accident usually known as *dislocation of the scapula*.

Fractures of the Scapula.—The scapula may be fractured in one of several places—viz., through the infra-spinous fossa, the coracoid or acromion processes may be fractured or separated as epiphyses, or the bone may fracture through its surgical neck—*i.e.*, through the narrow part extending around the glenoid cavity and into the supra-scapular notch. As the coracoid process is firmly attached to the clavicle and acromion by ligaments, great displacement cannot occur in this fracture without rupture of these ligaments.

Sterno-Clavicular Articulation.—In this articulation the bony surfaces are of unequal size, the sternal end of the clavicle being much larger than the sternal facet; but in spite of this, dislocations at this articulation are not common, due to the great strength of the ligaments, and when they do occur, the clavicle is usually displaced forwards, due to the comparative weakness of the anterior ligament.

Acromio-Clavicular Articulation.—The bony surfaces forming this joint are oblique, and inclined so that the plane of the joint corresponds to a line drawn downwards and inwards. This obliquity of the joint explains the greater frequency of dislocation of the clavicle in an *upward* direction. The capsular ligament is weak, the strength of the joint depends mainly on the coraco-clavicular ligaments.

SHOULDER JOINT.

The head of the humerus is very large compared with the glenoid cavity with which it articulates; the capsular ligament is very lax, and allows the humerus

to be drawn away some distance from its socket. For these reasons the joint is very insecure and liable to be dislocated. The tendon of the biceps arches over the joint, and assists the other muscles in keeping the head of the humerus in close contact with the glenoid cavity. The capsule is pierced by the biceps tendon, and an opening frequently exists in the capsule anteriorly through which the joint cavity communicates with a bursa beneath the subscapularis. If suppuration occur in the joint, the pus is likely to escape through one of the above openings.

The joint is protected above by an overhanging arch, formed by the acromion and coracoid processes and the coraco-acromial ligament. Between the capsule and this arch is the *sub-acromial bursa*, an extension upwards of the sub-deltoid bursa. This bursa may become inflamed or distended, and in such cases abduction of the arm would cause great pain, as in that position the bursa is pressed between the head of the humerus and the acromion process.

The dislocations of the shoulder are all primarily in a downward direction—*sub-glenoid;* and afterwards, depending on the direction of the force, may be directed forwards—*sub-coracoid* or *sub-clavicular;* or backwards —*sub-spinous.* Notice that the capsule is protected not only above (by the bony arch), but also in front by the subscapularis, and behind by the infra-spinatus and teres minor.

THE UPPER ARM.

Surface Anatomy.—On the front of the upper arm the biceps forms a well-marked prominence, which can

be traced down to the front of the elbow. On each side of the biceps is a small depression—*the inner and outer bicipital furrows.* In the outer groove the cephalic vein passes upwards, and the inner furrow contains the brachial artery, the basilic vein, median nerve, with the ulnar nerve in the upper half. In muscular subjects the biceps overlaps the brachial artery in a part of its course.

The insertion of the deltoid can be felt, for here the bone is almost superficial, while it is covered by muscles in the greater part of its extent.

The insertion of the deltoid is an important landmark in the upper arm—it is near the middle of the bone—on the inner side is the insertion of the coracobrachialis—the nutrient artery enters the bone near this level—it marks the upper limit of the brachialis anticus, and at this point the ulnar nerve and inferior profunda artery leave the inner side of the brachial artery to pass obliquely to the interval behind the internal condyle; near this point the median nerve usually crosses the brachial artery.

The *aponeurosis of the upper arm* forms a loose sheath for the muscles, vessels, and nerves. It is attached to the humerus at its sides, by means of the internal and external inter-muscular septa, which thus form two compartments.

The *anterior compartment* contains the biceps, coracobrachialis, and brachialis anticus muscles, the brachial vessels, median, ulnar, internal and external cutaneous nerves.

The *posterior compartment* contains the triceps, with the musculo-spiral nerve and superior profunda artery in a part of their course.

BRACHIAL ARTERY.

A *line* from the coracoid process to the middle of the bend of the elbow, with the fore-arm supine and extended, would lie over the brachial artery. It lies beneath the inner border of the biceps muscle.

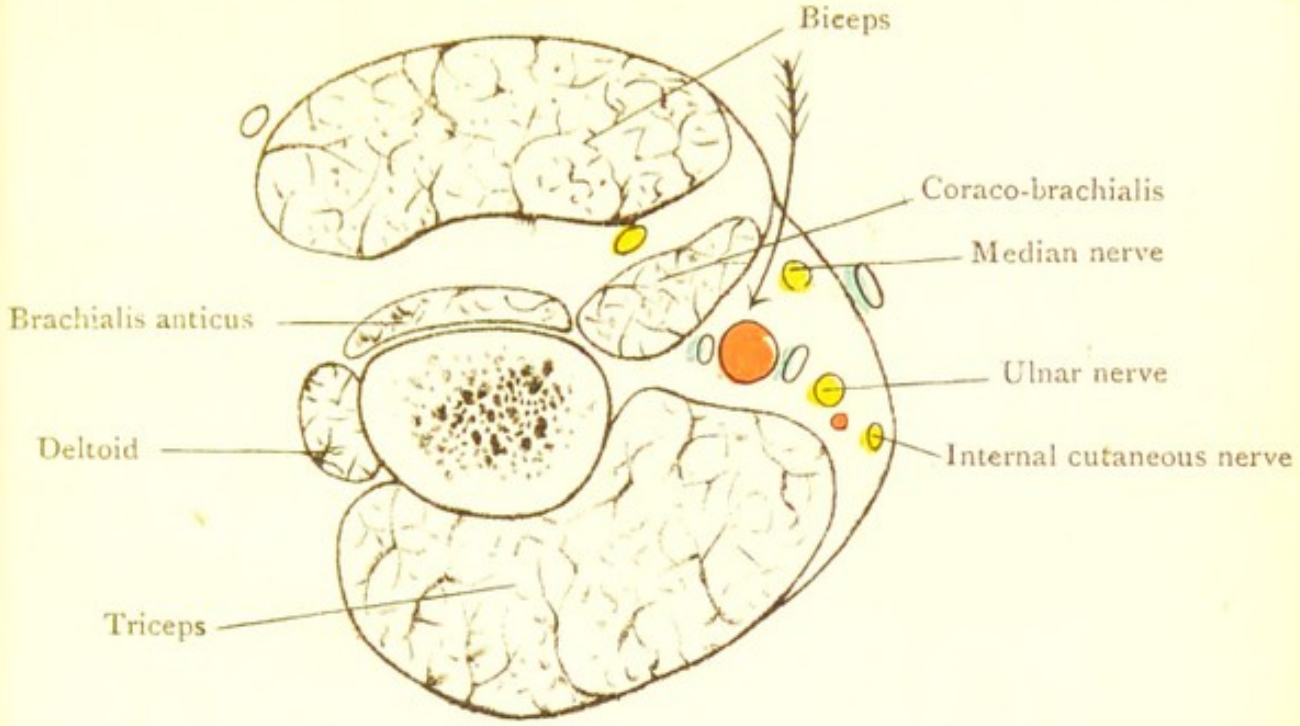
In its upper part it lies to the inner side of the shaft of the humerus, but at the lower part it lies in front of that bone. In order to *compress the artery*, it is therefore necessary, that pressure should be exerted from *within outwards* in the upper part, but from *before backwards* in the lower part.

The brachial artery commences at the lower border of the teres major muscle, and terminates a finger's breadth below the bend of the elbow, by dividing into its terminal branches radial and ulnar.

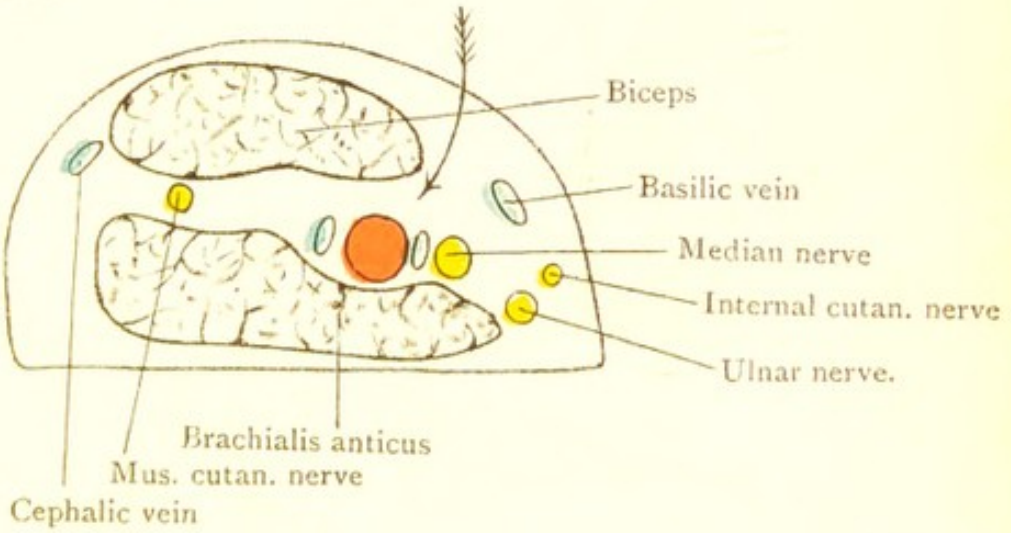
This point of division of the brachial artery is subject to some variation, as it sometimes divides at a much higher level, and two arteries may be found occupying the position of the brachial in the upper arm—these two arteries lying close together or at some distance from each other.

The artery is superficial throughout, being covered by the skin and fasciæ and overlapped by the inner border of the biceps. Near its termination it is crossed by the median basilic vein and the bicipital fascia. The median nerve lies to the outer side of the artery in its upper part, and usually crosses over it about its middle to lie on its inner side below. The ulnar nerve lies to its inner side at the upper part, and the musculo-spiral nerve lies behind it for a short distance. The internal cutaneous nerve may lie over the upper part of the artery.

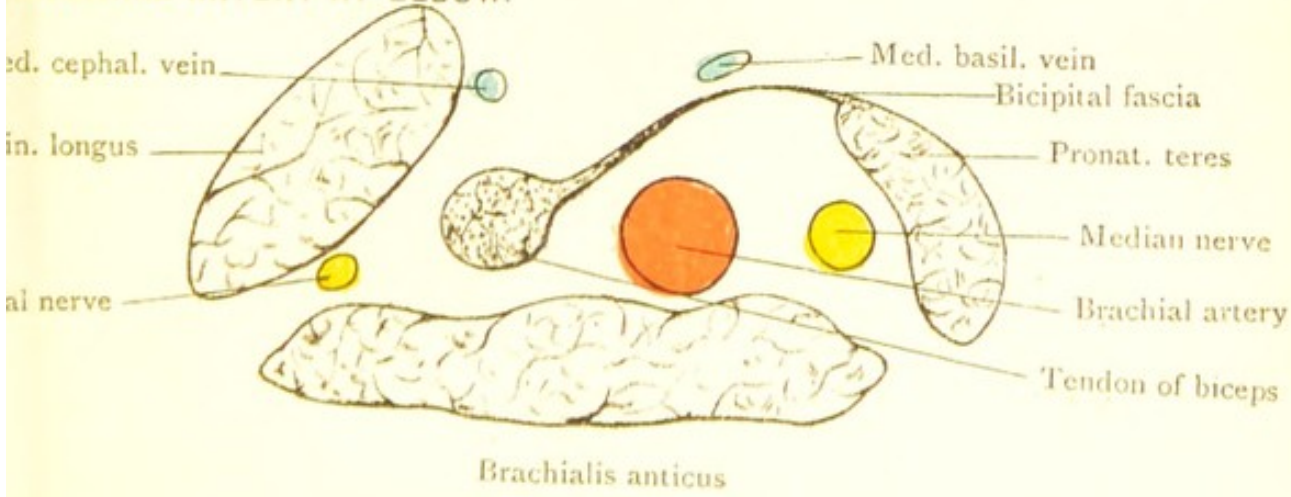
BRACHIAL ARTERY. PLATE I.



BRACHIAL ARTERY.



BRACHIAL ARTERY AT ELBOW.



Venæ comites accompany the artery very closely. The coraco-brachialis and biceps muscles lie to its outer side.

Ligature of Brachial Artery.—The artery may be reached at any part by an incision along the inner border of the biceps muscle, and from the close relation of nerves and veins to the artery it will be seen that great care is necessary when passing the needle in ligature of the vessel. It is well to remember that a small process of bone (supra-condyloid process) occasionally projects from the inner aspect of the humerus above the inner condyle, and when such a process exists the brachial artery usually passes behind it before the vessel reaches the front of the elbow. In this deviated course it is accompanied by the median nerve.

Musculo-Spiral Nerve.—The musculo-spiral nerve is derived from the posterior cord of the brachial plexus, and passes down behind the upper part of the brachial artery, to wind through the musculo-spiral groove with the superior profunda artery. After leaving the groove it passes beneath the supinator longus muscle, and at the elbow divides into the *radial and posterior interosseous nerves.*

Fractures of the shaft of the humerus may be followed by paralysis of the muscles supplied by the musculo-spiral nerve and by its posterior interosseous branch. This may occur at the time of accident, the nerve being injured by one of the sharp fragments of the bone, or at a later period when the nerve becomes included in or compressed by the callus which is formed between the broken fragments, as mentioned by Ollier, who cut down on the bone and removed

with chisel and mallet a portion of callus in which the nerve was imbedded. The nerve completely regained its functions in a few months.*

The paralysis which follows injury to the musculo-spiral nerve affects the muscles on the back of the fore-arm, and renders extension of the wrist impossible (drop wrist), and extension of the fingers incomplete. There remains, however, a slight power of extending the fingers though their main extensor muscles are paralysed, as the second and third phalanges are extended by the interossei and lumbrical muscles. The power of supination is also greatly diminished, due to paralysis of the long and short supinator muscles; it is not, however, entirely lost, as the action of the biceps remains unaltered. It is interesting to notice that the triceps and brachialis anticus, though supplied by the musculo-spiral nerve, are not paralysed, as the former is mainly supplied by branches which are given off from the musculo-spiral nerve before it comes into contact with the humerus, and the latter has an additional nerve of supply from the musculo-cutaneous.

The musculo-spiral may be paralysed by the pressure of the pad of a crutch (crutch palsy).

Fracture of the external condyle may cause paralysis of the *posterior interosseous nerve.* In such a case, as mentioned by Erichsen, the loss of supination and extension is not so complete as when the whole trunk is paralysed, these movements being still practicable to a slight extent, through the medium of the supinator longus and extensor carpi radialis longior, which are supplied by the trunk of the musculo-spiral nerve.

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* Ollier, "Traitè des Rèsections," page 170.

It might be well to notice that other fractures of the humerus may cause injury to certain nerves.

Thus *fracture of the surgical neck* may injure the *circumflex nerve*, which winds round that part of the bone, and this would result in paralysis of the deltoid. *Fracture of the internal condyle* may cause injury to the *ulnar nerve*, which lies in close relation to that process of bone.

FRACTURES OF THE HUMERUS.

In fracture of the *anatomical neck*, which is intra-capsular, no great displacement can occur.

If the *surgical neck* be fractured, the upper fragment is abducted by the supra-spinatus, and the lower fragment is drawn inwards by the muscles attached in the bicipital groove—pectoralis major, teres major, and latissimus dorsi.

The displacements due to *fractures of the shaft* vary.

When *above the insertion of the deltoid*, the upper fragment is drawn inwards by the muscles attached to the bicipital groove, and the lower fragment upwards and outwards by the deltoid.

When *below the insertion of the deltoid*, the upper fragment is tilted outwards by that muscle, and the lower fragment is drawn upwards by the biceps and triceps.

In *transverse fractures above the condyles*, the lower fragment and the fore-arm are drawn upwards and backwards by the triceps, so that the injury simulates a backward dislocation of the elbow. The T-shaped

fracture, and fractures of the condyles, involve the elbow joint, but the tip of the internal condyle may be broken off without injuring the joint.

REGION OF THE ELBOW.

Surface Anatomy.—The bony points in the region of the elbow should be carefully studied. Feel first the olecranon process, to which the tendon of the triceps may be traced. On the inner and outer aspects of the elbow the internal and external condyles of the humerus form distinct prominences, of which the internal is the more marked and pointed, and forms an extremely definite and important bony landmark. Notice that it lies on a slightly higher level than the external condyle.

If a line be drawn between the condyles, it will be found that in extreme extension the tip of the olecranon lies a little above that line.

If the fore-arm be placed at right angles to the arm, the tip of the olecranon lies below the condyles and in the same vertical plane; while in full flexion, the olecranon lies in front of that plane.

Just external to the olecranon process is a small depression when the fore-arm is extended. This depression corresponds to the head of the radius and the external condyle. The head of the radius may be felt on alternately pronating and supinating the fore-arm.

Notice especially that the internal condyle is prominent in flexion and extension. But the external condyle, which forms a marked prominence in the flexed position, disappears completely out of view in the extended position, and lies in the hollow on the outer side of the olecranon.

It is very necessary that the student should make himself very familiar with the position and relations of these bony eminences, as the diagnosis of injuries to the part is thereby considerably facilitated.

Olecranon Bursa.—Over the olecranon lies a large subcutaneous bursa, which may become enlarged or inflamed, as in *miner's elbow*. A small bursa also lies beneath the tendon of the triceps, close to its insertion.

In the groove between the internal condyle and olecranon, the ulnar nerve enters the fore-arm; its position has to be borne in mind in excision of the elbow joint, and, as previously mentioned, it is exposed to injury in fracture of the condyle.

In the depressions on each side of the olecranon the synovial membrane comes close to the surface, and in synovitis or joint disease these hollows become obliterated by the bulging of the distended or thickened membrane.

Front of the Elbow.—At the front of the elbow is a small depression, bounded externally by the supinator longus and extensor group of muscles, and on the inner side by the pronator teres and flexor group of muscles.

Into this hollow the tendon of the biceps may be traced, and passing from the tendon of the biceps to the inner group of muscles is the bicipital or semi-lunar fascia, which is rendered prominent during flexion and supination of the fore-arm. On the inner side of the tendon of the biceps, and above the free edge of the bicipital fascia, the pulsations of the brachial artery may be felt. The vessel bifurcates into the radial and ulnar arteries a finger's breadth below the bend of the elbow. On the inner side of the brachial artery the median nerve enters the fore-arm.

At the bend of the elbow a slight crease or line extends across between the two condyles. The joint line lies below this crease, and it is of use in diagnosing a backward dislocation of the bones of the fore-arm from a transverse fracture of the lower end of the humerus above the condyles; for in the dislocation the lower extremity of the humerus projects forwards *below* this line, while in the fracture the lower end of the upper fragment projects *above* this line.

Veins in front of the Elbow.—In the fore-arm are the median radial and two ulnar veins.

Near the elbow the median vein is joined by the profunda vein, and then divides into the median cephalic and median basilic veins.

The median basilic is joined by the ulnar veins to form the basilic vein, which joins the venæ comites of the brachial artery to form the axillary vein.

The median cephalic is joined by the radial vein to form the cephalic vein, which passes up on the outer side of the biceps, and then between the deltoid and pectoralis major, to pierce the costo-coracoid membrane and join the axillary vein.

Venesection.—Of the veins at the bend of the elbow, the one most commonly utilised for purposes of blood-letting is the median basilic. This vein is usually the largest and most constant in its position, and, moreover, the median cephalic vein lies in a hollow between the biceps and supinator longus, so that subsequent compression of the vein would be difficult.

The median basilic vein lies over the brachial artery, being separated from that vessel merely by the bicipital fascia, and care should be taken not to plunge the lancet

too deeply lest the fascia be pierced and the artery wounded—an accident which has frequently occurred.

Above the internal condyle there is a small *lymphatic gland* which receives the lymphatics of the inner side of the fore-arm. This gland may become inflamed, due to the absorption of some septic material conveyed along the lymphatics, and is important as being the lowest gland of appreciable size in the upper extremity.

Anastomoses around the Elbow Joint. — A very free anastomosis occurs in the region of the elbow. The most important arteries which share in this anastomosis are the superior profunda, with the radial recurrent and interosseous recurrent arteries, in front of and behind the external condyle—and the inferior profunda and anastomotic, with the anterior and posterior ulnar recurrent arteries in front of and behind the internal condyle.

THE FORE-ARM.

The upper and lower extremities of the radius and ulna are described with the regions of the elbow and wrist. Of the shafts of the bones, that of the ulna is subcutaneous throughout on its posterior aspect, and may with ease be felt beneath the skin, and traced in its whole length. For this reason the posterior surface of the limb is chosen for operations on this bone. The radius is covered by muscles in its upper half, but the lower half of the bone may be traced beneath the skin.

In treating fractures of the bones of the fore-arm, it is very necessary to prevent the interosseous space being encroached upon by one of the fragments; for if the bones be squeezed together, they may become

united by the projection of callus across the interosseous space, pronation and supination being thus lost, and the utility of the limb greatly impaired. The *interosseous space* is widest when the fore-arm is in a position midway between pronation and supination, with the thumb directed upwards towards the face.

Fractures of the Bones of the Fore-arm.—It should be noticed that the radius is covered in the greater part of its extent, while one of the borders of the ulna is superficial throughout. The articulation of the wrist is formed almost entirely by the radius and carpal bones, and all shocks transmitted from the hand pass into the radius; for these reasons the radius is usually fractured by indirect violence, while fractures of the shaft of the ulna are caused by direct violence.

Fractures of the Ulna.—In *fracture of the olecranon* the detached fragment is drawn upwards by the triceps.

Fracture of the coronoid process may cause or complicate a dislocation of the ulna backwards.

In *fractures of the shaft* of the ulna, the upper fragment may be tilted forwards by the brachialis anticus, and the lower fragment approximated to the radius by the pronator quadratus.

Fractures of the Shaft of the Radius.—If this bone be fractured between the attachments of the biceps and pronator radii teres, the upper fragment is flexed by the biceps and supinated by the same muscle and by the supinator brevis. The lower fragment is pronated by the pronator teres and pronator quadratus, and is drawn towards the ulna by the latter muscle.

If the fracture occur between the two pronators, the upper fragment is slightly flexed, but neither pronation

or supination occurs, as the supinators (biceps and supinator brevis) are antagonised by the pronator teres.

Colles' Fracture. — In this fracture, which occurs through the lower extremity of the radius, the lower fragment is displaced backwards, carrying the hand with it. The fragment is also displaced outwards, and the hand is approximated to the radial border of the fore-arm. A rotation also occurs by which the inferior articular surface of the radius is directed slightly backwards instead of directly downwards.

Blood Vessels of the Fore-arm. — The posterior aspect of the fore-arm is remarkably free of vessels and nerves — this being the part most exposed to injury. On this aspect we find the small posterior interosseous vessels and nerves, which course downwards between the superficial and deep layers of muscles.

On the anterior aspect are the ulnar and radial and the anterior interosseous arteries. This last vessel courses downwards on the anterior surface of the interosseous membrane and passes to the back of the fore-arm at its lower part.

Radial Artery. — The radial artery takes a straight course from a spot a finger's-breadth below the centre of the bend of the elbow to the fore part of the styloid process of the radius. In its upper half it is covered by the supinator longus, but is superficial in its lower half.

The upper half of the artery lies between the supinator longus and the pronator radii teres, and in its lower half between the supinator longus and the flexor carpi radialis. The radial nerve lies close to the outer

side of the vessel in its middle third. The artery may be readily reached in its lower half where it is superficial. In its upper half it is found beneath the inner border of the supinator longus.

Ulnar Artery.—A line drawn from the internal condyle to the outer border of the pisiform bone indicates the direction of the ulnar nerve.

The ulnar artery corresponds, in its lower half, to the above line. The upper half of the artery takes a curved course from the bifurcation of the brachial to the middle of the above line. In its upper part the artery lies deeply beneath the pronator radii teres and group of flexor muscles which arise from the internal condyle. In its lower part it is superficial, and is found between the flexor sublimis digitorum and the flexor carpi ulnaris, and may be easily reached in this position by an incision on the outer side of the flexor carpi ulnaris. The ulnar nerve lies close to its inner side in its lower half, and the vessel is crossed by the median nerve close to its origin.

Median Nerve.—The median nerve passes between the two heads of the pronator radii teres and crosses the ulnar artery close to its origin. It passes between the superficial and deep muscles and appears at the wrist between the tendons of the flexor carpi radialis and the palmaris longus.

Ulnar Nerve.—The ulnar nerve enters the fore-arm by passing behind the internal condyle, and lies between that bone and the olecranon process of the ulna. It reaches the inner side of the ulnar artery about the middle of the fore-arm, and is continued downwards on the inner side of that vessel to the hand.

It is important to bear in mind the close relation of the nerve to the internal condyle, as it is liable to be injured in fractures of that process, and has to be guarded in excision of the elbow joint.

THE WRIST AND HAND.

On the anterior surface of the wrist are seen several grooves in the skin: the lowest of these marks the upper limit of the short muscles of the thumb and little finger. This groove lies half-an-inch below the line of the wrist joint, and, immediately above its outer extremity, the lower end of the radius may be felt. The bone presents externally a tubercle, to which the tendon of the supinator longus is attached. Further inwards the tendon of the flexor carpi radialis may be felt, and between it and the above tubercle the pulsations of the radial artery are readily distinguishable. About the middle of the anterior aspect of the wrist the palmaris longus (when present) passes down to be inserted into the palmar fascia. It is rendered very prominent by flexing the wrist. The flexor sublimis digitorum lies beneath the palmaris longus, and between the tendons of the palmaris longus and the flexor carpi radialis, the median nerve lies; to the inner side of the flexor sublimis, the tendon of the flexor carpi ulnaris may be felt, as it passes down to the pisiform bone; and between this tendon and the flexor sublimis, the ulnar vessels and nerve lie.

The Palm of the Hand and Fingers.—The hollow of the palm is bounded by the thenar and hypo-thenar eminences, formed by the short muscles of the thumb and little finger respectively.

The palm of the hand presents several creases or lines, two of which run almost transversely, while one or more are oblique. The most distal of the transverse lines is caused by flexing the metacarpo-phalangeal articulations—these joints lying midway between this line and the clefts of the fingers.

On the fingers there are three well-marked transverse grooves. The upper one lies opposite the web of the fingers, and is half-an-inch below the metacarpo-phalangeal joint. The lower two lie opposite the inter-phalangeal joints. Of the two grooves on the thumb, the lower one is transverse, and lies over the inter-phalangeal articulation. The upper one crosses the metacarpo-phalangeal obliquely, and is in a line with the radial border of the index finger. It is well to notice that the web of the fingers projects further downwards anteriorly than posteriorly; so that, while the anterior part of the clefts is some distance below the metacarpo-phalangeal joints, the cleft slopes backwards, so that posteriorly it lies opposite that articulation—a fact of some importance in amputations.

Arteries of the Hand.—The *superficial palmar arch* extends from the pisiform bone in a curved direction across the palm, the lower part of the curve corresponding to a line drawn from the thumb when at right angles to the hand—here the arch lies immediately beneath the palmar fascia upon the flexor tendons and branches of the median nerve. This arch is formed mainly by the ulnar, and is completed by the superficial volar and radialis indicis branches of the radial artery; and from it the digital arteries are given off, which pass to the clefts of the fingers, where they divide.

In making *incisions in the palm* of the hand, it is well to remember that the *safe areas* are—*beyond* the line of the superficial palmar arch, and *opposite* the fingers, thus avoiding the palmar arch and its digital branches.

The *deep palmar arch* is about a finger's breadth nearer the wrist than the superficial arch, and lies on the bases of the metacarpal bones, and beneath the flexor tendons. It is formed mainly by the radial artery, and is completed by the deep branch of the ulnar.

Arteries of the Fingers and Thumb.—The palmar surfaces of the *three inner fingers* are supplied by digital branches of the superficial palmar arch, while the dorsal surfaces of the same fingers are supplied over the first phalanges by branches of the dorsal interossei, while the remaining parts of the fingers over the second and third phalanges are supplied by anastomosing twigs from the digital arteries. The *index finger* is supplied by two branches (radialis indicis and dorsalis indicis), in addition to a digital branch from the superficial palmar arch; and *the thumb* has two dorsal arteries (dorsales pollicis), and two palmar, derived from the princeps pollicis. It may be roughly stated that, in amputation of the three inner fingers beyond the first phalanges, only two arteries are divided; while in the index finger three, and in the thumb four, vessels are divided, as previously indicated.

Radial Artery at the Wrist and Back of the Hand.—From the front of the wrist the radial artery passes below the styloid process of the radius, and beneath the extensor muscles of the thumb. It rests upon the

external lateral ligament, the scaphoid and trapezium, and reaches the posterior extremity of the first interosseous space, where it passes between the heads of the first dorsal interosseous muscle to reach the palm of the hand. In this part of its course it gives off branches to the back of the hand and wrist, and to the thumb and index finger.

Palmar Fascia.—The palmar fascia consists of three portions, a central and two lateral. The lateral portions cover the short muscles of the thumb and little finger, while the central portion covers the flexor tendons. This central portion is triangular in shape. The apex, to which the palmaris longus is attached, is directed towards the wrist; the base divides into processes which are attached to the sheaths of the flexor tendons over the first phalanges and to the periosteum of the phalanges, while small slips dip downwards between the fingers to be attached to the transverse metacarpal ligament.

Dupuytren's Contraction.—In this affection one or more of the fingers (most commonly the ring and little fingers) are bent partly or completely towards the palm of the hand, the flexion being in part due to contraction of the palmar fascia and also of its digital prolongations. The skin is normally connected loosely to the palmar fascia by fibrous bands, which also become contracted in the above deformity, so that the skin becomes intimately adherent to the contracted portion of the fascia. Various operations have been recommended for this deformity. Of these the *open method* of Busch, and the *subcutaneous method* of Adams may be mentioned; the main indications being

the division of the contracted portion of the fascia, and the prolongations which extend to the phalanges, care being taken not to injure the digital vessels and nerves, the positions of which have been previously mentioned.

To account for the fact that the little and ring fingers are most commonly affected, several more or less feasible explanations have been offered; but it appears to me, from studying the normal movements of the fingers, that the little and ring fingers are in a state of greater flexion than the others at all times whether at rest or during activity, such as in walking, driving, writing, etc.; and moreover, due to connections between the extensor tendons at the back of the hand, flexion of either the little or middle fingers necessitates partial flexion of the ring finger; and, of all the fingers, the ring finger is the only one which can be flexed singly while its neighbours are in the extended position.

There is thus a natural tendency towards flexion of the ring finger, and the anatomical arrangements are such as to resist extension of that finger while its neighbours are flexed, a condition not found in relation to the other fingers.

Sheaths of the Flexor Tendons.—The flexor tendon sheaths form fibrous tunnels which extend from the metacarpo-phalangeal joints to the bases of the terminal phalanges. The sheath is attached to the margins of the anterior surfaces of the first and second phalanges, being very thick opposite the bones but thin opposite the joints. Each sheath is lined by synovial membrane, which in the case of the thumb and sometimes

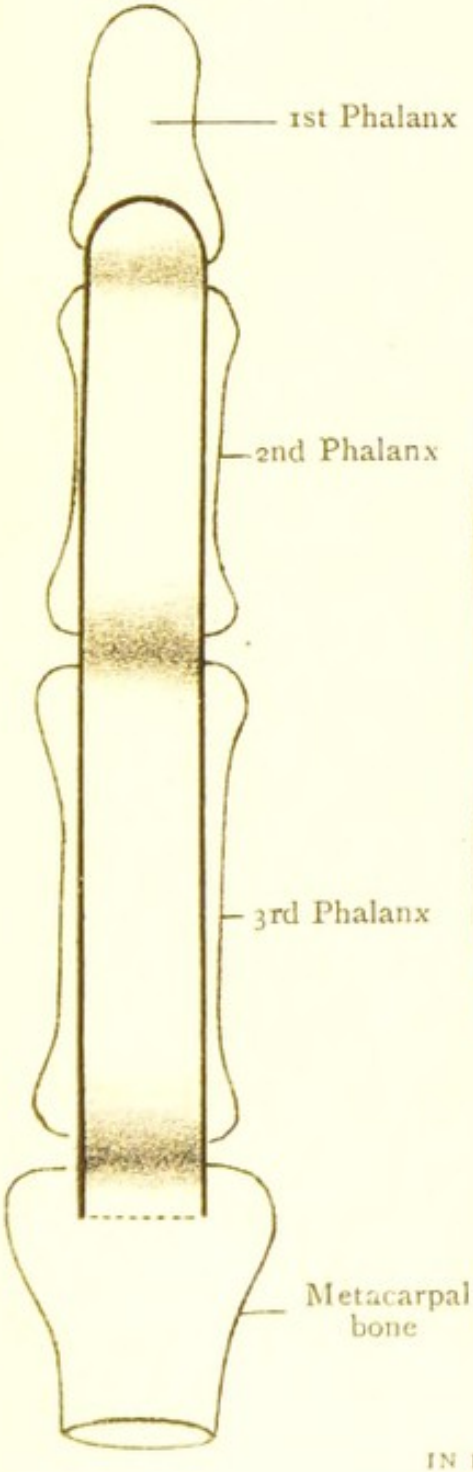
the little finger extends upwards to join the common synovial sheath beneath the anterior annular ligament, a fact which explains the tendency shown by suppuration within the sheath to pass upwards to the front of the wrist in the case of the thumb and little finger, while it rarely extends to the palm from the remaining fingers.

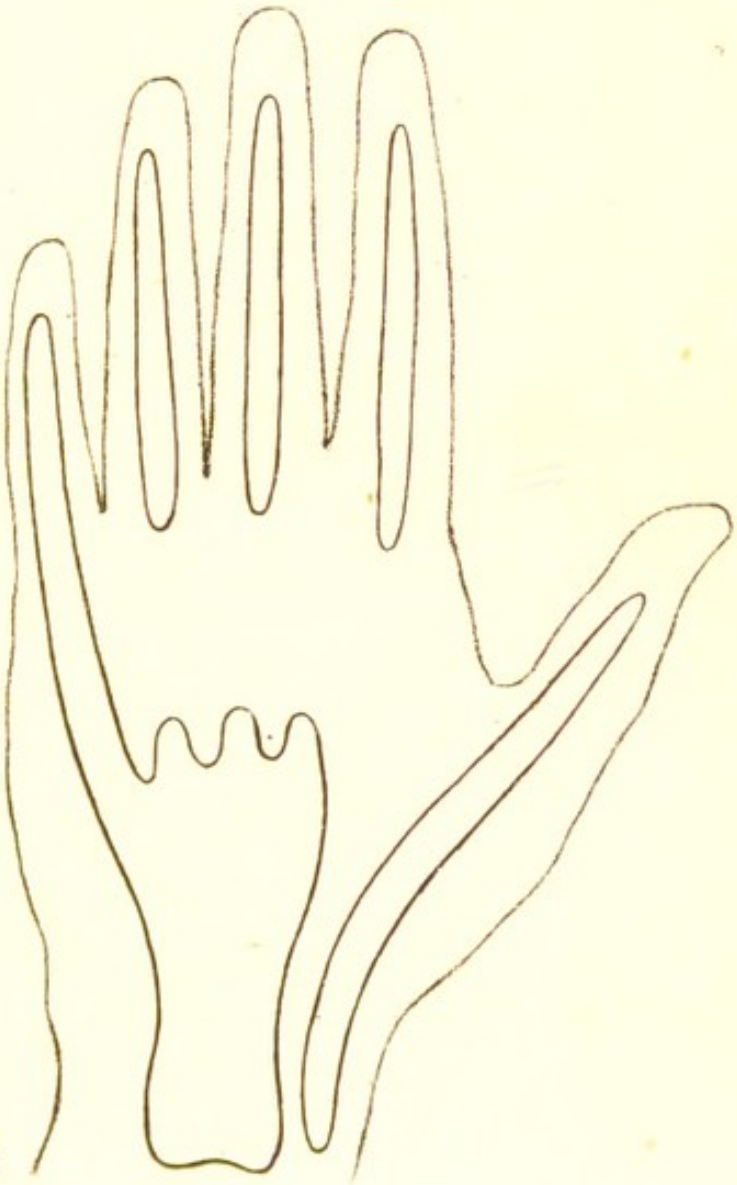
Whitlow.—A finger or thumb is frequently the site of a suppurative inflammation or *whitlow*. This may be superficial, or may affect the tendon sheath or the bone, and it is important to remember that the sheath lies superficial to the first and second phalanges, while the pulp of the finger lies directly on the periosteum of the terminal phalanx; and a whitlow in the pulp of the finger readily extends to the periosteum, causing necrosis of part of that phalanx. (*Vide* "Suppuration in synovial sheath," page 27.)

Anterior Annular Ligament and Synovial Sheaths.—The anterior annular ligament binds down the flexor tendons in front of the carpus. It is attached to the tubercle of the scaphoid and ridge of the trapezium externally, and to the hook of the unciform and pisiform bone internally.

Beneath the ligament the tendons of the superficial and deep flexor muscles, and the tendon of the flexor longus pollicis pass. The tendons of the superficial and deep flexors of the fingers are enclosed in a common synovial sheath, which is prolonged slightly above and below the annular ligament. This frequently communicates with the synovial sheaths in the little finger and thumb.

DIAGRAM SHEWING EXTENT
OF ATTACHMENT OF
FLEXOR TENDON SHEATH.





SYNOVIAL SHEATHS
IN FRONT OF WRIST AND FINGERS.

Extensor ossi metacarpi pollicis
" Primi Internodii "
" Carpi Radialis Longior
" " " Brevior
" Secundi Internodii pollicis
" Communis Digitorum
" Indicis
" Minimi Digiti
" Carpi Ulnaris

Flexor Carpi Ulnaris
Ulnar Nerve
" artery
Flexor Sublimis Digitorum
Palmaris ~~Longus~~
Median Nerve
Flexor Carpi Radialis
Radial artery
Supinator Longus —

The tendon of the flexor longus pollicis has a separate sheath beneath the ligament, continuous with that in the thumb. The surgical importance of these communications between the synovial sheaths has been referred to above.

When this common synovial sheath is distended with fluid or pus, it bulges into the palm, and in front of the wrist, the central part being constricted by the annular ligament, the swelling having thus an hour-glass shape. Such accumulations of fluid are best evacuated in front of the wrist by an incision to the inner side of the tendon of the palmaris longus; injury to the median nerve and ulnar vessels being thus avoided. (*Vide* "Structures in front of wrist," page 23.)

Back of the Wrist. — Towards the inner side the head of the ulna forms a rounded prominence, and the styloid process of the ulna may be felt a little below and internal to it. On the back of the radius a small tubercle may be distinguished, which will be found on tracing the tendon of the extensor secundi internodii pollicis upwards.

The styloid process of the radius may be felt lying between the above tendon and the remaining extensor tendons of the thumb. Notice that the styloid process of the radius lies about half-an-inch nearer the hand than the corresponding process of the ulna; and, in the diagnosis of a Colles' fracture, it is well to remember that the styloid process of the radius normally occupies a lower position than that of the ulna.

The pulsations of the radial artery may be felt immediately below the styloid process of the radius.

The styloid process of the ulna is on the same level as the wrist joint, but the styloid process of the radius lies below the level of the joint.

Back of Hand and Fingers.—The bases of the second and third metacarpal bones can be felt on the back of the hand; that of the second metacarpal bone and the tubercle on the back of the radius, mentioned above, form important landmarks in excision of the wrist by Lister's method.

On the back of the hand the extensor tendons lie superficially, and can be traced to the various digits and thumb; and superficial to them are several veins, which pass upwards from the fingers to the fore-arm. On each side of the tendon, which passes to the ring finger, fibrous bands may be felt connecting the tendon to those of the middle and little fingers.

It is well to notice the position and direction of the tendon of the extensor secundi internodii pollicis, which can be traced from the inner side of the tubercle on the back of the radius to the terminal phalanx of the thumb. It crosses the radial artery as that vessel enters the first interosseous space. The radial incision, in excision of the wrist by Lister's method, follows the tendon of the extensor secundi as far as the base of the second metacarpal bone, and it is evident that the direction of the incision has to be changed at that point so as to avoid wounding the radial artery.

The remaining tendons at the back of the wrist are indistinct.

As the extensor tendons pass downward over the radius and ulna they are held down by the posterior

annular ligament, which is but a thickened portion of the aponeurosis of the fore-arm. The various tendons, as they lie in the compartments beneath the ligament, are enclosed in synovial sheaths. These sheaths are prolonged downwards for a little distance on to the back of the hand, and here, where they are not supported by the annular ligament, they are very apt to become enlarged or sacculated, forming a small rounded swelling known as a *ganglion*. This affection is common in washerwomen, due to the wrist-straining movements of wringing clothes.

The three rows of knuckles are formed respectively by the heads of the metacarpal bone, first and second phalanges; *and the joints lie immediately beyond the knuckles.*

(For a "Synopsis of the Anatomy of Joints," see Appendix).

THE THORAX.

THE MAMMARY GLAND.

The mammary gland in the female, lies on the surface of the pectoralis major muscle, and extends from the third to the sixth ribs. The nipple lies on a level with the fourth rib, or fourth interspace. The nipple is very variable in size, and may be hardly raised above the level of the surrounding skin. Occasionally supernumerary nipples are found, and the breast itself may exhibit curious anomalies; thus, it may be absent, multiple, or removed to some other situation, as the groin or back.

Surrounding the nipple is a darkened *areola*, which varies in its tint in different individuals, and in the same individual becomes darker at certain periods, as during pregnancy. Small elevations are seen on the surface of the areola. These correspond to small glands which lie beneath the skin, and in which, small abscesses may form during lactation.

The breast is covered on its superficial and deep surfaces by a layer of connective tissue in which abscesses may arise (supra-mammary and post-mammary) without the substance of the gland being necessarily affected. Due to the layer of connective tissue which lies beneath

its deep surface, the gland is freely moveable on the surface of the pectoralis major, but when cancer attacks the gland, this connective tissue becomes sooner or later involved, and the gland is rendered more or less adherent to the pectoralis major.

The breast consists of racemose tubules, arranged in lobes, and terminating in ducts (galactophorous ducts), fifteen to twenty in number, which converge towards the nipple. The lobes are separated by fibrous septa of connective tissue, continuous with that which covers the superficial and deep surfaces of the gland. For this reason an abscess in the breast is usually multilocular, and when opened, the above septa should be broken down with the finger so as to ensure drainage of the whole cavity. In opening a mammary abscess the incision should radiate from the nipple, so that, if possible, the ducts may not be injured.

The *arteries* which supply the mammary gland are branches of the internal mammary, intercostals, long thoracic, and external mammary.

The *lymphatics of the gland* pass mainly to the axilla; and with the description of that space, reference has been made to the surgical importance of this course taken by the lymphatics (page 6). A few of the lymphatics open into the glands along the internal mammary artery.

THE THORACIC WALL.

The Sternum.—The anterior surface of the sternum is partly subcutaneous throughout. At the junction of the manubrium with the body of the sternum is a well-marked transverse ridge; as this lies opposite the second ribs, it is an important landmark in the obese.

Fractures of the sternum are rare, and when they occur are usually caused by severe direct violence.

Caries of the sternum is sometimes met with.

Sternal Foramen or Cleft Sternum.—Occasionally a fissure or foramen is found in the sternum, due to imperfect ossification and want of coalescence of its lateral halves.

The *innominate artery* lies behind and in close relation to the manubrium, and has been compressed against that bone.

The Ribs.—The ribs may be broken by direct or indirect violence. When fractured by indirect violence, as by severe pressure on the front of the chest, the rib snaps at the point of its greatest convexity, and the fragments, if displaced at all, are displaced outwards. When the rib is fractured by direct violence, it fractures at the spot where the force is applied. The fragments are forced inwards, and may cause great injury to underlying structures—viz., pleura, lung, diaphragm, or liver. The middle ribs—fourth to the eighth—are those most commonly fractured; the first and second ribs are very rarely injured, due to the protection afforded them by the clavicle and shoulder.

Vessels of the Thoracic Wall.—The only vessels of importance in the thoracic wall are the internal mammary and the intercostals.

The *internal mammary artery* passes downwards just external to the outer border of the sternum as far as the seventh rib, where it divides into the superior epigastric and musculo-phrenic arteries. It lies immediately behind the costal cartilages and when wounded may be the cause of very serious hæmorrhage. Above

the level of the fourth rib, the vessel may perhaps be reached by an incision in an intercostal space, but beyond the fourth rib the cartilages are so near each other, and the spaces, consequently, very narrow, that a cartilage would have to be resected in order to reach the bleeding vessel.

The *intercostal vessels* lie along with the accompanying nerves, at the upper part of each intercostal space, and more or less protected by the upper rib of the space—as the groove for an intercostal artery is found on the *inner* surface of each rib, close to the lower border.

Wounds of the intercostal arteries are for the above reasons rare, and when they do occur are very difficult to treat, and may even require resection of part of a rib before the bleeding vessel can be reached.

Paracentesis thoracis is usually performed in the fifth intercostal space, opposite the mid-axillary line. Occasionally it is recommended to tap the pleural cavity further back below the angle of the scapula, in the seventh or eighth interspace. In performing this operation, care should be taken to introduce the trocar close to the *upper* border of the lower rib of the space, so as to avoid injuring the intercostal vessels.

The *pericardium* may be tapped, according to Dieulafoy, in the fifth or sixth interspace, 2 to $2\frac{1}{2}$ inches from the left margin of the sternum. The interspaces are here very narrow, and the intercostal artery has divided into two branches of small size, which lie close to the upper and lower ribs of the space.

HEAD AND NECK.

THE NECK.

Middle Line of the Neck.—Just below the chin the hyoid bone may be felt. Between this and the symphysis of the jaw is the median raphé of the mylo-hyoid muscles. Below the hyoid bone is the thyroid cartilage, more prominent in the male than in the female, but very indistinct in the child. Between the hyoid bone and the thyroid cartilage is the thyro-hyoid membrane. Below the thyroid cartilage, the cricoid may be felt; and between the two is the crico-thyroid membrane, which is crossed by the small crico-thyroid artery. Below the cricoid the trachea may be felt, its upper part being superficial, but the lower part lies deeply. Crossing the second and third rings is the isthmus of the thyroid body. The anterior jugular veins lie on each side of the middle line of the neck, and are usually joined by one or two transverse branches which cross the middle line.

Thyrotomy.—The thyroid cartilage is quite superficial, and its alæ may be separated by a mesial incision without dividing any important structures.

Laryngotomy.—In this operation an incision is made through the crico-thyroid membrane. It is easily

performed, as the crico-thyroid membrane is almost subcutaneous. Some trouble may arise from division of the crico-thyroid branch of the superior thyroid artery, which crosses the membrane, but as the membrane is divided transversely the artery usually escapes.

Tracheotomy—(high and low).—In this operation the trachea is opened *above* or *below* the isthmus of the thyroid body. The trachea is almost subcutaneous above the isthmus, and merely covered by skin, superficial and deep fascia, and overlapped by the sterno-hyoid muscles; but below the isthmus the trachea recedes from the surface and is deeply placed, and has in front of it, in addition to skin and fascia, the sterno-hyoid and sterno-thyroid muscles, the inferior thyroid veins, and occasionally the thyroidea ima artery. Besides these, communicating branches between the anterior jugular veins will be found beneath the fascia. Due to the depth and to the important relations of the trachea, the difficulties of the low operation are great, and, according to Erichsen, as no advantage is gained, scarcely commendable.

Bursæ of the Neck.—Of the bursæ on the front of the neck, that in the thyro-hyoid space and extending beneath the hyoid bone is the most important, as it not infrequently becomes enlarged, forming a fluctuating tumour below the chin.

THYROID BODY.

The isthmus of the thyroid, as previously mentioned, lies on the second and third rings of the trachea. Each lateral lobe lies against the trachea as low as

the fifth or sixth ring, and extends upwards to the surface of the thyroid cartilage. It lies beneath the depressor muscles of the hyoid bone, and is in contact posteriorly with the carotid sheath. The gland is enclosed in a fibrous capsule derived from the cervical fascia.

The relations of the gland to the larynx, trachea, and œsophagus, explain certain symptoms which appear when the gland becomes enlarged. Of these, a hoarse voice, and a difficulty in breathing and swallowing, are the most common; and in some cases the larynx, trachea, and the carotid sheath may be considerably displaced. The thyroid body moves with the larynx during deglutition. This fact should be remembered in the diagnosis of tumours of that body.

The gland is supplied by the superior and inferior thyroid arteries, derived respectively from the external carotid and thyroid axis (subclavian). Its veins are three in number on each side, the superior and middle thyroid veins cross the carotid sheath to open into the internal jugular, but the inferior thyroid veins descend in front of the trachea to open into the innominate veins.

Removal of the Thyroid Gland.—In removing the gland by a mesial incision (Dr P. H. Watson's method), it is important to bear in mind that its vessels, the superior and inferior arteries, enter at the upper and lower limits of the gland, and that these should be secured by ligatures before opening the sheath of the gland. The vessels are tied *en masse*, by passing a needle round the sheath; for if the sheath be opened previous to the ligature of the arteries, troublesome

bleeding will occur, as the gland tissue and the arteries within it are extremely friable. In separating the gland, care should be taken lest the trachea, carotid artery, or jugular vein be injured, as their sheaths are frequently adherent to and thinned by the pressure of the tumour.

THE ŒSOPHAGUS.

The gullet commences at the level of the cricoid cartilage. In the neck the œsophagus lies behind the trachea, and in front of the vertebral column. It deviates slightly to the left side, and on each side is in relation with the carotid sheath.

In the thorax the œsophagus lies behind the arch of the aorta, and descends along with the descending aorta to the diaphragm, being in contact with both pleural membranes. It is crossed by the left bronchus.

Any of these structures may be invaded by carcinomatous tumours spreading from the gullet, or may be opened by ulcerations due to impacted foreign bodies in the tube.

The narrowest parts of the œsophagus are at its commencement and near its termination where it passes through the diaphragm, and these are the points where foreign bodies are most commonly found impacted.

Aneurism of the aorta or of one of its large branches may, by pressure on the gullet, give rise to difficulty of deglutition.

Œsophagotomy and Œsophagostomy.—The œsophagus is occasionally opened for the removal of a

foreign body, or in order to feed a patient with a high stricture. The tube is reached on the left side by an incision, similar to that used for ligature of the common carotid. The carotid sheath is separated from the larynx and trachea, and behind the trachea the œsophagus is found — care being taken not to injure the inferior thyroid artery and recurrent laryngeal nerve.

DEEP CERVICAL FASCIA.

The deep cervical fascia is important, due to its influence in directing tumours or extravasations in certain fairly definite directions.

Traced across the neck, after enclosing the trapezius, it crosses the posterior triangle, being attached below to the clavicle, and above to the mastoid process and occipital bone.

Having crossed the posterior triangle, the fascia splits to enclose the sterno-mastoid, and is prolonged across the anterior triangle to meet the fascia of the opposite side in the middle line; it is attached below to the manubrium sterni and above to the lower jaw, being prolonged upwards over the parotid gland to be attached to the zygoma. A deep process of the fascia becomes continuous with the stylo-maxillary ligament, which separates the parotid from the sub-maxillary gland. The fascia thus closes in the anterior and posterior triangles, and tends to prevent an abscess from reaching the surface. For this reason, suppuration may extend deeply and involve the deeper structures, and may open into the trachea, the gullet, or even into the great vessels.

In the posterior triangle the fascia is very thick, and, on drawing the head to the opposite side, it is rendered very tense, and is sometimes so resistant as to cause some difficulty in compressing the third part of the subclavian artery above the clavicle.

From the deep surface of this fascia various processes are given off; one encloses the depressor muscles of the hyoid bone, and is attached below to the manubrium sterni. This, with the superficial layer, shuts in a small space, in which an abscess may be pent up. Another layer lies in front of the trachea, and invests the thyroid body, and is prolonged on the trachea to the thorax, where it is attached to the pericardium. Another layer passes behind the gullet and covers the longus colli and scalene muscles *(prevertebral fascia)*. From the scalene muscles it is prolonged beneath the clavicle to join the axillary sheath. Besides the above layers, the carotid sheath is formed by a deep process of the cervical fascia.

From the above disposition of the fascia it will be readily seen that an abscess beneath the cervical fascia may extend to the anterior or posterior mediastinum or into the axilla.

Lymphatic Glands of the Neck.—The lymphatic glands of the neck are more frequently enlarged than any in the body, and the enlargement may in some cases be primary—*e.g.*, lymphadenoma; but more frequently it is secondary, due to some irritation in parts whence the glands derive their lymph supply. In scrofula especially, they are found enlarged.

These glands are arranged in more or less definite groups, which will be mentioned with the regions

from which they receive lymph, as it is frequently possible to trace the connection between a group of glands, and some peripheral irritation in the course of its lymph supply.

The *mastoid, sub-occipital, and parotid* lymph glands receive the lymphatics of the scalp, and are frequently found enlarged, due to the irritation of the scalp by pediculi.

The *sub-maxillary lymphatic glands* receive the lymphatics of the face, mouth, tip of the tongue, gums of the lower jaw, and salivary glands.

The *superficial cervical lymphatic glands* lie beneath the platysma and close to the external jugular vein, and receive lymph from all the above mentioned groups of glands, and from the superficial structures of the neck.

Of the *deep cervical glands* two groups may be mentioned. The upper group lies close to the bifurcation of the common carotid, and receives the lymphatics from the deeper parts of the head, as the tongue and mouth (partly), orbit, nose, pharynx, larynx, etc.

The *lower group* lies at the root of the neck, and receives lymph from the upper set. It also extends to the supra-clavicular fossa, where it becomes continuous with the axillary group of glands; and thus may become enlarged secondarily to the enlargement of the axillary glands, as in scirrhus of the mamma.

SUBCLAVIAN ARTERY.

The course of the subclavian artery at the root of the neck is indicated by a curved line from the sterno-

clavicular articulation to the middle of the clavicle, the line extending half-an-inch above the bone. The vessel forms an arch, which is divided into three parts by the scalenus anticus muscle.

The first and second parts of the artery lie deeply, and are not accessible; and from the numerous large branches given off, are not suitable for the application of a ligature.

The third part, *i.e.*, the part beyond the scalenus anticus, lies at the lower part of the posterior triangle and disappears beneath the clavicle. Here the vessel may be compressed against the first rib, which it crosses. The pressure should be exerted almost vertically downwards, as pressure made in a backward direction would be above the level of the artery and ineffectual.

Third Part of Subclavian Artery.—This portion of the artery lies partly beneath the clavicle and subclavius muscle, but above the clavicle it lies in the lower part of the posterior triangle. The vessel is covered by the integuments, platysma, descending branches of cervical plexus, deep fascia, and by a venous plexus formed by the supra-scapular and transversalis colli veins; these join the external jugular, which crosses the artery. The nerve to the subclavius passes over the vessel. The omo-hyoid and cords of the brachial plexus lie above the artery, the trunk formed by the last cervical and first dorsal nerves lying behind and in close contact with it.

The vessel rests on the first rib, and the scalenus medius lies behind it. The subclavian vein lies at some distance below, and in front of the artery.

Ligature of Subclavian (third part). — The arm should be drawn well downwards, lest the clavicle should completely cover the artery. The skin is drawn downwards over the clavicle, and an incision is made on to the bone. When the skin is released, the incision will lie over the lower part of the posterior triangle; the deep fascia is then divided, care being taken not to divide the external jugular vein. The areolar tissue containing the supra-scapular and transversalis colli veins is scraped through, and the scalenus anticus felt for. The outer border of the muscle will guide the finger to the scalene tubercle on the first rib. Behind this tubercle the vessel lies on the rib.

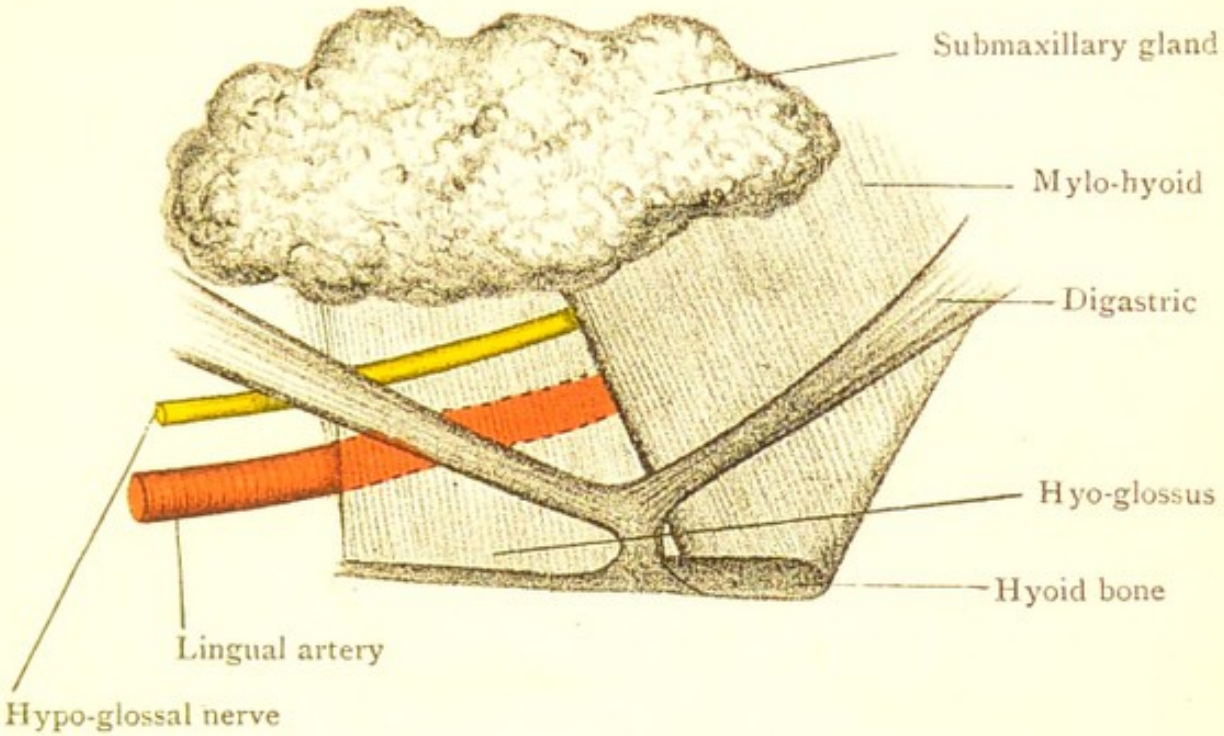
In passing the needle, care should be taken, lest the lower trunk of the brachial plexus be included.

Severe venous hæmorrhage sometimes occurs from division of the plexus above named, or from wound of the external jugular vein.

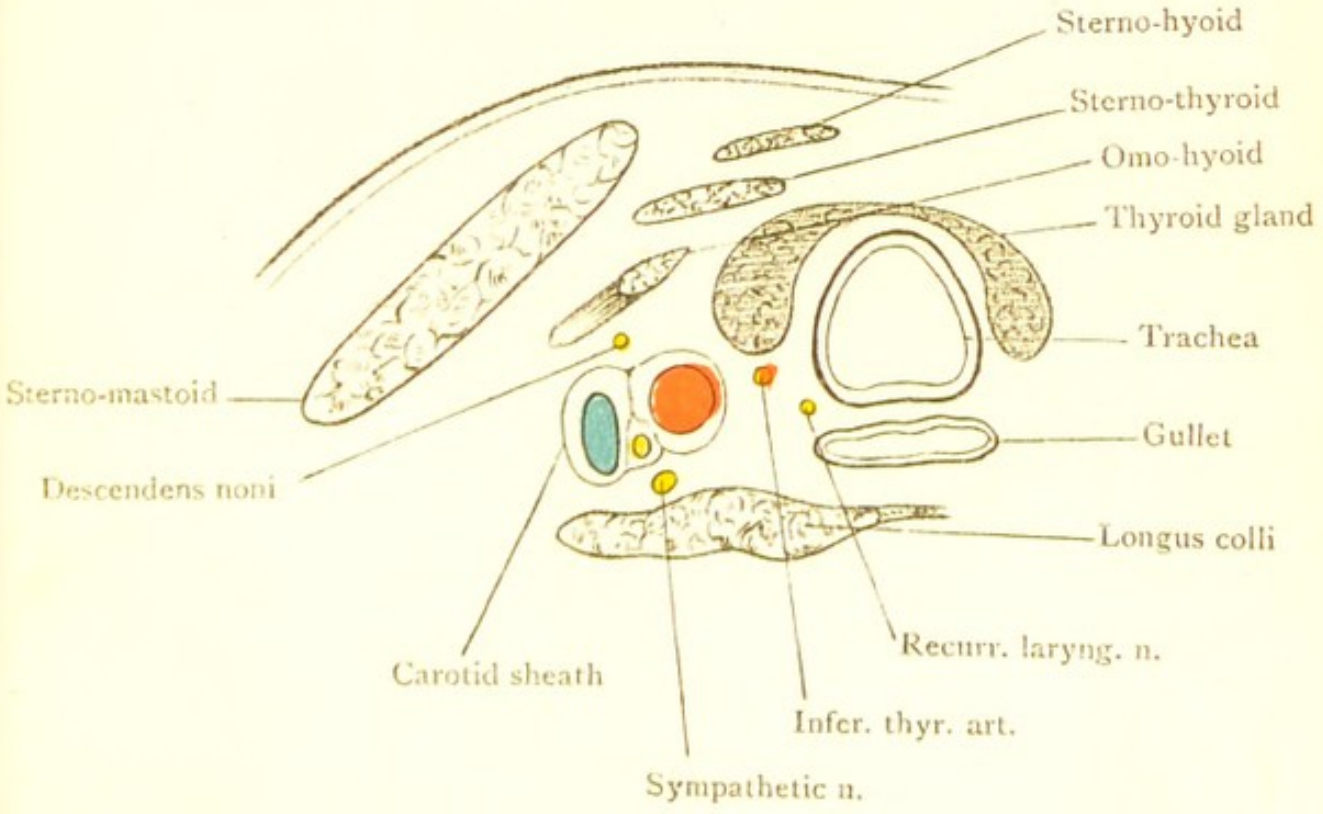
Collateral Circulation.—The chief anastomosing arteries are the posterior scapular branch of the transversalis colli with the subscapular; the supra-scapular with the dorsalis scapulæ and circumflex arteries; and the internal mammary and intercostal arteries with the superior and long thoracic branches of the axillary.

COMMON CAROTID ARTERY.

In the neck, the common carotid artery on each side extends from the sterno-clavicular articulation to the upper border of the thyroid cartilage, and its direction corresponds to a line drawn from the sterno-clavicular articulation to a point midway between the angle of



COMMON CAROTID ARTERY.



the jaw and the mastoid process. At the lower part of the neck the arteries are deeply placed, but close to each other, being merely separated by the narrow trachea; but as they pass upwards they become more superficial, and more widely separated by the increased width of the larynx.

The artery is covered, in addition to the skin and fascia, by the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles, and is crossed by the omo-hyoid. At its upper part a few arterial twigs to the sterno-mastoid lie superficial to it, and it is also crossed by the superior thyroid, middle thyroid, and the anterior jugular veins.

The descendens noni nerve descends in front of the artery.

The vessel is enclosed in a fascial sheath (carotid sheath), having the internal jugular vein external to it. Behind and between the artery and vein (within the sheath) the vagus nerve lies.

Behind the artery are the transverse processes of the cervical vertebræ—that of the sixth being prominent; and against this the artery may be compressed; hence it is called the *carotid tubercle.*

Common Carotid Artery (in the neck).—

In Front.

Integument and fascia.
Platysma, sterno-mastoid.
Sterno-hyoid, sterno-thyroid.
Omo-hyoid, descendens noni.
Sterno-mastoid artery.
Superior and middle thyroid veins.
Anterior jugular vein.

Externally.		Internally.
Internal jugular vein. Vagus nerve.		Trachea, larynx. Œsophagus, pharynx. Recurrent laryngeal nerve. Inferior thyroid artery.

Behind.

Longus colli, rectus capitis anticus major.
Sympathetic and recurrent laryngeal nerves.
Inferior thyroid artery.

Ligature of Common Carotid Artery.—This may be performed either above or below the omo-hyoid muscle. When ligatured above the omo-hyoid, an incision is made along the anterior border of the sterno-mastoid.

The skin and fascia having been divided, the sterno-mastoid is turned outwards, and the carotid sheath is exposed, with the descendens noni nerve on its surface. Some small branches of the superior thyroid artery to the sterno-mastoid, and the middle thyroid vein may be divided and require a ligature.

The sheath is to be opened towards the inner or tracheal side, so as not to injure the internal jugular vein, which lies external to the artery; and the needle is passed from the outer side, care being taken not to include the vagus nerve, which lies behind.

When the vessel is tied below the omo-hyoid the sternal head of the sterno-mastoid and the sterno-hyoid muscles have to be divided or turned aside, and care has to be taken lest the anterior jugular vein be wounded.

EXTERNAL CAROTID ARTERY.

The external carotid extends from the upper border of the thyroid cartilage to the neck of the lower jaw, where it divides into the temporal and the internal maxillary branches.

Near its origin the vessel is close to the surface, and overlapped by the sterno-mastoid muscle, but as it extends upwards it passes beneath the stylo-hyoid and digastric muscles, and becomes imbedded in the parotid gland. The temporo-maxillary, facial, and lingual veins are superficial to the artery, and it is crossed by the hypo-glossal and facial nerves. At first the external and internal carotid vessels lie in contact with the pharynx, and close to each other, the external carotid being somewhat nearer the mesial plane, but as they pass upwards they are separated by the styloid process and stylo-pharyngeus muscle and by the glosso-pharyngeal nerve.

Owing to the size and number of the branches given off from the external carotid, this vessel is hardly ever tied.

Internal Carotid Artery (cervical portion).—The internal carotid lies at first behind the external carotid, and is covered by the sterno-mastoid and integuments. It soon passes beneath the styloid process, stylo-pharyngeus and parotid gland, which separate it from the external carotid. On the inner side of the vessel are the pharynx and tonsil; and behind, it rests on the rectus capitis anticus major muscle and the sympathetic nerve. The internal jugular vein and vagus nerve lie to its outer side. The internal carotid artery is hardly ever tied.

VEINS OF THE NECK.

The important relations of the internal and anterior jugular veins have been elsewhere mentioned.

External Jugular Vein.—This vein extends from the parotid gland to the lower part of the posterior triangle, where it enters into the subclavian vein. A line from the angle of the jaw to the middle of the clavicle corresponds to the course of the vein. It crosses the sterno-mastoid obliquely, and close to the posterior border of that muscle it pierces the deep fascia which covers the posterior triangle. The vein lies beneath the platysma, the fibres of which pass *upwards and inwards*. In venesection of the external jugular vein an incision is made parallel to the fibres of the sterno-mastoid, so that the fibres of the platysma are divided almost transversely, thus providing a gaping wound favourable to the flow of blood from the vein.

SIDE OF THE NECK.

Sterno-Mastoid.—The sterno-mastoid forms a marked prominence which lies obliquely across the side of the neck, and divides the region into two triangles, anterior and posterior. The lower part of the posterior triangle is marked by a shallow depression, which corresponds to the lower part of the posterior triangle, and in which the third part of the subclavian artery and the brachial plexus are found. Beneath the inner margin of the muscle the carotid sheath with its contents lie, and if pressure be exerted opposite the cricoid cartilage, the anterior tubercle of the transverse process of the sixth cervical vertebra (carotid tubercle) may be felt; against this the carotid artery may be compressed.

The sternal and clavicular heads of the muscle are separated by a slight interval, which is marked by a depression on the surface; if a probe be passed through this interval on the right side, it would touch the bifurcation of the innominate artery. The external jugular vein crosses the muscle obliquely, and as the vein enters the lower part of the posterior triangle it lies close to the posterior border of the muscle. The anterior jugular vein crosses beneath the lower part of the muscle, and the subclavian artery and brachial plexus are separated from it by the scalenus anticus. The muscle is pierced obliquely by the spinal accessory nerve which supplies it. The exact position of this nerve will be described presently.

Wry Neck or Torticollis.—Wry neck is frequently due to rigid contraction of the sterno-mastoid. The head is displaced laterally towards the affected side, and is rotated so that the occiput is approximated to the shoulder of the affected side, and the chin is approximated to the opposite shoulder. This displacement is easily understood if the direction and attachments of the sterno-mastoid be considered, as contraction of the muscle will approximate the mastoid process to the manubrium sterni. The anterior fibres of the trapezius, which correspond in direction to that of the sterno-mastoid, are frequently contracted and shortened.

One form of wry neck is due to cervical caries, the muscles becoming secondarily shortened to accommodate themselves to the bony displacement; but in the muscular form of wry neck, the vertebræ become secondarily distorted and displaced so as to adapt themselves to the altered position of the head.

Division of the Sterno-Mastoid.—In dividing the sterno-mastoid in the treatment of wry neck, care should be taken lest the carotid artery or jugular veins be injured. The carotid artery and internal jugular vein pass upwards at a little distance behind the muscle. The anterior jugular vein crosses outwards immediately beneath the lower extremity of the muscle, and the external jugular lies close to its posterior border just above the clavicle. The tenotome should therefore not penetrate beyond the posterior border, nor beyond the deep surface of the muscle.

Spinal Accessory Nerve.—The spinal accessory nerve pierces the sterno-mastoid obliquely, and supplies that muscle; it then crosses the posterior triangle to enter the under surface of the trapezius. The nerve enters the under surface of the sterno-mastoid opposite the angle of the jaw, and leaves the posterior border of the muscle opposite a line drawn across the neck, from the upper border of the thyroid cartilage. This nerve is occasionally divided or stretched for wry neck, and for this purpose it may be exposed at the anterior or posterior border of the sterno-mastoid. In the former position the nerve is reached by an incision commencing at the mastoid process, and extending for two inches along the anterior border of the sterno-mastoid, care being taken not to injure the external jugular vein, which lies at the lower part of the wound. The nerve will be found entering the muscle opposite the angle of the jaw.

WOUNDS OF THE THROAT.

These are frequently suicidal, and may be in one of four situations—(1) Above the hyoid bone; (2) through the thyro-hyoid space; (3) through the larynx; or (4) through the trachea.

1. Above the Hyoid Bone.—It will be readily seen that wounds in this position would sever the structures between the hyoid bone and the jaw—viz., mylo-hyoid, genio-hyoid, and digastric, and the structures which connect the tongue to the hyoid bone—viz., hyo-glossus and genio-hyo-glossus. Moreover, as the mylo-hyoid lies immediately beneath the mucous membrane of the mouth, the floor of that cavity is usually freely opened. Hæmorrhage is very free from the severed lingual artery, and the lingual and hypo-glossal nerves are divided as they pass to the under surface of the tongue. The power of swallowing is completely lost, due to division of the attachments of the hyoid bone.

2. Through the Thyro-Hyoid Space.—This is the most common situation of suicidal wounds; and wounds through this space, after dividing the depressors of the hyoid bone and the thyro-hyoid membrane, may detach the epiglottis and open the pharynx. In some cases the edges of the glottis and arytenoid cartilages are injured, and the cut may extend to the bodies of the vertebræ. The superior thyroid artery is divided, and suffocation may ensue from injury to, blocking, or œdema of the glottis.

3. Through the Larynx.—In this situation the cartilages of the larynx, crico-thyroid membrane, vocal

cords, and superior thyroid artery may be divided, and great danger ensues, due to the passage of blood into the trachea.

4. Through the Trachea.—When the wound is opposite the trachea, the depressor muscles of the hyoid bone, the edge of the sterno-mastoid, thyroid gland, thyroid veins, cervical fascia, and, more rarely, the inferior thyroid arteries and recurrent laryngeal nerves, are divided.

The large vessels are very rarely injured in cut-throat, due partly to the protection afforded by the cartilages in the middle line and the sterno-mastoid at the side; and in suicidal attempts the head is thrown back, which renders the larynx and spine more prominent, but moves the great vessels still further away from the anterior surface of the neck. Besides, the great mobility of the vessels and their dense fascial sheath offer a marked protection against injury.

At the lower part of the neck additional dangers are found—viz., the entrance of air into the veins, and the extension of suppuration into the thorax beneath the pre-tracheal layer of the cervical fascia.

THE FACE.

VESSELS ON THE FACE.

Facial Artery.—Below the jaw the facial artery, after passing beneath the stylo-hyoid and digastric muscles, becomes more or less imbedded in the sub-maxillary gland. The vessel appears on the face, by crossing the jaw at the anterior inferior angle of the masseter;

it lies immediately beneath the platysma, and its pulsations may easily be felt; and here the artery may be compressed against the jaw. The vessel passes in a tortuous manner towards the angle of the mouth and side of the nose, and terminates near the inner angle of the orbit by anastomosing with a branch of the ophthalmic artery. The artery is crossed by the zygomatic muscles, and distributes named branches to the lips and nose—viz., inferior labial, inferior and superior coronary, and lateral nasal. The coronary arteries lie immediately beneath the mucous membrane of the lip, and in operations on the lips (as for hare-lip) these branches may bleed freely.

The *facial vein* lies behind and close to the artery on the lower jaw, but it takes a straight course across the face and is separated by an interval from the artery.

The other vessels of any surgical importance on the face are branches of the temporal—viz., the transverse facial and anterior temporal.

Temporal Artery. — This vessel commences in the parotid gland and ascends over the zygoma in front of the ear to the temporal region, where it divides into anterior and posterior branches. The anterior branch passes forwards to the forehead and front of the scalp, and the posterior branch extends towards the occiput and vertex of the head. As bleeding from either of these branches is usually very free, it should be remembered that the trunk of the temporal artery may be compressed against the zygoma.

Besides small branches to the ear and temporal region, the temporal artery gives off the transverse facial artery.

This crosses the masseter just above *Stenson's duct*, which extends across the face opposite the middle third of a line drawn from the lobule of the ear to the middle of the upper lip. The anterior branch of the temporal artery was the vessel usually selected for the operation of arteriotomy.

Nerves on the Face.—The nerves found on the face are branches of the facial and fifth. The facial nerve passes from the front of the mastoid process, through the parotid gland, to be distributed on the face by branches which extend with varying directions—the uppermost passing to the temporal region, the lowest passing below the jaw.

In making incisions in the posterior parts of the face care should be taken so as (if possible) not to divide the facial nerve or Stenson's duct; and in incising the anterior part of the face the position of the facial vessels should be borne in mind.

Of the branches of the fifth nerve the *supra-orbital*, *infra-orbital*, and *mental*, appear through their respective foramina, which lie in a vertical line drawn downwards from the junction of the middle and inner thirds of the supra-orbital arch. The long *buccal nerve* lies on the surface of the buccinator between the upper and lower jaws. The *auriculo-temporal nerve* is in contact with the temporal artery. Some of these branches have been divided for facial neuralgia.

BONES OF THE FACE.

Nasal Bones.—Notice that the bridge of the nose is formed by the nasal bones, and when fractured, as by a blow, the bones are usually pressed in. The under

surface of the bones is supported by the septum of the nose, formed mainly by the ethmoid, and when the septum becomes destroyed, as by necrosis, the bridge of the nose falls in, producing great deformity. The close relation of the nasal bones to the ethmoid explains the extension of injury to the base of the brain, which sometimes occurs in fracture of the nasal bones.

Malar.—This bone is of great strength and is rarely fractured; but from the shell-like structure of the superior maxilla which supports it, that bone may be smashed by blows on the malar.

Superior Maxilla.—The outline of the facial surface of the bone should be carefully made out, partly from the face and partly beneath the lip and cheek. In the dried skull, notice the surfaces and connections of the bone, as these are of immense surgical importance, and tumours of the jaw usually modify the shape of all the surfaces of the bone. Thus the facial surface bulges forwards, and the cheek becomes prominent. The tumour may push upwards the orbital surface and displace the eyeball. If it grows inwards, involving the nasal surface, the cavity of the nose is encroached upon; and a growth downwards will project into the roof of the mouth and alter the shape of the palate. Notice carefully, that the posterior surface of the bone is directed towards the zygomatic fossa, and here comes into close relation with the pterygoid plates of the sphenoid; and thus tumours attacking this surface of the bone, soon involve the body of the sphenoid and base of the skull, complete removal of the tumour being then hopeless.

Antrum of Highmore.—The substance of the bone is hollowed out by this cavity, so that fractures are not uncommon, either from direct blows or from being smashed in by the malar. The antrum is bounded by walls corresponding to the surfaces of the bone, and tumours growing in the antrum may involve some or all of those surfaces, and expand the bone in the directions mentioned above.

The cavity of the antrum is of some size, and cases are recorded in which bullets or musket-balls have been lodged in the cavity for months or even years.

The cavity is lined by mucous membrane continuous with that of the nose. This is occasionally the seat of cystic disease, due to which the cavity becomes distended with fluid and the bone becomes thinned out like parchment.

Into the floor of the antrum the fangs of one or two teeth project (usually the second molar), and in connection with these suppuration occasionally occurs, forming an *abscess of the antrum.*

The opening of communication between the nose and the cavity is very small, and situated at some distance from the floor, so that a considerable amount of pus or fluid may collect and cause distension of the bone. This may be let out by drawing one of the teeth in this region and puncturing the socket, or by drilling the anterior surface of the bone between the gum and the cheek.

Another relation of the superior maxilla should be mentioned—viz., it forms part of the nasal duct, and tumours or injuries of the bone may block the duct and interfere with the passage of tears.

Excision of the Upper Jaw. — The bone is usually exposed by an incision along the side of the nose and middle of the upper lip, the muscles of the upper lip and cheek being then lifted from the surface of the bone, and some branches of the facial artery and nerve, with the infra-orbital vessels and nerve, are divided.

The bony connections are divided—viz., the palate and nasal processes—and the malar bone is sawn through into the spheno-maxillary fissure. In wrenching the bone from its other attachments, the inferior turbinated, and parts of the palate and pterygoid plates, are also removed—the attachment between these bones being too firm to yield unless extensively diseased (Erichsen). The superior maxillary nerve and terminal branches of the internal maxillary artery are also torn through.

Inferior Maxilla.—The weakest part of the bone is near the mental foramen, where the bone is weakened by the mental foramen and the socket of the canine tooth. It is here the bone most frequently fractures; but it may suffer fracture at the angle, neck, or symphysis, and very rarely through the coronoid process. In fractures of the body of the bone, the anterior fragment is drawn down by the muscles which extend to the hyoid bone; while the posterior fragment is drawn upwards by the muscles of mastication (masseter, temporal, and internal pterygoid).

The inner surface of the jaw is separated from the cavity of the mouth merely by the mucous membrane; and as this is readily torn through, fractures of the jaw are usually compound.

The lower jaw has several important relations; thus the sub-maxillary gland lies in a groove on the inner

surface of the bone. The lingual nerve crosses the inner surface just below and behind the last molar tooth. The inferior dental nerve enters the foramen on the inner surface of the ramus. The internal maxillary artery passes immediately beneath the neck of the bone. The external carotid artery lies just behind the ramus, and the facial artery crosses the outer surface of the bone a little in front of the angle. The parotid gland lies behind the ramus and gives off processes on its facial and inner surfaces, so that the bone is partly enveloped by the gland; these relations should be borne in mind in excising the bone.

Temporo-Maxillary Articulation.—The condyle of the jaw is separated from the glenoid fossa by the inter-articular fibro-cartilage which thus materially diminishes the depth of that cavity and renders the position of the bone less secure. In front of the glenoid fossa is the eminentia articularis on which the fibro-cartilage glides, and if the mouth be opened very widely the condyle is apt to slip over this eminence into the zygomatic fossa, carrying with it the fibro-cartilage, as this is attached partly to the condyle. The external pterygoid muscle, which is inserted into the front of the neck of the jaw, is also attached partly to the fibro-cartilage. When the condyle is thus dislocated forwards the coronoid process lies below the malar bone; and if it be of unusual length may become hitched against the malar, and thus add to the difficulties of reduction. The capsule of the joint is thickest externally (external lateral ligament), the fibres here passing downwards and backwards. When the jaw is depressed these fibres are put on the stretch and tend to prevent

dislocation. The internal lateral ligament is thin and at some distance from the joint. Posteriorly, the condyle is in close relation with the auditory meatus and the tympanum, which may be injured by blows on the jaw, or disease may extend readily from the one to the other.

The Parotid Gland.—The gland lies in the interval between the jaw and the mastoid process, and gives off processes in various directions—on the face, beneath the jaw, beneath the styloid process—and the gland projects inwards towards the internal carotid artery, where it comes into close relation with the wall of the pharynx.

The process, which passes on to the face (socia parotidis), lies on the surface of the masseter muscle, and, close to it, the duct (Stenson's) of the gland lies. The position of this duct has been described with the face. (See page 54.)

The superficial surface of the gland is covered by a layer of the deep cervical fascia, which is prolonged upwards to the zygoma. Inferiorly, the gland is limited by a deep layer of the above fascia, which dips inwards to be attached to the styloid process and angle of the jaw. The gland is thus enclosed in an incomplete capsule, open above towards the temporal fossa, and internally towards the pharynx. This disposition of the fascia explains the progress of pus from a parotid abscess, which, instead of reaching the surface, may travel upwards into the temporal region or burst inwards towards the pharynx. For similar reasons, a post-pharyngeal abscess may burst into the parotid region.

Several important structures traverse the parotid gland. Of these the following may be mentioned. The external carotid, with its auricular and terminal branches—viz., temporal and internal maxillary—the temporal also giving off the transverse facial branch. Superficial to the external carotid artery are the facial nerve passing from behind forwards, and the external jugular vein, which is formed here by a plexus derived from the temporal and internal maxillary veins. The auriculo-temporal nerve traverses the upper part of the gland; and internally, the internal carotid artery and internal jugular vein are in close relation to it.

It will readily be understood, due to the important vessels and nerves which traverse the gland, and to the unapproachable positions of its deep processes, that, excepting the removal of simple superficial tumours, and incisions into an abscess, operations in this region are almost impracticable.

Sub-maxillary Gland.—The sub-maxillary gland lies immediately beneath the jaw in the sub-maxillary region; it is covered by the platysma and deep fascia, and is in relation below with the digastric muscle. The gland lies on the mylo-hyoid muscle, and gives off a deep process, which passes beneath the mylo-hyoid and lies between that muscle and the mucous membrane of the mouth. From this deep process *Wharton's duct* is given off; this extends beneath the mucous membrane of the floor of the mouth to open close to the frænum linguæ. The facial artery, before it reaches the jaw, lies in a groove in the gland, and here it gives off its submental branch. The facial vein lies on the surface of the hinder part of the gland.

The Sub-lingual Gland lies beneath the mucous membrane of the floor of the mouth, close to the symphysis of the jaw. Here the eminence formed by the gland may be felt; its ducts open close to Wharton's duct.

In the region over the sub-lingual gland a cystic tumour (Ranula), with clear viscid contents, is sometimes met with; this may arise from distension of one of the small ducts of the sub-lingual gland or of one of the mucous glands of the mouth.

THE MOUTH.

Lips.—The greater part of each lip is formed of connective tissue and orbicularis oris. The outer surface of the muscle is covered by skin and fascia; its inner surface by mucous membrane; between the muscle and the mucous membrane the coronary artery lies. This may bleed very profusely in operations on the lip.

Hare Lip.—In the upper lip, on one or both sides of the middle line, a cleft may be present (single or double hare lip). This cleft varies in size from a slight notch in the margin to a complete fissure extending into the nostril, and is frequently associated with cleft palate.

The Palate.—The *hard palate* is formed by the palate processes of the superior maxillary and palate bones, and is covered by mucous membrane, which is very dense and inseparably united to the periosteum of the bones.

Cleft Palate.—A cleft is occasionally met with in the hard and soft palates; this lies for some distance in the middle line, but anteriorly when it extends through the alveolar margin of the jaw, it deviates to one or both sides, and traverses the interval between the lateral incisor and canine teeth, and may be associated with a corresponding cleft in the upper lip.

The cleft is due to a want of union of the palate plates of the superior maxillary and palate bones, which normally separate the nasal from the buccal cavity; and when the cleft extends through the alveolar margin it is due to the non-union of the pre-maxillary or incisive bone (in which the incisor teeth are developed) with the main part of the superior maxillary bone.

The *soft palate* is attached to the posterior border of the hard palate, and consists of connective tissue and layers of muscles, tensor and levator palati, palato-glossus and palato-pharyngeus, and is covered on both surfaces by mucous membrane.

The *uvula*, which hangs from the middle of the posterior or inferior border of the soft palate, contains the azygos uvulæ muscles. It overhangs, but normally does not reach, the root of the tongue. In some cases, however, the uvula is so much elongated as to reach the base of the tongue, and may require removal.

The *pillars of the fauces* extend from the sides of the soft palate, and are formed, by the elevation of the mucous membrane by muscles.

The *anterior pillar* extends to the side of the tongue, and contains the palato-glossus muscle.

The *posterior pillar* extends to the pharynx, and is formed by the palato-pharyngeus.

The *tonsil* lies between the pillars of the fauces, and is opposite the angle of the jaw. Externally, the tonsil is separated from the internal carotid and ascending pharyngeal arteries by the superior constrictor muscle and fibrous layer of the pharynx. The tonsil, however, lies on a level slightly anterior to that of the internal carotid artery, and if ordinary care be taken in the removal of the tonsil, there need be no fear of wounding that vessel. The knife should be so directed as to cut vertically, and its edge should on no account be turned outwards.

Just above and behind the tonsil lies the opening of the *Eustachian tube.* This explains probably the deafness and other ear symptoms so frequently present when the tonsil is enlarged or inflamed.

The tonsil consists of lymphoid tissue, and this tissue is here, as elsewhere, very liable to inflammation, suppuration, or ulceration.

On the surface, the openings of crypts or recesses may be seen. The crypts are sometimes filled with retained mucous secretion, epithelium, or even calcareous concretions.

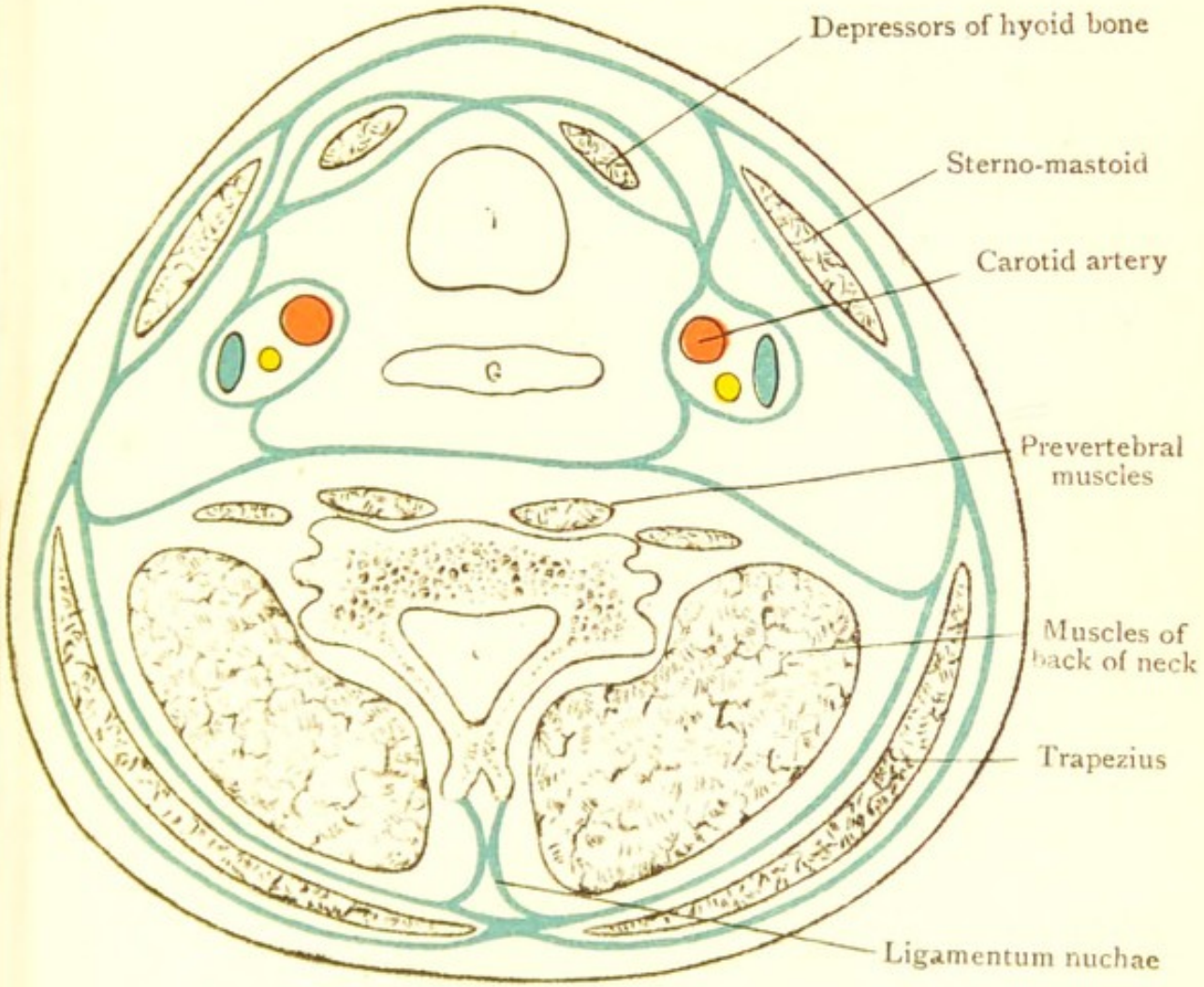
When the tonsil is enlarged or inflamed, as in quinsey, it projects inwards, causing great interference with deglutition; and if both are enlarged, serious difficulty of breathing may be present.

The Tongue and Floor of the Mouth.—The tongue consists mainly of muscular tissue, with a median fibrous raphé separating its two halves. This raphé is attached posteriorly to the hyoid bone. The mucous

membrane on the dorsum of the tongue is roughened by three sets of papillæ (filiform, fungiform, and circumvallate) in its anterior two thirds; while the mucous membrane over the posterior third is smooth, and rendered irregular by masses of lymphoid tissue which lie beneath it. Posteriorly, the mucous membrane is conducted to the epiglottis, forming three folds.

At the sides and tip of the tongue the mucous membrane is prolonged to the under surface of the organ. Here the membrane is smooth, and having covered a small portion of the under surface, it extends across the floor of the mouth to the inner surface of the jaw. As the mucous membrane crosses the floor of the mouth, it lies directly over several important structures (already mentioned)—viz., sub-lingual gland, deep part of sub-maxillary gland with Wharton's duct, and the lingual nerve which crosses obliquely from the inner surface of the jaw to the side of the tongue.

Beneath the tip of the tongue the mucous membrane forms a mesial fold, the *frænum linguæ*, which in some cases is abnormally short, causing the tongue to be depressed and fixed to the floor of the mouth so that it cannot be protruded beyond the teeth. This condition, known as *tongue-tie*, is relieved by division of the frænum. In performing this operation, it is important to remember the position of the ranine arteries, which lie under the tip of the tongue on each side of the frænum. For this reason the point of the scissors should be directed *downwards* and *backwards* towards the floor of the mouth, and the mucous membrane torn rather than divided. The tongue is attached to other structures by muscles in the following manner:—The genio-hyo-glossus and hyo-glossus extend



T Trachea
G Gullet
C Cervical vertebra

from the hyoid bone and jaw to the under surface of the tongue; the stylo-glossus extends to the side near the base; and the palato-glossus extends from the soft palate to the base of the tongue.

The *nerves of the tongue* are the following:—The lingual supplies the mucous membrane of the anterior two thirds; the glosso-pharyngeal, that of the posterior third; and the hypo-glossal supplies the muscles of the tongue. The only vessels of any importance found in the tongue are the lingual artery and vein.

From the above description of the connections of the tongue it will be readily understood what structures are divided in its complete removal—viz., mucous membrane, genio-hyo-glossus, hyo-glossus, stylo-glossus, palato-glossus muscles, intrinsic substance and median raphé, lingual vessels, lingual hypo-glossal and glosso-pharyngeal nerves.

The *lymphatics of the tongue* enter partly into the sub-maxillary glands, and into small lingual glands on the hyo-glossus muscle, on their way to the deep cervical glands.

The Lingual Artery.—The lingual artery, from the external carotid, passes above the great cornu of the hyoid bone to the under surface of the tongue. It passes under the digastric and stylo-hyoid muscles, disappears beneath the hyo-glossus, and lies between that muscle and the genio-hyo-glossus, one of its branches (ranine) being prolonged on the under surface of the tongue to the tip, where it lies at the side of the frænum. Care should therefore be taken in dividing the frænum in children, lest by cutting too deeply the ranine artery be divided.

Ligature of the Lingual Artery.—This is sometimes required for severe hæmorrhage from a cancerous ulcer, or as a preliminary procedure previous to removal of the tongue.

A curved incision is made above the great cornu of the hyoid bone, and prolonged towards the chin and angle of the jaw. After dividing the skin, platysma, and fascia, and turning the sub-maxillary gland upwards, a small triangle is exposed, formed by the mylo-hyoid in front, digastric behind and below, and the hypo-glossal nerve above. The floor of the triangle is formed by the hyo-glossus, and if the fibres of this muscle be divided, the artery is exposed lying beneath it.

The Lingual Nerve.—This nerve is occasionally divided, with the view of relieving the pain caused by a cancerous ulcer of the tongue.

After leaving the pterygo-maxillary region the lingual nerve crosses the inner surface of the lower jaw just behind and below the last molar tooth, and here it is merely covered by mucous membrane; it then passes obliquely across the floor of the mouth, lying immediately beneath the mucous membrane, and reaches the side of the tongue.

The nerve is divided most easily as it crosses the jaw. In this position it lies half-an-inch behind the last molar tooth, and an incision at this spot, through the mucous membrane right down to the bone, will divide the nerve.

The nerve may also be divided as it lies beneath the mucous membrane of the floor of the mouth.

THE PHARYNX.

The pharynx is a fibro-muscular bag which extends from the base of the skull to the upper aperture of the œsophagus opposite the cricoid cartilage. Opening into the cavity anteriorly are the posterior nares, mouth, and larynx; and behind the posterior nares are the openings of the Eustachian tubes.

The cavity is broader from side to side than from before backwards, and is broadest opposite the hyoid bone. The narrowest part of the pharynx is at its lowest part, opposite the cricoid cartilage, where it becomes suddenly constricted as it terminates in the œsophagus. It is here that foreign bodies are most usually found impacted and, due to the close proximity of the upper aperture of the larynx, are very likely to obstruct the breathing. This point is just within the reach of the finger from the mouth.

The *roof* of the pharynx is formed by the basilar process of the occipital and body of the sphenoid; and since this is the most common site of naso-pharyngeal polypi, it is important to notice that this part can be investigated by the finger passed up from the mouth behind the soft palate.

The *posterior wall* is in relation to the anterior surfaces of the upper five cervical vertebræ, being separated from those vertebræ by a layer of loose connective tissue in which suppuration occasionally occurs, forming a *post-pharyngeal abscess* which causes the posterior wall of the pharynx to bulge forward towards the mouth. Such suppuration is frequently due to disease of the cervical vertebræ. The anterior surfaces of these vertebræ may be investigated from the mouth.

The *lateral walls* of the pharynx are in relation to various structures, the most important being the internal carotid artery and internal jugular vein, vagus, hypo-glossal, and glosso-pharyngeal nerves. Beneath the mucous membrane of the pharynx much lymphoid tissue is found; this is mostly found opposite the soft palate, where it extends as an ill-defined band across the posterior wall. It is frequently the seat of inflammation in tubercular subjects (tubercular pharyngitis).

The Eustachian Tube.—The pharyngeal opening of the above tube lies just behind the posterior extremity of the inferior turbinated bone, and just above the soft palate. In passing an *Eustachian catheter*, the instrument is carried along the floor of the nose until its point is felt dropping over the posterior edge of the hard palate; the point is then rotated outwards through a quarter of a circle, and if pushed onward in this direction it will enter the orifice of the tube.

THE NASAL CAVITY.

The nasal cavity extends from the anterior to the posterior nares, and is divided into two fossæ by the septum.

The *anterior nares* are bounded below by the superior maxillary bones, and at the sides by the lateral cartilages.

The *posterior nares* are bounded by the body and pterygoid plates of the sphenoid, and by the palate bones, and separated in the middle line by the vomer. It should be noticed that the posterior nares may be investigated from the mouth by passing the finger

upwards behind the soft palate, and in this direction the finger can even reach the base of the skull.

The *roof* of the nasal fossæ is formed mainly by the nasal bones, cribriform plate of the ethmoid, and body of the sphenoid. The cribriform plate of the ethmoid is extremely thin, and would be readily pierced by an instrument thrust upwards through the nose, which would thus enter the under surface of the brain. The relation of these bones in the roof of the nose explains the diagnostic importance of bleeding from the nose in fractures of the base of the skull involving the anterior or middle fossæ.

The *septum* of the nose is formed mainly by the vertical plate of the ethmoid, the vomer, and triangular fibro-cartilage. It is rarely mesial, but is usually deflected more or less to one side. In front, the septum supports the nasal bones; and when the septum becomes destroyed by necrosis, as occurs occasionally in syphilis, the nasal bones tend to drop and produce flattening of the bridge of the nose.

The *outer wall* of the nose is formed by the turbinated bones, superior maxilla, palate, and internal pterygoid plate. The upper and middle turbinated bones are parts of the ethmoid, while the inferior bone is distinct. Beneath the turbinated bones are the respective *meati of the nose.*

The *superior meatus* communicates with the ethmoidal and sphenoidal sinuses.

The *middle meatus* communicates with the antrum, and with the ethmoidal and frontal sinuses, by means of a funnel-shaped tube (infundibulum). The communication with the antrum has been previously mentioned in connection with that cavity. The communication

with the frontal sinuses, by means of the infundibulum, explains the frequent concomitance of frontal headache with nasal catarrh (or head cold), the mucous membranes of the two regions being continuous through the infundibulum. Through this channel insects occasionally find their way to the frontal sinuses.

The *inferior meatus* receives, near its anterior part, the nasal duct, and catarrh may extend to that duct and interfere with the flow of tears to the nose. The proximity of the Eustachian tube to the posterior nares may account for the deafness sometimes caused by nasal catarrh. The mucous membrane over the inferior turbinated bone is very vascular.

The *floor* of the nasal cavity is formed by the palatal portions of the superior maxilla and palate bones. It is horizontal and smooth, a fact which should be remembered in passing instruments through the nose to the posterior nares.

Nasal Polypi. — Of the polypi which grow in the nasal cavity, the mucous polypi usually grow on the outer wall from one of the turbinated bones; while the fibrous polypi grow from the roof, and as the roof is formed by the base of the skull, such tumours are of very grave significance.

THE ORBITAL REGION.

The Eyelids.—In the eyelids the following layers are met with from before backwards—(1) The skin; (2) subcutaneous tissue (devoid of fat); (3) orbicularis palpebrarum; (4) a layer of condensed fibrous tissue (tarsal cartilage and tarsal ligament); (5) Meibomian

glands; and (6) conjunctiva. In the upper eyelid the levator palpebræ superioris is also found.

The subcutaneous tissue is very lax and readily becomes œdematous, and extravasated blood travels rapidly in it, as in "black eye."

The tarsal cartilages are attached to the margin of the orbit by the tarsal ligament, which thus prevents the extension of extravasated blood from the orbit to the subcutaneous tissue—as in fracture of the base of the skull involving the roof of the orbit—the blood then passes beneath the conjunctiva, and forms an important diagnostic symptom.

The Meibomian glands may be seen by everting the lids. The contents of one of these glands are occasionally retained, forming *tarsal cysts*. Close to the margin of the eyelid are the openings of other glands in relation to the follicles of the eyelashes. These are sometimes found dilated from pent-up secretion, and may inflame, forming a *stye*.

The *conjunctiva* is prolonged from the eyelid to the surface of the eyeball, forming a *cul de sac* beneath each eyelid. Internally, as the conjunctiva passes from the upper to the lower eyelid, it forms a crescentic fold, the *plica semi-lunaris*. Internal to this, between the inner extremities of the eyelids, is a reddish mass, the *caruncle*.

Lachrymal Apparatus.—This apparatus consists of (1) the lachrymal gland and its ducts, from which the tears flow to the surface of the eyeball; and (2) certain ducts along which the tears are conveyed to the nose.

The *lachrymal gland* lies behind and beneath the external angular process of the frontal bone, and is

placed across the eyeball close to the superior and external recti muscles; a small portion of the gland is prolonged beneath the upper eyelid. When the gland becomes enlarged by inflammation or a tumour, the eyeball is displaced downwards and inwards.

The *lachrymal ducts* extend from the lachrymal gland to the conjunctiva of the upper and lower eyelids, close to the outer canthus.

The *punctum lachrymale* opens in each lid on a papilla close to the inner canthus. From the puncta the *canaliculi* extend almost horizontally inwards in each eyelid to the *lachrymal sac.*

The punctum is normally directed towards, and is in contact with, the eyeball; and any cause which removes the punctum from the globe—as in contraction of the eyelids (ectropion)—interferes with the passage of tears to the lachrymal sac, they then flow on to the cheek (epiphora).

The *lachrymal sac* lies in a groove on the superior maxillary and lachrymal bones. The anterior margin of this groove may be felt with the finger. The sac is covered by the tendon of the orbicularis palpebrarum (tendo-oculi). It receives the canaliculi, and terminates below in the nasal duct.

The *nasal duct* extends from the lachrymal sac to the inferior meatus of the nose, and is formed by the lachrymal, superior maxillary, and inferior turbinated bones. The duct is directed downwards, backwards, and outwards—a direction which should be borne in mind in passing a probe along the duct.

Boundaries of the Orbit.—The *roof* is formed by the orbital plate of the frontal and lesser wing of the

sphenoid. This plate is very thin, and may be easily penetrated by instruments thrust into the orbit, the under surface of the brain being thus injured.

The *floor* is formed by the orbital plate of the superior maxillary and the malar bone. Notice that this surface forms the roof of the antrum, and growths from that sinus may thus project into the orbit.

The *inner wall* is formed mainly by the nasal process of the superior maxillary, lachrymal, and os planum of the ethmoid. Notice that the inner wall of the orbit corresponds to the outer wall of the nose, and that tumours may thus extend from one cavity to the other.

The *outer wall* is formed by the greater wing of the sphenoid and the malar bones.

Near the *apex of the orbit* are the optic foramen and sphenoidal fissure, through which inflammations or growths may extend from the orbit to the membranes of the brain or *vice versa*.

THE EAR.

The Pinna.—The *pinna* presents no characters of special surgical importance. The skin is very closely adherent to the cartilage, and it is occasionally the seat of frost-bite or erysipelas.

External Auditory Meatus.—This is a curved, partly osseous, and partly cartilaginous canal about one and a quarter inches long. It is directed forwards and inwards, and the concavity of the curve is directed downwards. If the pinna be drawn upwards and backwards, the cartilaginous portion is brought into a line with the osseous portion, and the canal is straightened. This should be done in examining the

meatus. It is narrowest about its middle, and is closed internally by the membrana tympani; and due to the obliquity of that membrane, the lower wall of the meatus is longer than the upper.

The skin of the meatus is furnished at its outer part with hair, and sebaceous and ceruminous glands; and, in connection with these glands, small abscesses, polypi, or hardened wax may be found.

Exostoses may grow from the osseous canal, and these may completely occlude the meatus.

In removing foreign bodies from the ear, care should be taken not to injure the membrana tympani.

Relations of the Meatus.—The *superior wall* is separated by a thin plate of bone from the middle fossa of the skull, and thus suppuration in the meatus may cause meningitis.

The *anterior wall* is in relation to the parotid gland, and abscesses of the parotid may thus extend to the meatus. The lower jaw also lies in front of the canal, and falls on the chin may fracture this wall. Copious bleeding may occur from such fractures, which should not be confounded with fractures of the base of the skull.

The *posterior wall* is separated by a thin scale of bone from the mastoid cells, and when suppuration occurs in these cells the pus may find its way to the auditory meatus.

MIDDLE EAR OR TYMPANUM.

The *outer wall* is formed by the *membrana tympani*. This membrane is placed obliquely, and its concavity is directed outwards. At its centre is a slight depression (umbilicus). The handle of the malleus and the chorda tympani are in

relation to its upper part. When it is necessary to pierce the membrane, this should therefore be done at its lower part.

On the *inner wall* are the promontory and fenestra rotundum and ovalis, corresponding to parts of the internal ear; and skirting the hinder part of this wall is the canal for the facial nerve. This nerve may become affected by inflammation in the tympanum.

The *roof* is formed by a thin scale of bone, which separates the tympanum from the middle fossa of the skull. Fractures of the base of the skull, involving the tympanum, are necessarily compound, due to the entrance of air to the tympanic cavity along the Eustachian tube.

The *inferior wall* is separated by a thin piece of bone from the internal carotid artery and jugular vein, and necrosis of this bone, by causing ulceration into the coats of one of these vessels, may lead to fatal hæmorrhage.

Posteriorly, the tympanum communicates with the mastoid antrum and cells, to which suppuration may extend from the ear. In trephining the mastoid process for the relief of pus, it should be borne in mind that the mastoid cells are separated from the lateral sinus merely by a thin scale of bone.

Anteriorly, the opening of the Eustachian tube is seen, through which the mucous membrane of the tympanum is continuous with that of the pharynx.

THE SCALP.

Covering the outer surface of the cranial bones are the following layers which constitute the scalp :—

(1) Skin; (2) subcutaneous tissue; (3) occipito-frontalis and its aponeurosis; (4) a layer of very loose connective tissue; (5) pericranium (or external periosteum).

The *skin* is plentifully supplied with sebaceous glands, which may, by closure of their ducts and retention of their secretion, form cystic tumours named *wens*.

The *subcutaneous tissue* is very dense, and composed of fibrous septa, which bind the skin firmly to the aponeurosis beneath. Suppuration in this tissue is usually localised, due to the dense septa present.

The *epicranial aponeurosis* forms a broad sheet to which the frontal and occipital parts of the occipito-frontalis are attached. At the sides it is prolonged on the surface of the temporal fascia as far as the zygoma.

The *connective tissue* beneath the above aponeurosis is very loose, and allows the aponeurosis to move freely on the surface of the skull. Pus or extravasated blood readily travels in this tissue between distant parts of the skull, and may find its way to the forehead, occiput, or temporal regions. This is known as the *dangerous area of the scalp*, due to the great ease with which suppuration extends in it.

The *pericranium* is not very firmly attached to the cranial bones, excepting at the sutures, where it dips in between the bones and is firmly attached. Suppuration, or extravasation of blood (cephalhæmatoma), occurring in this situation is usually limited to one bone; and though the membrane is extensively stripped from the surface of a bone, necrosis is not so apt to occur as might be imagined, as the bone is mainly nourished by the dura mater or internal periosteum.

Vessels of the Scalp.—The scalp is supplied by the following arteries:—The frontal and supra-orbital from the ophthalmic artery; the anterior and posterior branches of the temporal; and the posterior auricular and occipital arteries.

These vessels ramify in the subcutaneous tissue, and when divided they bleed very freely, as their outer coat is firmly attached to the fibrous septa already mentioned, which prevent the retraction and closure of the bleeding vessel.

BONES OF THE CRANIUM.

The cranial bones consist of two *tables*, separated by an intervening soft *diploë*, containing venous spaces. The inner layer is much more brittle than the outer; hence, it is called the *vitreous layer*.

In the frontal and mastoid regions the diploë is replaced by air sinuses; and in these regions the outer table may be fractured and driven into the air sinuses without the inner table suffering injury.

When the skull is fractured the inner table is usually more extensively fissured than the outer. This is due partly to its greater brittleness, and also to the force of the blow having become diffused over a wider area by its passage through the outer layer and the diploë, for it has been found that if a bullet be made to pass from the inside of the skull, as in shots fired through the roof of the mouth, the outer table in these cases is more widely damaged than the inner.

The thickness of the skull varies considerably, being thickest over the occipital protuberance, the mastoid process, and near the frontal sinuses; and thinnest over the squamous portion of the temporal bone.

Blood Channels on Inner Surface of the Skull.—Only those the position of which should be borne in mind in trephining need be noticed.

The *superior longitudinal sinus* extends from the root of the nose to the occipital protuberance.

The *lateral sinus* extends in an arched direction from the occipital protuberance to the inner surface of the mastoid process, and at a point one and a half inches behind, and half-an-inch above the level of the auditory meatus, it bends inwards to reach the jugular foramen.

The *middle meningeal artery* crosses the anterior inferior angle of the parietal bone, and, as it lies in a groove or canal in the bone, is occasionally torn by fissured fractures; and trephining over the site of the artery is not very uncommon. The artery lies one and a half inches behind the external angular process of the frontal, and one and three-quarter inches above the zygoma.

Position of the Motor Centres.—These lie in close relation to the fissure of Rolando.

Fissure of Rolando.—The upper end of the fissure of Rolando lies half-an-inch behind a point midway between the occipital protuberance and root of the nose. The lower end lies about two and a quarter inches behind and a quarter of an inch above the level of the external angular process of the frontal bone.

The centres for the muscles of the lower extremity lie close to the upper third of the fissure of Rolando; the centres for the upper extremity close to the middle third; and the face centres lie in relation to the lower third.

Broca's convolution or centre for speech lies a little below and in front of the lower extremity of the fissure.

ABDOMEN.

ANTERIOR ABDOMINAL WALL.

In the middle line a slight groove is seen between the recti muscles, corresponding to the *linea alba*. At the outer border of the rectus is a curved depression, *the linea semi-lunaris*. These lines are important, as they are the least vascular portions of the abdominal walls; they are therefore chosen when incisions are necessary, for the linea alba contains merely a few anastomosing twigs of very slight importance, and the linea semi-lunaris is merely traversed by the terminations of the intercostals which are about to enter the sheath of the rectus.

Occasionally the positions of the *lineæ transversæ*, or tendinous intersections in the rectus, are indicated by depressions on the surface.

The *aorta bifurcates* a little below ($\frac{3}{4}$ inch) and to the left side of the umbilicus. This corresponds to the level of the highest points of the iliac crests. Just above this point the abdominal aorta has been compressed, and its pulsations are readily felt in thin subjects.

A line drawn from the above point to the middle of Poupart's ligament, would indicate the direction of the *common and the external iliac arteries*—the upper two

inches of the line corresponding to the common iliac, and the remainder to the external iliac artery.

The *deep epigastric artery* extends, on the deep surface of the anterior abdominal wall, from the middle of Poupart's ligament towards the umbilicus and anastomoses in the sheath of the rectus, with the superior epigastric branch of the internal mammary artery.

The *deep circumflex iliac artery* lies just above the outer half of Poupart's ligament, and extends backwards close to the iliac crest; near the anterior iliac spine it gives off a large ascending branch, from which troublesome hæmorrhage may occur, if wounded during an operation in this region.

The *superficial fascia* of the abdomen is at its lower part divisible into two layers. The superficial, or fatty layer, is continued upwards towards the chest, and downwards over the thigh; but the deep or membranous layer, which is continuous with the superficial fascia of the scrotum, is intimately attached to the fascia lata of the thigh just below Poupart's ligament, and thus effectually prevents any extravasated urine, which may have passed forwards from the perineum to the front of the abdomen, from extending downwards to the thigh.

The lateral muscles of the abdomen (external and internal oblique and transversalis) terminate in front in aponeuroses, all of which share in the formation of the sheath of the rectus muscle, and at the groin form important relations to inguinal herniæ, elsewhere described. Posteriorly, the transversalis and internal oblique muscles arise in an important aponeurosis, the fascia lumborum, which must be described with the anatomy of the loins.

On the inner surface of the transversalis muscle is the fascia transversalis, which is of immense importance, as it forms one of the coverings of the spermatic cord, and of an inguinal hernia; it also enters into the formation of the femoral sheath.

THE INGUINAL CANAL.

The inguinal canal is an oblique channel which lies above the inner half of Poupart's ligament and nearly parallel with that structure. It extends from the internal to the external abdominal ring, and represents the passage made by the testicle in its descent from the abdomen to the scrotum. In the adult it contains the vas deferens and the accompanying vessels.

The *external abdominal ring* lies immediately above and external to the spine of the pubes, and may be readily felt by invaginating the skin of the scrotum in a direction upwards and outwards. The external abdominal ring is a slit in the aponeurosis of the external oblique muscle, the separated fibres forming two columns or pillars, of which the outer one corresponds to Poupart's ligament.

Passing between these pillars are transverse fibres, which are prolonged on the cord forming the intercolumnar or external spermatic fascia.

The *internal abdominal ring* lies about half-an-inch above the middle of Poupart's ligament, and is an opening in the fascia transversalis; it lies immediately external to the deep epigastric artery.

In front the canal is bounded by the aponeurosis of the external oblique, and partly by the internal oblique.

Posteriorly, are the fascia transversalis, deep epigastric artery, the conjoined tendon, and the triangular fascia. *Above*, are the lower arched fibres of the transversalis; and *below*, it is bounded by Poupart's ligament, which forms a broad floor separating the canal from the femoral vessels and sheath.

Spermatic Cord and its Coverings.—The inguinal canal contains the spermatic cord, which here derives certain coverings from the fascial layers forming the boundaries of the canal.

From the external oblique the *inter-columnar fascia* is derived, as previously mentioned; from the internal oblique the *cremaster muscle* and fascia are prolonged over the cord; and the transversalis fascia supplies the *infundibuliform fascia*. The transversalis muscle gives off no covering to the cord, as the testicle passes down *below* the lower arched fibres of that muscle.

The *spermatic cord* is composed of the vas deferens, spermatic vessels, nerves, and lymphatics, bound together by areolar tissue, and covered by the structures mentioned above. Feel the cord-like form of the vas deferens, and trace it to the testicle.

Spermatic Veins and Varicocele.—The spermatic veins are very tortuous and form a long meshed network, the *pampiniform plexus*. The veins of the right side open into the inferior vena cava, those of the left side into the left renal vein.

From their great length, dependent position, imperfect valves, and want of support, these veins are very liable to become varicose, giving rise to the condition of varicocele.

Varicocele is most common on the left side, and certain facts relating to the anatomy of the veins serve to explain this; thus the left vein enters the renal vein *at right angles*, while the vein of the right side opens obliquely into the inferior vena cava in the direction of the blood stream, the left testicle hangs lower than the right, and on the left side the vein passes beneath the sigmoid flexure, and may be compressed by its contents.

The Scrotum.—The skin of the scrotum is very extensible, and is occasionally enormously distended by scrotal herniæ or tumours. The surface is marked by *rugæ*, between which dirt or sweat may accumulate, and be the cause of considerable irritation, or even of an eczematous condition. For the same reason the skin of the scrotum is occasionally the site of epithelioma, as in chimney-sweeps (chimney-sweep's cancer)—the exciting cause being the accumulation of soot between the folds.

In tropical regions the scrotal tissues are sometimes enormously enlarged, as in the disease, elephantiasis Arabum.

It should be noticed that when the scrotum is enlarged the skin of the penis is drawn downwards with it, and in extreme cases that organ may disappear from view, as it is attached by its root to the pubis; in such cases its position may be indicated on the surface by a depression.

The scrotum is divided by a mesial septum (septum scroti); this separates the tunicæ vaginales of opposite sides.

The Testicle.—With the exception of its posterior border, the testicle is invested by the tunica vaginalis, which also covers the epididymis, and forms a small pouch (digital fossa) between the two structures. A parietal layer of the membrane lines the inner surface of the scrotum.

When fluid accumulates in the cavity of the tunica, as in hydrocele, the testicle remains at its posterior part, and is, therefore, away from the reach of the trocar.

In some cases, however, the testicle lies in the anterior part of the scrotum, having the epididymis in front and the tunica vaginalis behind it (inversion of the testicle). The position of the testicle should therefore be determined previous to tapping a hydrocele. In such cases the vas deferens lies in the *anterior* part of the spermatic cord.

Beneath the tunica vaginalis lies the *tunica albuginea*, a tough inelastic membrane which closely surrounds the testicle; its unyielding character explains the great pain felt in inflammatory conditions of the testicle.

The *epididymis* lies behind the testicle, and is only partially attached to it; at its upper part (globus major) it receives the small tubes from the testicle, and inferiorly (globus minor) it is directly continuous with the vas deferens. This continuity serves to explain how affections extending from the urethra or prostate, as gonorrhœa or tubercular disease, usually involve the epididymis; while inflammatory affections due to injury, as a rule, affect the body of the testis, which lies in front of the epididymis and is therefore more exposed.

The lymphatics of the testicle pass upwards along the spermatic cord, in company with the spermatic vessels, and enter into the lumbar glands, while the

lymphatics of the scrotal tissues pass to the inguinal glands; malignant tumours of the testicle are therefore accompanied by enlargement of the inguinal glands, only when the skin of the scrotum has become adherent to the testicle and involved in the growth.

Descent of the Testicle.—The testes, in the fœtus, lie behind the peritoneum in the lumbar region, just below the kidneys, but as development proceeds they descend through the inguinal canal to the scrotum. About the seventh month they reach the internal abdominal ring. During the eighth month they traverse the inguinal canal, and reach the scrotum towards the end of the ninth month.

From some developmental causes this descent of the testicle may be delayed or incomplete, and the testicle may be retained—within the abdomen, in the inguinal canal, or close to the external abdominal ring, but not passing into the scrotum; in some cases it, as it were, misses the scrotum and passes on to the perineum.

When the testicle lies in one of these abnormal situations it may be the source of great pain, due to its being exposed to frequent injuries from pressure. Previous to the descent of the testicle a process of peritoneum (funicular or vaginal process) passes along the inguinal canal to the scrotum, and the testicle in its descent lies behind this process. The lowest part of the funicular process forms the tunica vaginalis, which thus lies in front of the testicle, while the remaining part usually becomes obliterated and forms a fibrous cord. The history of this funicular process is important, as it explains the production of some forms of hernia and hydrocele.

When this process remains unobliterated throughout, an open channel is left between the tunica vaginalis and the general cavity of the peritoneum, and along this channel a knuckle of bowel may descend, forming a *congenital hernia;* and if fluid collect in the tunica vaginalis under such conditions, a *congenital hydrocele* is formed, the fluid being reducible into the peritoneal cavity by firm pressure or by inverting the patient. Normally, however, this funicular process becomes in part obliterated, its lowest part remaining patent as the tunica vaginalis.

This obliteration occurs—first; at the internal abdominal ring; next, at the upper part of the epididymis; and lastly, along the length of the spermatic cord. If the obliteration takes place at the upper part of the epididymis, but not at the internal abdominal ring, then the funicular part of the process is in communication with the general peritoneal cavity, and a *hernia into the funicular process* may occur; or if fluid collect in the unobliterated space, a *hydrocele of the cord* is formed.

When the obliteration occurs only at the internal abdominal ring, a coil of intestine may find its way down behind the septum of obliteration, or push the septum in front of it, and thus invaginate itself into the unobliterated portion below, and thus reach the tunica vaginalis, forming an *encysted* or *infantile hernia.*

When the closure takes place at the upper and lower points of obliteration, but remains patent over the cord, fluid may collect in this unclosed portion and form an *encysted hydrocele of the cord,* which is shut off from the peritoneal cavity and from the tunica vaginalis.

INGUINAL HERNIA.

There are two forms of hernia which leave the abdomen through the external abdominal ring. The *oblique* form traverses the whole length of the inguinal canal from the internal to the external abdominal ring. The *direct* form does not traverse the length of the canal, but pushes through its posterior wall in order to reach directly the external abdominal ring—hence its name.

It has been previously mentioned that the internal abdominal ring lies immediately *external* to the deep epigastric artery, and for this reason the oblique form is called an *external hernia;* and the direct variety, which leaves the abdomen on the inner side of the artery, is called an *internal hernia.*

If the posterior surface of the anterior abdominal wall be examined from within, a ridge of peritoneum is seen which corresponds to the deep epigastric artery, and on each side of the ridge is a depression corresponding to the points through which the two forms of hernia pass out.

The direct form of hernia passes through a space (Hesselbach's triangle) bounded by the outer border of the rectus, the deep epigastric artery, and Poupart's ligament.

Coverings of Inguinal Hernia.—The *oblique form of hernia*, as it follows the course of the spermatic cord, will receive the same coverings as that structure, in addition to the extra-peritoneal fat and peritoneum, viz.—(1) Skin and superficial fascia; (2) inter-columnar

fascia; (3) cremaster muscle and fascia; (4) infundibuliform fascia; (5) extra-peritoneal fat; (6) peritoneum, forming the "sac." The source of these coverings has been already mentioned.

The *direct form*, which, instead of traversing the length of the inguinal canal, pushes through its posterior wall—formed by the conjoined tendon and fascia transversalis, which are spread out over the hernia as coverings—and as it passes through the external abdominal ring, it is covered by the inter-columnar fascia. The coverings of this form are therefore—(1) Skin and superficial fascia; (2) inter-columnar fascia; (3) conjoined tendon; (4) fascia transversalis; (5) extra-peritoneal fat; (6) peritoneum.

It will readily be noticed that the above coverings differ from those of oblique hernia, in having the conjoined tendon and fascia transversalis instead of the cremaster muscle and infundibuliform fascia.

Femoral Hernia.—The anatomy of femoral hernia is described along with that of the fascia over Scarpa's triangle and the femoral sheath.

Peritoneum.—The parietal portion of the peritoneum varies in its thickness and adherency at different parts; thus at the linea alba it is very thin and closely adherent to the abdominal wall, a point favourable to operations on the abdominal contents through this part of the parietes.

At certain parts the peritoneum forms merely a loose covering for the subjacent structures, and is readily separable from them; thus it can be easily lifted from the iliac arteries, as in the operations of ligature of those vessels.

In general, the peritoneum is thin, and separated from the parieties only by a thin layer of delicate tissue; but in some situations, as in the lumbar regions and iliac fossæ, the peritoneum is very thick, and the extra-peritoneal tissue so increased as to form large fatty masses in which suppuration may occur as in perinephritis and perityphlitis.

While the peritoneum is normally very thin and transparent, and its vessels barely distinguishable, still, when exposed to pressure and distension, as in the sac of a hernia, it may become enormously thickened, and even laminated, and its vessels easily recognised.

The *great omentum*, or epiplöon, is attached above to the stomach, and extends downwards as far as the brim of the pelvis, forming an excellent covering and protection to the abdominal contents. From its position it is liable to be injured by penetrating wounds of the front of the abdomen, and is very apt to protrude from the wound; for the same reason, it very commonly forms one of the contents of an umbilical hernia. The great omentum hangs more to the left than to the right side, for which reason omental hernia (epiplocele) are said to be more common on the left side.

The visceral layer of the peritoneum forms a more or less complete covering for the intestines and abdominal viscera; for this reason the intestines move very freely, and are thus protected in a very marked manner from injuries; and it is found that the part of the intestine most frequently injured by blows or severe concussions is the third portion of the duodenum, which is fixed to the posterior abdominal wall and uncovered by peritoneum.

The mesentery varies in its length in different individuals, and in hernial protrusions becomes very much elongated. Occasionally small holes are found in the mesentery, through which a piece of gut may pass and become strangulated. An abnormally long mesentery tends to the production of a twist, or volvulus, of the intestine. This occurs most frequently, in fact almost exclusively, at the sigmoid flexure, which is usually furnished with a very long meso-colon.

The relations of the peritoneum to some of the abdominal and pelvic organs will be mentioned subsequently.

THE STOMACH.

The anterior surface of the stomach is in relation to the diaphragm, liver, and the anterior abdominal wall. Through that portion which lies in contact with the anterior abdominal wall, the stomach is opened in the operations of *gastrotomy* and *gastrostomy*. This uncovered area is triangular, with the base downwards. It is bounded by the edge of the liver towards the right and the costal margin towards the left, the base-line passing between the ninth costal cartilages; this base-line corresponds to the greater curvature of the stomach.

In performing the above operations, the incision is made about an inch below the left costal margin, and is sometimes made in the linea semi-lunaris; at other times the sheath of the rectus is opened, as in Howse's method.

The *pylorus* varies greatly in its position, but usually when the viscus is empty, the pylorus lies just to the right of the middle line, about three inches below the xiphi-sternal articulation. When the stomach is

distended, the pylorus moves considerably to the right. In cancer of the pylorus its position is much altered, as the organ is drawn downwards by the weight of the cancerous mass. Fortunately, this is of no practical import, as in the operation of pylorectomy the incision is made over the most prominent part of the tumour.

The Small Intestines.—With the exception of the duodenum the small intestines are completely covered by peritoneum and connected to the posterior abdominal wall by the mesentery; the intestines are thus very freely moveable and protected in a very marked manner from injury. The duodenum, however, especially its third part, differs from the rest of the small intestines in being uncovered by peritoneum and in being fixed. For this reason, this part of the duodenum is more frequently injured by concussions, or blows, than any other part of the intestine, but for similar reasons is hardly ever found as a content of a hernia.

Diverticula or *bands* are occasionally found attached to the small intestine; these may become adherent to neighbouring structures, and thus form loop-holes through which a knuckle of gut may protrude and become strangulated.

The surgical relations of the large intestine will be mentioned with the lumbar and pelvic regions.

The Posterior Abdominal Wall.—This may be said to be formed by the lumbar region of the spine and the muscles which fill in the space bounded above by the last rib, and below by the crest of the ilium. These are the psoas and quadratus lumborum, the erector spinæ and the backward prolongations of the antero-lateral muscles of the abdominal wall.

The external oblique extends backwards as far as the middle of the crest of the ilium, a small space intervening between it and the latissimus dorsi, which is usually attached further back to the crest.

This space is triangular in shape and is known as the *triangle of Petit.* The base of the triangle is formed by the iliac crest, and its floor by the internal oblique muscle. As the abdominal wall is weakened at this spot, a portion of gut may protrude, forming a *lumbar hernia;* but in well-developed subjects I have frequently seen the attachment of the latissimus and external oblique almost continuous, so that in such cases no triangle of Petit existed.

The posterior aponeurosis of the transversalis forms the *fascia lumborum*, which is attached above to the last rib and below to the crest of the ilium, while internally it divides into three laminæ, which are attached to the spines and transverse processes of the lumbar vertebræ, forming two compartments for the quadratus lumborum and erector spinæ. To the outer surface of the fascia lumborum the internal oblique and latissimus dorsi are attached, and its inner surface is covered by the fascia transversalis, which becomes continuous with the fasciæ of the psoas and iliacus; it is attached below to the iliac crest, and may thus influence the extension of abscesses in this region.

Psoas Muscle and its Fascia.—The psoas is attached to the bodies and transverse processes of the lumbar vertebræ, and its upper part is attached to the body of the last dorsal vertebra. The muscle passes beneath Poupart's ligament, and is joined by the iliacus previous to its insertion into the lesser trochanter.

The *fascia of the psoas* is attached to the bodies of the vertebræ internal to the attachment of the muscle; lower down it is attached to the brim of the pelvis. Superiorly, the fascia is continuous with the ligamentum arcuatum internum of the diaphragm; and below and externally, it is continuous with the fascia of the iliacus. Inferiorly, the fascia passes beneath Poupart's ligament and forms the posterior layer of the sheath of the femoral vessels.

Psoas Abscess.—This is usually due to caries of the bodies of the dorsal or lumbar vertebræ. When due to disease in the lumbar region, the pus immediately enters the substance of the psoas muscle. When the disease originates in the dorsal region, the pus passes beneath the ligamentum arcuatum internum of the diaphragm, and thus reaches the abdomen and enters the sheath of the psoas. The pus then burrows downwards and destroys the psoas extensively, but is prevented from extending into the pelvis by the attachment of the fascia to the pelvic brim. It then extends downwards and outwards to the iliac fossa, where it forms a large fluctuating tumour beneath the iliac fascia, which is continuous with that of the psoas. The abscess may then follow the ilio-psoas and anterior crural nerve beneath Poupart's ligament, lying to the outer side of the femoral vessels, and it then usually extends inwards, beneath the vessels, to the inner side of the thigh by following the course of the profunda artery.

"A psoas abscess, when fully developed, usually consists of four parts—a narrow track in the upper part of the psoas muscle, a wide expansion in the iliac

fossa, a second narrow part extending beneath Poupart's ligament and the femoral vessels, and a large cavity on the inner side of the thigh." (Erichsen.)

The Colon.—The ascending and descending portions of the colon closely resemble each other in their relations. Each lies on the surface of the quadratus lumborum muscle, corresponding to a line drawn vertically upwards from a point half-an-inch behind the mid-point of the crest of the ilium. The anterior and lateral surfaces are covered by peritoneum, but the posterior surface is usually uncovered and is separated from the quadratus lumborum by some connective tissue. In some cases the peritoneum forms a complete covering for the colon, this being more common on the right side, the ascending colon in such cases possessing a meso-colon.

Colotomy.—The colon is most frequently opened on the left side in the lumbar region (Amussat's operation). The operation is performed preferably on the left side, because the descending colon is nearer the anus, has a larger non-peritoneal surface, and is more fixed than the ascending colon. Moreover, strictures are more common in the rectum, or sigmoid flexure, than in any other part of the large intestine. In the operation of colotomy the following structures are divided:—Integuments and fascia, latissimus dorsi and external oblique, internal oblique, transversalis, fascia lumborum, and fascia transversalis. Occasionally some fibres of the quadratus are divided. It is well to remember that the large intestine is distinguished from the small by its sacculated walls, its three longitudinal muscular bands, and appendices epiploicæ.

THE KIDNEYS.

The more important relations of the kidneys will be evident from the subjoined table:—

IN FRONT.

Left.	*Right.*
Colon.	Colon.
Pancreas.	Liver.
Stomach.	Duodenum.
Peritoneum.	Peritoneum.

BEHIND.

Left.	*Right.*
Crus of diaphragm.	Crus of diaphragm.
Psoas.	Psoas.
Quadratus lumborum.	Quadratus lumborum.
Eleventh and twelfth ribs.	Twelfth rib.

It will be noticed that the left kidney is on a higher level than the right, and extends to the upper border of the eleventh rib. The lower border of each kidney is separated by a slight interval from the iliac crest, this interval being greater on the left side.

The kidney receives only a slight covering of peritoneum—viz., on a part of its anterior surface and its outer border. The posterior surface of the gland can therefore be reached without injuring the peritoneum.

In some cases, however, the kidney is completely covered by peritoneum, and is then freely moveable, forming a *floating kidney*.

The kidney is surrounded by a quantity of loose fat, in which suppuration may occur, forming a *perinephritic abscess*.

In operations on the kidney, as evacuation of pus, removal of stone, and removal of the kidney, the structures divided are closely similar to those cut in lumbar colotomy, *q.v.*

THE ILIAC ARTERIES.

Common Iliac Artery.—The aorta bifurcates into the common iliac arteries a little to the left of the middle line opposite the body of the fourth lumbar vertebra, this being on a level with the highest points of the iliac crests.

The artery extends as far as the lumbo-sacral articulation, where it divides into the internal and external iliac vessels. The line of the artery has been elsewhere indicated (page 79).

In front of each artery are the intestines and peritoneum, and the ureter crosses the vessel near its bifurcation. The left artery is crossed in addition by the sigmoid flexure of the colon, and by the inferior mesenteric vessels. The left vein lies to the inner side of the left artery, and then passes beneath the right artery to join the right vein, so as to form the inferior vena cava. On the right side the vein lies first beneath, and then to the outer side of the artery.

Ligature of Common Iliac Artery.—The vessel is reached by a curved incision, from a point one inch above and external to the middle of Poupart's ligament to a point two inches above and internal to the anterior superior iliac spine. The muscular layers of the abdomen (external oblique, internal oblique, and transversalis) and the fascia transversalis are divided,

and the peritoneum is carefully stripped from the iliac fossa until the external iliac artery is reached. This is then used as a guide to the common trunk. The ureter adheres closely to the peritoneum, and being lifted up with that membrane is rarely seen.

Collateral Circulation.—After ligature of the common iliac the blood reaches the lower extremity and pelvis by the anastomoses of (1) the internal mammary of the subclavian with the deep epigastric of the external iliac; (2) the ilio-lumbar and deep circumflex iliac arteries with the lower intercostal and lumbar arteries; and (3) the lateral sacral of the internal iliac with the middle sacral of the aorta.

Internal Iliac Artery.—The internal iliac artery extends from the lumbo-sacral articulation to the upper part of the sacro-sciatic notch. It is covered in front by the peritoneum, and is crossed by the ureter. Behind, are the internal iliac vein, and parts of the pyriformis and sacral plexus.

Ligature of Internal Iliac Artery.—The vessel is reached by steps exactly similar to those required for ligature of the common iliac, and when the vessel is reached it should be remembered that the external and internal iliac veins are in close relation to it, the former being to its outer side, the latter behind it.

External Iliac Artery.—This artery extends from the lumbo-sacral articulation to Poupart's ligament. Its direction and relations to the abdominal wall have been previously mentioned (page 79). In its course it runs along the brim of the pelvis, and it frequently dips into the pelvis with a considerable curve.

It is covered by peritoneum and a process of fascia, and is crossed by the spermatic vessels and the genital branch of the genito-crural nerve, and, near its termination, by the deep circumflex iliac vein. It rests mostly against the psoas muscle. The veins differ in their relations to the artery. On the left side the vein is internal to the artery throughout, but on the right side the vein passes behind the artery at its upper part.

The only branches given off from the external iliac artery are the deep epigastric and circumflex iliac arteries, and as these are given off close to the termination of the vessel, it is free from vessels in almost its entire length—a fact of great importance relating to the prognosis of ligature of the artery.

Ligature of External Iliac Artery.—The artery is reached by an incision about an inch above the outer half of Poupart's ligament. The external oblique, internal oblique, and transversalis muscles are divided; the fascia transversalis is then divided, the peritoneum stripped off the artery, and the thin layer of fascia which covers it scraped through.

Collateral Circulation.—The main channels of anastomoses are the following:—

1. Deep epigastric with internal mammary.
2. Deep circumflex iliac with ilio-lumbar.
3. Gluteal, sciatic, and obturator branches of the internal iliac artery with the internal and external circumflex branches of the profunda femoris.

THE PELVIS.

BONES OF THE PELVIS.

The deformities of the pelvis produced by rickets and osteo-malacea need not be mentioned here.

As a consequence of blows or crushes, fractures or dislocations of the pelvis may occur.

Fractures of the Pelvis.—The pelvis may give way through the rami of the pubis and ischium, where the circle is weakened by the thyroid foramen; and along with this some injury may occur at or near the sacro-iliac synchondroses. The ilium may be broken through, or portions of the crest may be chipped off.

In fractures of the pelvis, the muscles, nerves, and vessels of the pelvic cavity may be injured or torn; and fractures of the pubes or ischium may cause injury to the bladder or urethra.

Dislocation of the bones of the pelvis may occur at the pubic symphysis or sacro-iliac synchondroses; or a displacement of the coccyx may occur—either forwards by falls, or backwards during parturition.

THE PELVIC FLOOR.

The cavity of the pelvis is separated from the structures in the perineum and ischio-rectal fossæ by certain layers which constitute the pelvic floor. These

are, from above downwards—(1) Peritoneum; (2) extra-peritoneal fat; (3) pelvic fascia; (4) muscles (levatores ani and coccygei); and (5) triangular ligament. With the exception of the peritoneum and extra-peritoneal fat, these structures which form the pelvic floor are intimately attached to the pelvic viscera.

THE PELVIC FASCIA.

The pelvic fascia is attached to the brim of the pelvis, and is continued downwards on the surface of the obturator internus muscle; posteriorly it covers the pyriformis and sacral plexus of nerves.

Opposite a line extending from the lower part of the symphysis pubis to the spine of the ischium (white line) the fascia gives off a *visceral layer*, which is prolonged inwards to join the pelvic viscera and to unite with a similar layer from the opposite side.

The *parietal layer* is continued downwards on the surface of the obturator internus as far as the tuber ischii to which it is attached. This parietal or *obturator layer* forms the outer boundary of the ischio-rectal fossa.

The *visceral or recto-vesical layer*, as previously noticed, passes across the pelvis and becomes firmly attached to the viscera (bladder and rectum in the male) in such a manner as to exclude certain portions of these viscera from the pelvic cavity—viz., prostate, base of the bladder, vesiculæ seminales, and the lower three inches of the rectum.

Suppuration occurring in the extra-peritoneal tissue on the upper surface of the pelvic fascia (pelvic cellulitis) is prevented by the attachments of that fascia from finding its way into the perineum.

THE PELVIC VISCERA.

The relations of the female pelvic viscera, and the disposition of the pelvic peritoneum in the female are not mentioned here, as they are so fully described in all Gynæcological works.

THE MALE BLADDER.

The shape and relations of the bladder vary with the degree of emptiness or distension of the viscus.

When empty the bladder lies entirely in the pelvic cavity, and appears triangular in a vertical antero-posterior section, with its apex directed upwards and forwards towards the symphysis pubis, and its base downwards and backwards towards the rectum. When distended the bladder becomes pyriform or egg-shaped, and rises above the brim of the pelvis, so as to come into contact with the anterior abdominal wall.

Relations.—The *summit* is connected to the anterior abdominal wall by the urachus, which in very rare cases remains pervious; behind the attachment of the urachus, the summit is covered by peritoneum.

The *base* or *fundus* is placed against the second part of the rectum, being separated from that tube by the vesiculæ seminales and vasa deferentia, and by a process of pelvic fascia. A small portion of this surface is covered by peritoneum, but that membrane is immediately reflected on to the rectum, forming the recto-vesical pouch. The ureters reach the base of the bladder at this point. Through that portion of the base which is uncovered by peritoneum, and in direct

contact with the rectum, the bladder may be tapped *per rectum.*

The *inferior or pubic surface* is uncovered by peritoneum, and, when the viscus is empty, is in relation with the back of the pubis, its lower part being connected to the pubis by two bands of pelvic fascia—the pubo-prostatic or anterior true ligaments. When distended, this surface comes into contact with the anterior abdominal wall; and as the peritoneum is raised from that wall during distension of the viscus, the bladder may be punctured or opened in this situation without injuring that membrane.

The *sides* of the bladder are crossed by the obliterated hypo-gastric arteries and the vasa deferentia. Above the obliterated hypo-gastric artery the side is covered by peritoneum; but below it is uncovered and joined by the recto-vesical fascia, which forms the lateral true ligaments of the bladder.

The *neck* of the bladder, from which the urethra is given off, lies in front of the base, and is directed towards the prostate.

Parts of the Bladder uncovered by Peritoneum.—From what has been mentioned as to the relations of the bladder, it will be noticed that the parts not covered by peritoneum are the pubic surface, part of the lateral surfaces, and the part of the base which rests against the rectum.

In the child the bladder lies mainly in the abdomen, and is pear-shaped, with its narrowest part below and directed into the pelvis, which in the child is of very small dimensions, and does not allow of a base being formed in the child's bladder.

Structure of the Bladder.— The *serous coat* is incomplete.

The *muscular coat* consists of fibres which interlace in all directions; many of the fibres are longitudinal; these constitute the *detrusor vesicæ.* Many fibres are circular, and these are greatly increased in number around the neck of the bladder, so as to form the *sphincter vesicæ.*

When there is any obstruction to the outflow of urine, these interlacing fibres, while attempting to empty the bladder, become thicker and better developed, giving rise to the appearance known as *fasciculated bladder;* and if the bladder be over-distended, the mucus membrane tends to bulge outwards between the bundles, and form small or large sacculi—thus constituting a *sacculated bladder;* in these sacculi *encysted calculi* may be developed.

The *mucous membrane* of the bladder is attached to the muscular layer by means of a sub-mucous coat. This attachment is loose over the greater part of the bladder, and allows the membrane to be thrown into folds when the viscus is empty. At the base of the bladder, however, the mucous membrane is closely adherent to the muscular coat, and always remains smooth. This surface forms the *trigone* of the bladder, the boundaries of which are formed by lines drawn between the orifices of the ureters and urethra. The trigone corresponds to the surface already mentioned, through which the bladder may be punctured per rectum. At the urethral orifice is a small elevation, the *uvula vesicæ*, having behind it a shallow depression, which is well marked when the prostate is enlarged; in this a calculus may be lodged.

THE PROSTATE GLAND.

The prostate lies between the symphysis pubis and the bend of the rectum at the junction of its second and third parts, against which the posterior surface of the gland rests. It lies about half-an-inch below and behind the pubis, and one and a half inches from the anus.

The prostate can easily be felt by the finger passed into the rectum, and directed towards the pubis.

The close proximity of the prostate to the rectum explains the intense pain experienced during defæcation by patients suffering from prostatitis.

The prostate gland is invested by a sheath of pelvic fascia; the disposition of this, and the relative thickness of its different parts, explain the course taken by a *prostatic abscess.*

An *abscess in the prostate* is most likely to open into the urethra; failing this, it may open into the rectum, which, as previously mentioned, lies in close contact with the prostate, and separated merely by a thin layer of fascia. In some cases it travels into the perineum, but is prevented by the pelvic fascia from opening into the pelvis.

Relations. — The *base* embraces the neck of the bladder, and posteriorly is marked by a cleft which separates the two lobes. Between the base and the bladder the ejaculatory ducts pierce the prostate.

The *apex* is directed towards the triangular ligament.

The *anterior or pubic surface* is connected to the pubis by the pubo-prostatic ligaments.

The *posterior surface*, as previously stated, is in contact with the bend between the second and third portions of the rectum.

The *lateral surfaces* are covered by the anterior fibres of the levatores ani muscles (levator prostatæ). The prostatic plexus of veins encircle the gland.

The prostatic portion of the urethra will be described with that canal.

Lobes of the Prostate Gland. — The prostate is usually described as consisting of three lobes; two are *lateral*, and meet behind in the posterior notch— these are continuous in front, forming the anterior wall of the urethra.

The *middle lobe* is normally smaller than the lateral lobes, and fits in between the two, having the bladder above and the urethra in front; it is not distinguishable on the outer surface of the gland.

When enlarged and prominent the middle lobe corresponds to the elevation at the neck of the bladder— the uvula vesicæ. Enlargement of the middle lobe is a frequent cause of obstruction to the passage of urine, and by its enlargement the prostatic urethra becomes greatly curved, the curvature being more or less angular with its concavity forwards; so that the catheter used in such cases has to be more curved than an ordinary one, or elbowed, so that during its introduction the point of the catheter is tilted forwards in order to escape the enlarged middle lobe.

Enlargement of one of the lateral lobes causes a deviation of the urethra to one or other side; and enlargement of both lateral lobes converts the prostatic urethra into a chink-like slit.

THE MALE URETHRA.

The urethra is about eight and a half inches long, the prostatic portion being one and a quarter inches, the membranous portion three-quarters of an inch, and the remainder, or spongy portion, six and a half inches.

The *prostatic portion* is the widest part of the urethra, and being widest at its middle it is fusiform on longitudinal section. On transverse section it is curved, or horse-shoe-shaped, due to a projection on its floor.

On the floor of the prostatic urethra is a projection, the *veru-montanum*, or *caput gallinaginis*, and at the anterior part of this there is a depression, the *sinus pocularis* or *utricle*, within which the common ejaculatory ducts open.

On each side of the veru-montanum is a groove, the *prostatic sinus*, into which the prostatic ducts open.

The prostatic portion is more dilatable than any other part of the urethra, and this dilatability of the prostatic urethra is of service in median lithotomy.

The *membranous portion* extends from the apex of the prostate to the triangular ligament. It is the narrowest part of the urethra, and is surrounded by the compressor urethræ muscle.

The *spongy portion* is that which lies in front of the triangular ligament. It includes the remainder of the canal, and is enclosed in the corpus spongiosum. It varies in its calibre at its different parts, being dilated posteriorly, forming the *bulbous portion;* and also near the meatus, forming the *fossa navicularis*. On transverse section the canal forms a transverse slit, excepting in the glans where the slit is vertical.

The *mucous membrane of the urethra* is beset with small mucous glands, known as the *glands of Littré*, and larger follicles called *lacunæ*.

The openings of these recesses are turned forwards, and they lie mostly on the floor of the urethra, especially in the bulbous portion. One large recess, however, the *lacuna magna*, lies in the roof of the fossa navicularis. This lacuna should be avoided in passing a catheter.

The ducts of Cowper's glands open into the bulbous portion.

Muscular Tissue of the Urethra. — Outside the mucous membrane of the urethra, as shown by Hancock and Kölliker, is a layer of muscular tissue, which is most abundant in the membranous portion. From some local or reflex irritation, this tissue may undergo contraction, causing a *spasmodic stricture*.

The narrowest part of the urethra is at the meatus. Consequently, if an instrument enter into the meatus it should, in the absence of a stricture, readily pass into the bladder. The next narrowest part is the membranous portion, while the bulbous and prostatic portions are somewhat dilated.

Organic strictures occur most frequently in the spongy portion, just in front of the triangular ligament. It is well to notice that in the erect posture this part is dependent, and forms a "well" between the spongy and membranous portions in which discharges may accumulate and cause irritation. Organic strictures are occasionally found near the meatus, but never in the prostatic portion. In the membranous portion organic stricture is extremely rare, and when present, is almost invariably of traumatic origin.

THE RECTUM.

The rectum extends from the left sacro-iliac articulation to the anus. At first it is directed obliquely downwards, and from left to right, so as to gain the middle of the sacrum. It is then continued downwards and forwards in the middle line as far as the tip of the coccyx, where it bends downwards and backwards towards the anus. This bend, which is formed at the junction of the second and third portions of the rectum, lies immediately behind the prostate. Above this bend the rectum is in relation to the base of the bladder in the male, and in the female is in contact with the vagina and cervix uteri.

If the finger be passed into the rectum in the male, and directed upwards towards the pubis, the prostate is readily felt, and abscesses or enlargements of the gland detected. If the finger be directed slightly backwards behind the prostate, the base of the bladder is felt, and the detection or dislodgement of a vesical calculus is facilitated.

By slipping the finger downwards and forwards, below the prostate, it is brought into relation with the membranous portion of the urethra, and in this position it may assist in the passage of a catheter into the bladder in cases of difficulty.

That portion of the rectum, which is in contact anteriorly with the bladder, rests directly against the sacrum and coccyx; and I have recently seen the lower part of the sacrum removed in order to enable the Surgeon to reach a tumour of this part of the gut.

Relations of the Rectum to Peritoneum. — The upper portion of the rectum is completely invested by peritoneum, but in its second part it is gradually uncovered—the peritoneum leaving it first on its posterior aspect, then at the sides, and lastly anteriorly, to be reflected on to the fundus of the bladder, forming the recto-vesical pouch. In the female it is reflected on to the vagina and uterus, forming the recto-vaginal pouch, or pouch of Douglas.

The distance of the recto-vesical pouch from the anus is about two and a half inches if the bladder is empty, and about an additional inch when it is distended (Cripps). In the female the distance of the recto-vaginal pouch from the anus is a little greater.

In the male the peritoneum descends to about an inch or more from the prostate—a point which should be remembered in the operation of excision of the rectum, lest the peritoneum be wounded — a very serious though not necessarily fatal accident. This is most likely to happen in removing the anterior wall of the rectum, as the peritoneum descends lower on the anterior than on the posterior wall of the gut.

Lumen of the Rectum.—At its upper part the lumen of the rectum is rather smaller than that of the sigmoid flexure, but a little above the anus, where the rectum lies in front of the lower part of the sacrum, the tube becomes greatly dilated, and in this *ampulla* considerable fæcal accumulations may lodge.

Near its termination at the anus, the rectum forms, for an inch or so, merely a potential channel capable of dilatation during defæcation. This is called by Symington the *anal canal*.

Mucous Membrane of the Rectum.—The mucous membrane of the rectum is very lax and thrown into numerous folds, which are for the most part effaced by distension of the gut.

Near the anus these folds are longitudinal, and appear to be due to contraction of the sphincter muscles.

Higher up transverse or oblique folds are found, which have been described by Houston. The lowest of these projects from the upper and fore part of the rectum near the prostate, and this may impede the introduction of instruments into the rectum.

VEINS OF THE RECTUM.

Hæmorrhoids.—The veins of the rectum are peculiar in their arrangement, and show a marked predisposition to the development of a varicose condition.

Near the anus the veins lie in a loose areolar tissue between the muscular layer and the muco-cutaneous surface, and here they form a close plexus of tortuous vessels in which transverse branches are of large size.

In this, as in all other similar plexuses, there is a tendency for the blood to circulate slowly; and this tendency is increased by the dependent position of the part and by the absence of valves in the veins above—viz., superior hæmorrhoidal and portal system of veins—so that the whole length of the portal system may exert a pressure on the hæmorrhoidal veins, and any congestion in that system due to hepatic or to intestinal causes must interfere with the circulation in these terminal radicles.

It has been mentioned that the dilated or ampullary portion of the rectum is frequently distended with

fæcal contents. This distension of the walls of the rectum materially retards the flow in the veins, and thus favours the production of varicosity; while the very act of defæcation would, under such conditions, seem to produce a backward flow in the veins towards the very verge of the anus; and the veins, being unsupported on their mucous surfaces, would bulge towards the lumen of the gut. Some of the veins of the rectum convey blood into the systemic veins through the pudic and internal iliac veins. This communication may serve to minimise some of the tendencies mentioned above; though by some it is regarded as favouring varicosity.

MALFORMATIONS OF THE RECTUM AND ANUS.

The anus may be completely absent, with the rectum terminating in a kind of *cul-de-sac*, or the anus may be merely closed by a thin septum. In some cases the anus is normal, but the rectum is occluded by a membranous septum about an inch above the anal aperture. Sometimes the anus is perfectly formed while the rectum is absent, or both rectum and anus may be entirely wanting.

In rare cases the anus is absent, and the rectum opens into a neighbouring canal, bladder, urethra, or vagina.

These anomalous cases are easily explained by referring to the development of the rectum and anus. The anus is formed by an invagination of the epiblast which meets the downward growing gut—the intervening septum being gradually absorbed. At first, the rectum communicates with the uro-genital sinus, but is afterwards separated by a septum. A failure of any of these processes will account for the above abnormalities.

ISCHIO-RECTAL FOSSÆ.

The ischio-rectal fossæ lie one on each side of the rectum, between it and the ischium.

Each fossa is somewhat wedge-shaped with its apex upwards, and is bounded *externally* by the obturator internus muscle with the parietal layer of pelvic fascia, which is prolonged downwards to the tuber ischii, and in which the pudic vessels and nerves are contained.

Internally, it is bounded by the levator ani and anal fascia, which, if traced upwards, are found to become attached to the outer wall at the apex of the space, the fossa being thus shut off from the cavity of the pelvis.

In *front* are the transversus perinei muscle and the posterior border of the triangular ligament; and *posteriorly* the space is limited by the gluteus maximus and the great sacro-sciatic ligament.

Inferiorly, the space is closed in by the integument. The fossa is filled up by loose fat, and is crossed by the inferior hæmorrhoidal vessels and nerves, which pass inwards to the rectum.

Ischio-Rectal Abscess.—Abscess formation in the ischio-rectal fossa is not uncommon, and when it occurs is very apt to burrow deeply in the loose fat of the space. Such an abscess may burst in one or in two directions—thus, it may discharge itself through the skin or into the rectum, or in both ways.

If the abscess burst through the skin only, a *blind external fistula* is formed. If it open into the bowel only, a *blind internal fistula* is formed. If it open

in both directions, leaving a channel from the surface of the skin into the rectum, it then forms a *complete fistula in ano*.

The internal opening of a fistula is usually situated just above the sphincter muscle—*i.e.*, within an inch of the anus—as the abscess is prevented by the levator ani from opening into the rectum at a higher level; and the pus finds its way to the mucous surface by burrowing between the levator ani and the sphincter—*i.e.*, in those cases of fistula due to ischio-rectal abscess.

ANTERIOR PART OF MALE PERINEUM.

The posterior part of the perineum includes the anus and ischio-rectal fossæ. The anterior part consists of a triangle, bounded behind by a line drawn between the ischial tuberosities, and having its apex at the pubic symphysis.

The most important structure in this triangle is the bulbous portion of the urethra, which lies here on the anterior or superficial surface of the triangular ligament. The more important structures met with in the anterior part of the perineum are here named in their order, from the skin towards the pelvic cavity:—

Superficial fascia, two layers.

Bulb, with superficial perineal muscles (accelerator urinæ, erector penis, and transversus perinei).

Triangular ligament (anterior layer).

Membranous part of urethra, with the compressor urethræ muscle, pudic artery, and Cowper's glands.

Posterior layer of triangular ligament (consisting of pelvic fascia), levator ani, and capsule of prostate.

SUPERFICIAL PERINEAL FASCIA.

This consists of two layers, of which the superficial layer is unimportant.

The *deep layer* or *fascia of Colles* has certain definite and important attachments. Posteriorly, it winds round the transversus perinei to be attached to the posterior border of the triangular ligament. At the sides it is attached to the rami of the pubes and ischium. In front, this fascia is continuous with the dartos tissue of the scrotum and the subcutaneous tissue of the root of the penis and anterior abdominal wall. It will thus be understood how urine, extravasated beneath this fascia, is prevented from passing backwards and reaching the ischio-rectal fossæ by the attachment of the fascia to the posterior border of the triangular ligament. It is prevented from passing down the inner side of the thigh by the attachment of fascia to the rami of the pubes and ischium. It therefore travels forwards through the subcutaneous tissue of the scrotum and penis to the anterior abdominal wall, and is moreover prevented from passing down on to the front of the thigh by the attachment of the superficial fascia to the fascia lata, just below Poupart's ligament.

THE TRIANGULAR LIGAMENT.

The triangular ligament consists of two layers, which enclose between them an aponeurotic space, through which the membranous portion of the urethra passes.

The *anterior layer of the triangular ligament* is a firm, tough membrane, having its *apex* directed upwards and forwards to be attached to the sub-pubic ligament.

Its *sides* are attached to the rami of the pubes and ischium, and *its base* is directed backwards towards the rectum. To its base the deep layer of the superficial fascia and the posterior layer of the triangular ligament are attached.

About an inch below the pubis the triangular ligament is pierced by the urethra, and between the urethra and the pubis the dorsal vein passes through so as to reach the prostatic plexus. On each side of the dorsal vein the dorsal artery and nerve pierce the ligament.

The *posterior layer of the triangular ligament* is derived from the pelvic fascia, and is attached to the posterior margin of the anterior layer, thus enclosing an aponeurotic space, through which, as previously mentioned, the membranous urethra passes. In this space are also contained the pudic artery and nerve, Cowper's glands, the dorsal vein of the penis, and the compressor urethræ.

EXTRAVASATION OF URINE.

Extravasation of urine is usually due to rupture of the dilated portion of the urethra behind a stricture, though in some cases it is due to a peri-urethral abscess opening into the urethra, and the subsequent escape of urine into the abscess cavity.

Extravasation of urine may occur in one of three situations—behind the triangular ligament, between its layers, or in front of the ligament.

Extravasation *behind the triangular ligament* is very rare. When it occurs the urine finds its way towards the base of the bladder and rectum, and if not rapidly fatal may follow the rectum to the posterior part of the perineum.

Extravasation *between the layers of the triangular ligament*, due to rupture of the membranous urethra, is the most common form. Here the urine is at first confined between the layers of the ligament, but afterwards finds its way through the anterior layer, where it is perforated by the urethra, and thus reaches the pouch bounded superficially by the deep layer of the superficial fascia, and follows the course taken by urine extravasated into that space, in front of the triangular ligament.

Extravasation *in front of the triangular ligament* has been previously described (page 114). The urine is prevented from passing into the ischio-rectal fossæ, and down the thigh, by the attachments of the deep layer of the superficial fascia. It therefore extends forwards beneath the superficial fascia of the scrotum and penis to the front of the abdomen.

LITHOTOMY.

Lateral Lithotomy.—In the first incision, which commences about one and a half inches in front of the anus, and extends to a point a third nearer the ischial tuberosity than the anus, the following are the more important structures divided:—Skin, superficial fascia, transversus perinei muscle and artery, superficial perineal artery, posterior border of the triangular ligament, and inferior hæmorrhoidal vessels.

As the knife is passed along the groove in the staff into the bladder the following structures are divided:—Membranous urethra, compressor urethræ muscle, the posterior layer of the triangular ligament, left lobe of the prostate, and the prostatic urethra.

ACCIDENTS THAT MAY OCCUR DURING LATERAL LITHOTOMY.

1. Hæmorrhage.—This may occur from the superficial vessels above named, from the *artery to the bulb* or *pudic artery*, or from the *prostatic plexus of veins*. The artery to the bulb may be injured if the incision be commenced too far forwards, or if its distribution be abnormal. The *pudic artery* lies under cover of the ramus of the ischium, and can hardly be wounded unless the knife be lateralised too much.

2. Wound of the Bulb.—The *bulb* is small in children, but in adults, and especially in old age, it becomes enlarged, and in many cases overlaps the membranous urethra, so that this can scarcely be opened without wounding the bulb.

3. Wound of the Rectum.—The rectum may be wounded if over-distended, or if the knife be carried too far back, or its edge turned inwards. Wound of the posterior part of the bladder and pelvic fascia is rare.

LATERAL LITHOTOMY IN CHILDREN.

In children it should be borne in mind that—(1) the bladder lies high, being rather in the abdomen than in the pelvis, so that the point of the knife has to be raised in the deep incision in order to enter the bladder; (2) the pelvis is narrower; and (3) the prostate is small and almost rudimentary, so that the deep incision has to pass into the neck of the bladder.

MEDIAN LITHOTOMY.

In median lithotomy an incision is made from a point just in front of the anus, forwards for about an inch and a half.

The parts divided are—Skin and superficial fascia, external sphincter, posterior border of the triangular ligament, membranous urethra, and compressor urethræ muscle.

It will be noticed that the parts divided differ materially from those in lateral lithotomy—as no vessels are divided, and consequently the hæmorrhage is very much less—and that the prostate is dilated by the finger, and is not supposed to be divided by the knife; but in children the prostate is so rudimentary that some laceration of the gland must occur before the finger could be introduced into the bladder.

It will readily be understood that in median lithotomy the rectum and bulb are in greater danger of being wounded than in the lateral operation.

THE LOWER EXTREMITY.

SUPERFICIAL ANATOMY OF THE GROIN AND FRONT OF THE THIGH.

The anterior superior iliac spine and the spine of the pubis, with Poupart's ligament stretching between them, should be felt.

From the spine of the pubis the finger should be passed upwards and outwards, and a depression, the external abdominal ring, will be felt. Through this opening an inguinal hernia emerges.

The opening is most easily reached by invaginating the skin of the scrotum upwards and outwards; and passing out through the aperture in the male the spermatic cord may be felt, having at its posterior part the hard cord-like vas deferens.

The relative positions of the iliac spines of opposite sides should be noticed, for though normally on the same level, in disease they are frequently found on different levels, due to a tilting of the pelvis; and this tilting may cause apparent inequalities in the lengths of the lower extremities, which should always be excluded in measuring the limbs.

The pulsations of the femoral artery may be felt below and a little internal to the middle of Poupart's ligament, and in this position the vessel may be compressed.

The great trochanter should be felt on the outer side, and its range of movement on rotating the femur carefully noticed.

Generally the head of the femur cannot be felt, but in thin subjects its movements may be recognised by extending and rotating the limb outwards. The same movements bring the lesser trochanter forwards, but excepting in thin subjects this process cannot be felt.

On the front of the thigh the quadriceps extensor forms a fleshy mass, having the rectus femoris in the middle, and the vasti on each side. The prominence formed by the vastus internus is well marked, and extends almost as far as the knee.

On the inner side of the thigh the adductors are prominent. If traced upwards, the tendon of the adductor longus may be followed to the front of the pubis; and inferiorly the tendon of the adductor magnus may be traced to the adductor tubercle on the femur. In front of this tendon the anastomotica artery runs downwards; and just above the adductor tubercle the superior internal articular artery winds round the femur. These points should be remembered in performing osteotomy of the femur by MacEwen's method.

On the outer side of the thigh the ilio-tibial band may be felt. It extends from the iliac crest to the outer tuberosity of the tibia, and into this band the gluteus maximus and tensor fasciæ femoris are inserted.

LYMPHATIC GLANDS OF THE GROIN.

The lymphatic glands in this region consist of two sets—vertical and oblique.

The *vertical* group of glands lie superficial to the femoral artery, and receive the lymphatics of the lower extremity.

The *oblique* set of glands lie below and parallel to Poupart's ligament, and receive the lymphatics from the superficial structures of the penis and scrotum, together with a few from the front of the abdomen and gluteal region.

The *lymphatic vessels* of the lower extremity form two main groups, which accompany the internal and external saphenous veins.

The above glands may become enlarged, or inflamed, due to septic absorption from the genitals or lower extremity; and it is usually pointed out that the oblique or vertical set are involved according as to whether the genitals or the extremity are the source of infection, but, due to the frequent communications between the two sets, this differentiation is not always borne out clinically.

Superficial Fascia.—In the groin the superficial fascia consists of two layers. The *superficial layer* is fatty, and frequently the starting place of fatty tumours. The *deep layer* is membranous and is firmly attached to the fascia lata just below Poupart's ligament, and thus hinders the passage of superficial collections of pus, or other fluids, from passing down the thigh from the front of the abdomen.

Fascia Lata.—The fascia lata is attached above to the pubis, Poupart's ligament, and the iliac crest. Externally, it is much thickened and forms the *ilio-tibial band.* The fascia is interrupted at the saphenous opening.

This deep fascia has a marked influence on the course of pus beneath it, and may cause an abscess to travel a long distance down the limb before reaching the surface.

THE SAPHENOUS OPENING.

This is an opening in the fascia lata just below the inner extremity of Poupart's ligament, which transmits the long saphenous vein and the lymphatics of the lower extremity. Its inner margin is thin and formed by the fascia covering the pectineus.

The outer margin is thick and sickle-shaped, and hence called the *falciform margin*, or *process of Burns*. The superior cornu of this margin is prolonged upwards, as *Hey's ligament*, to be attached to Gimbernat's ligament.

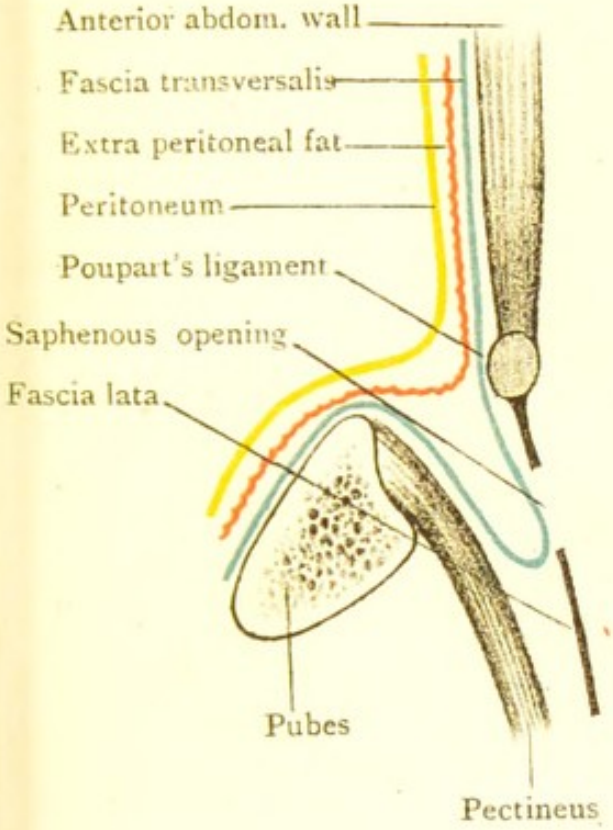
The opening is covered by the *cribriform fascia*, which is derived from the deep layer of the superficial fascia, as it stretches across the opening.

The cribriform fascia is pierced by the lymphatics and the long saphenous vein, and it forms one of the coverings of a femoral hernia, which reaches the surface through this opening.

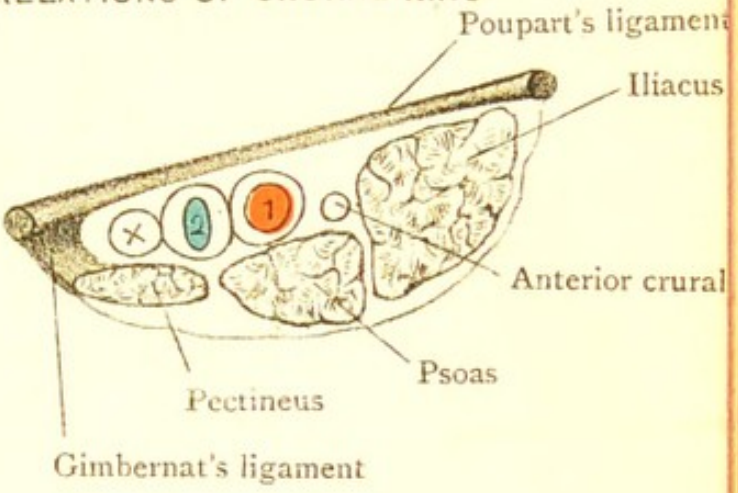
FEMORAL SHEATH.

The above sheath encloses the femoral vessels and lymphatics in Scarpa's triangle, and is formed by prolongations of the fasciæ of the abdomen on the vessels—its anterior layer being formed by the fascia transversalis, which lines the anterior abdominal wall, and its posterior layer is formed by the iliac fascia, which covers the psoas and iliacus. The sheath is

CRURAL CANAL.

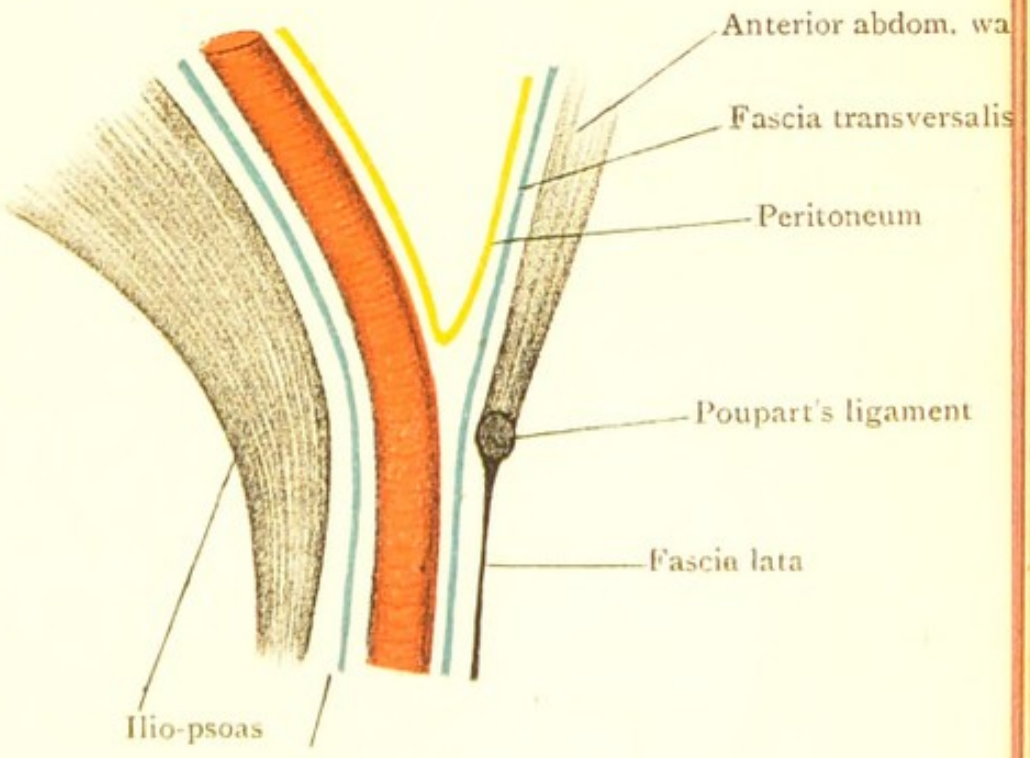


RELATIONS OF CRURAL RING



1 Femoral artery
2 Femoral vein
X Crural ring

FEMORAL SHEATH.



divided by thin septa into three compartments. The outer compartment contains the femoral artery, the middle contains the femoral vein, and the internal compartment is occupied by the lymphatics.

This inner compartment of the femoral sheath is the *crural canal*, and extends from the saphenous opening to Poupart's ligament; the upper part of this canal, as it lies beneath Poupart's ligament, being the *crural* or *femoral ring*.

Into the crural ring a small portion of the extra-peritoneal fat projects. This is the *septum crurale*, which separates the crural canal from the abdominal cavity.

CRURAL OR FEMORAL RING.

The ring lies beneath the inner extremity of Poupart's ligament, and has the following boundaries :—

In front, Poupart's ligament.
Behind, Pectineus and fascia covering it.
Internally, Gimbernat's ligament.
Externally, Femoral vein and septum of sheath.

FEMORAL HERNIA.

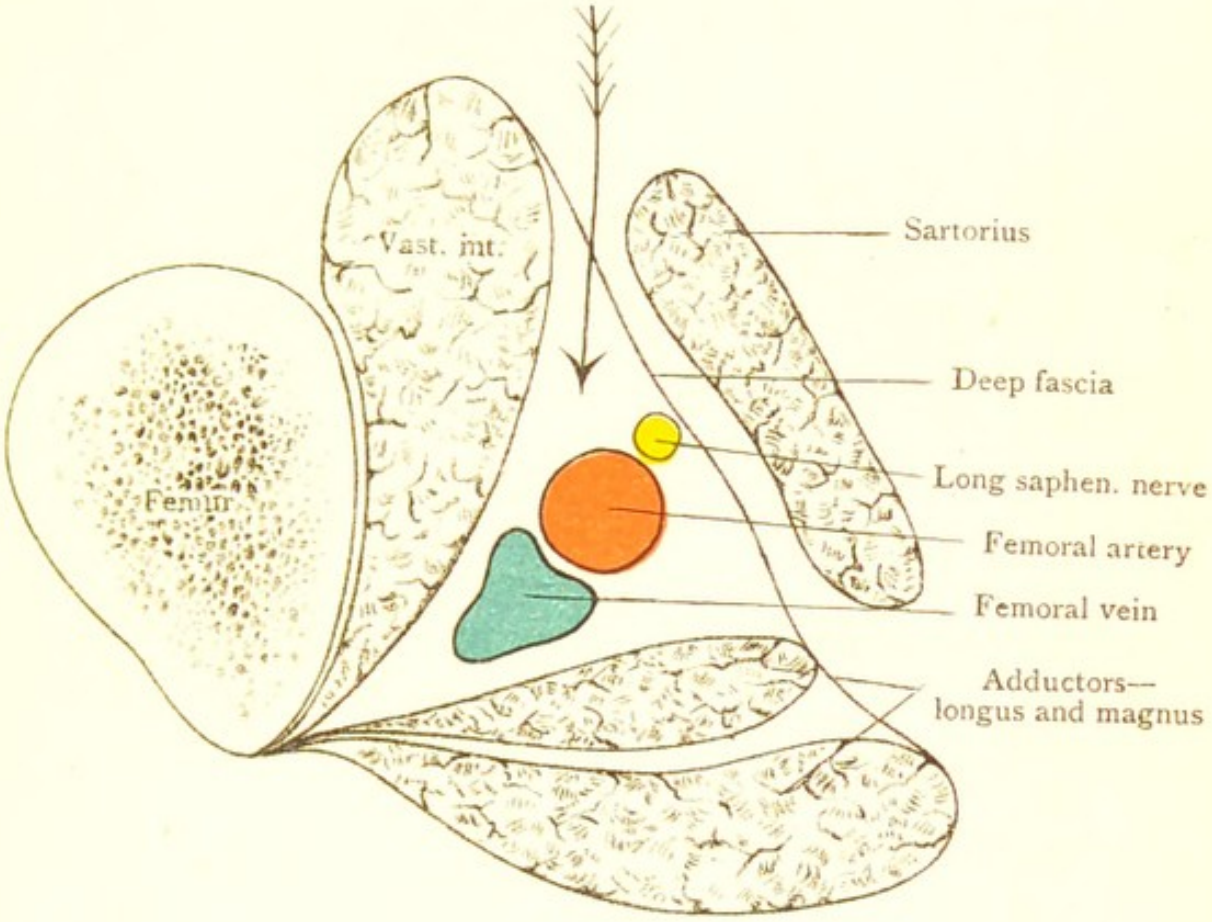
A femoral hernia projects through the femoral ring and crural canal, and reaches the surface by passing through the saphenous opening. Having reached the subcutaneous surface, a femoral hernia tends to mount up over or in a line with Poupart's ligament, where it may simulate an inguinal hernia; but the relation of the neck of the sac to Poupart's ligament is sufficient to differentiate the two forms, the neck being above in the inguinal but below in the femoral form of

hernia. The relation of the neck of the sac to the spine of the pubis (which can always be felt) is a valuable diagnostic point. The spine is to the outer side of an inguinal, but to the inner side of a femoral, hernia.

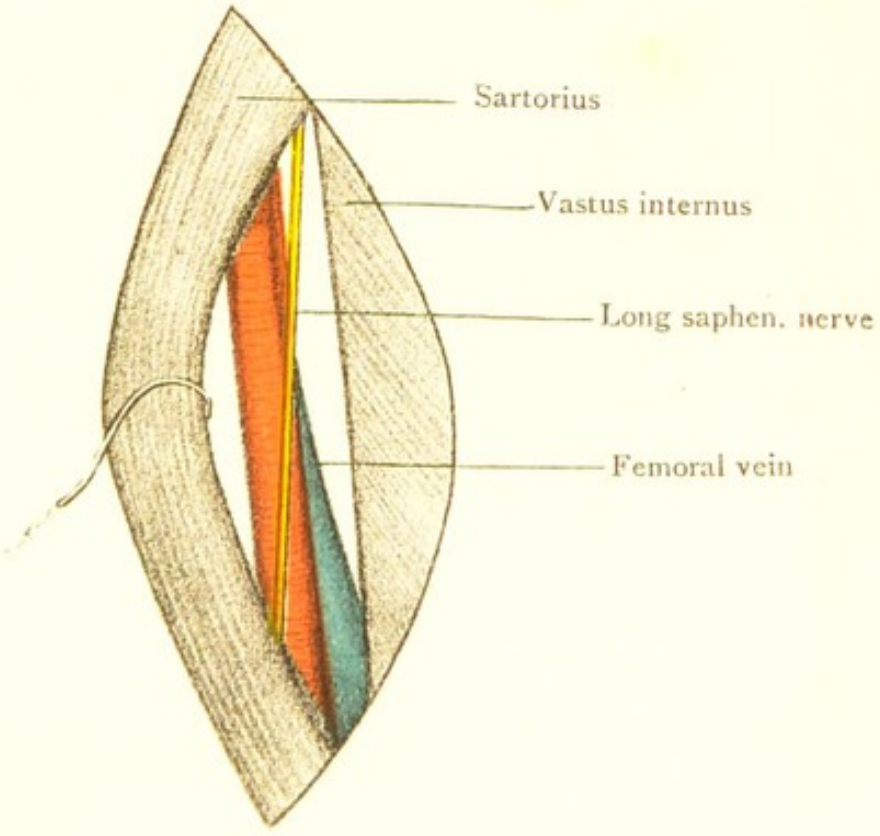
The sac of a femoral hernia, as it passes through the femoral ring, has important relations. The deep epigastric artery lies above and to its outer side. The femoral vein is separated merely by a septum of the sheath. The spermatic cord in the male, and round ligament in the female, are almost immediately over it. The obturator artery, when it comes off in the normal manner from the internal iliac artery, does not come into relation with the neck of the sac; but when it arises, as it occasionally does, from the epigastric, external iliac, or femoral arteries, it crosses inwards in close relation to the femoral ring, and may be exposed to the risk of being wounded in dividing the constriction around a strangulated femoral hernia. The stricture is usually caused by the sharp edge of Gimbernat's ligament, which lies on the inner side of the crural ring, and has to be divided by incising inwards. Fortunately the abnormal obturator artery very rarely passes round the inner side of the crural ring, but dips downwards on its outer side, and is thus protected.

Coverings of a Femoral Hernia.—On its way to the surface a femoral hernia receives the following coverings:—

Peritoneum (sac of hernia).
Septum crurale } fascia propria (Cooper).
Femoral sheath }
Cribriform fascia.
Superficial fascia and skin.



FEMORAL ARTERY IN HUNTER'S CANAL.



FEMORAL ARTERY.

The femoral artery extends from Poupart's ligament to the opening in the adductor magnus, and its course may be indicated by a line drawn from a point midway between the anterior superior spine and the pubic symphysis to the inner condyle of the femur, the thigh having been previously flexed, abducted, and rotated outwards.

The artery is divided into two parts—that in Scarpa's triangle, and that in Hunter's canal.

Femoral Artery in Scarpa's Triangle.—In Scarpa's triangle the artery is superficial, and merely covered by skin and fascia.

RELATIONS.

Skin and fascia.
Superficial veins.
Internal cutaneous nerve.

Internally.
Femoral vein.

Externally.
Anterior crural nerve.

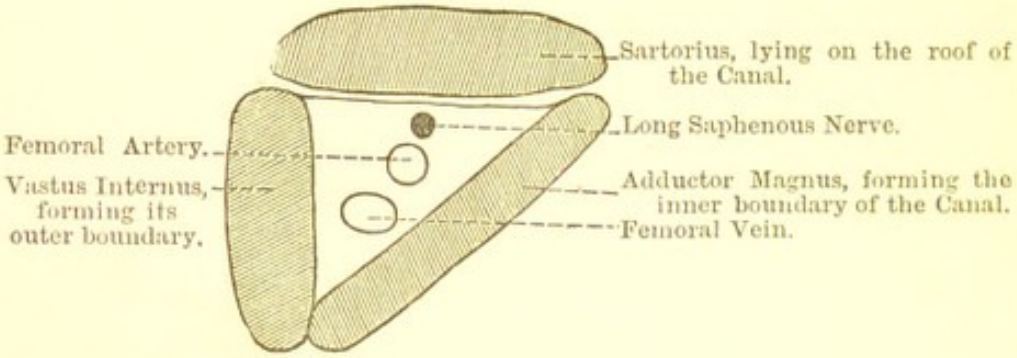
Psoas, pectineus.
Adductors longus and brevis.
Profunda artery and vein.
Femoral vein.

Femoral Artery in Hunter's Canal.—Hunter's canal is an inter-muscular space beneath the sartorius, through which the lower part of the femoral artery passes.

The canal is bounded externally by the vastus internus; internally and posteriorly by the adductors;

and is roofed over by a layer of fascia, which extends from the adductors to the vastus internus, and on which the sartorius rests.

The canal contains the femoral artery and vein, and the long saphenous nerve—the nerve being superficial to, and the vein beneath, the artery.



Branches of the Femoral Artery.—Besides a few superficial branches, the femoral artery gives off the large profunda branch, which usually arises about one and a half inches below Poupart's ligament. The part of the femoral above the origin of the profunda branch is frequently spoken of as the *common femoral.*

The *profunda artery* is given off from the outer side of the femoral artery; it then winds inwards beneath that artery, and is separated from it by the adductor longus. By means of its circumflex and perforating branches it forms a long anastomosing chain, which extends from the gluteal region to the popliteal space. This anastomosis connects the internal iliac with the popliteal artery.

The upper part of the femoral artery may be the seat of aneurism. Several causes have been mentioned as predisposing to aneurism of this vessel:—(1) Superficial position and exposure to injury; (2) proximity

to the hip joint, and its frequent movements; (3) local increase of vascular tension where the large profunda artery is given off.

Ligature of Femoral Artery.—Although the femoral artery lies quite superficially just below Poupart's ligament, it is hardly ever tied in this situation, due to the number of small branches given off from the artery itself—viz., superficial epigastric, circumflex iliac, and external pudic, and also due to the close proximity of the profunda and of the branches of the external iliac (deep epigastric and deep circumflex iliac), which would interfere with the proper plugging of the vessel by blood clot.

The vessel is tied at the apex of Scarpa's triangle or in Hunter's canal.

Ligature at the Apex of Scarpa's Triangle.—An incision is made about four inches along the line of the artery; the skin, superficial and deep fasciæ are divided. The sartorius is then turned *outwards*, and the artery exposed. The needle should be passed close to the artery, so as not to injure the vein which lies behind it.

Collateral Circulation.—(1) Descending branch of external circumflex, with superior external articular of popliteal; (2) muscular branches of profunda, with those of femoral and anastomotica magna; (3) branches of profunda, with superior muscular branches of popliteal.

Ligature in Hunter's Canal.—An incision four inches long is made through skin and fascia a finger's-breadth internal to the line of the artery. The middle of the incision should correspond to the middle of the thigh.

The sartorius is turned *inwards*, and the fascia which roofs over the canal is opened. The long saphenous nerve is turned aside, and having opened the sheath of the artery, the needle is passed close to the vessel, lest the vein which lies beneath the artery be injured.

The collateral circulation is similar to that mentioned under ligature at the apex of Scarpa's triangle.

GLUTEAL REGION AND BACK OF THIGH.

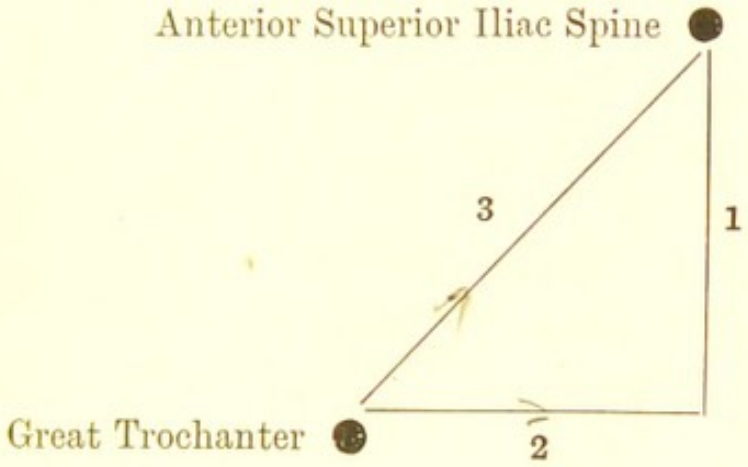
Surface Anatomy.—The crest of the ilium, the great trochanter, and the ischial tuberosity, are readily felt. Midway between the tuber ischii and great trochanter, the great sciatic nerve descends to the thigh.

The *gluteal fold* passes across the lower part of the buttock, it is most distinct in well-nourished subjects, and when the thigh is extended it is transverse in direction. Muscular atrophy and flexion of the limb are said to cause the fold to become indistinct.

A loss of the gluteal fold is considered by some to be pathognomonic of hip disease, but its disappearance in such cases is probably due to the muscular wasting and flexion which occur. Beneath the gluteus maximus are two bursæ which lie respectively over the trochanter and tuber ischii. These occasionally become enlarged or inflamed.

Nélaton's Line.—This is a line drawn from the anterior superior iliac spine to the tuber ischii. Normally, the tip of the great trochanter just touches this line; and any marked deviation of the trochanter in an upward direction is a certain sign of fracture of the neck or dislocation of the head of the femur.

Bryant's Triangle. — To form this triangle the following lines are drawn with the patient in the *recumbent* posture:—(1) Dropped vertically from the anterior superior iliac spine; (2) at right angles from the above line to the tip of the great trochanter; and (3) from the anterior superior iliac spine to the great trochanter.



2 shows any upward displacement of the femur.
3 shows any backward displacement of the femur.

Another method of determining any upward displacement of the trochanter is that of Professor Chiene. Two straight metal bars are placed across the body; one over the anterior superior iliac spines, the other opposite the trochanters. Normally, two such lines are parallel, but if one of the trochanters be on a higher level than the other, this parallelism is destroyed.

If a line be drawn from the posterior superior iliac spine to the tuber ischii it will pass over the spine of the ischium and the posterior inferior iliac spine. The upper two inches of this line will be over the sacro-iliac articulation, and pressure in this situation will cause pain in sacro-iliac disease.

The spine of the ischium lies about four inches below the posterior superior iliac spine. This corresponds to the position of the *pudic artery*, which winds round the ischial spine.

The *sciatic artery* appears in the buttock at the junction of the middle and lower thirds of the above line.

The *gluteal artery* appears at a spot opposite the junction of the inner and middle thirds of a line drawn from the anterior superior iliac spine to the great trochanter.

At the back of the thigh the fleshy mass formed by the hamstring muscles may be felt. These arise in one group from the tuber ischii, but separate below to enclose the popliteal space. The biceps may be traced to the head of the fibula; the semi-membranosus and semi-tendindosus pass to the inner tuberosity and shaft of the tibia.

GREAT SCIATIC NERVE.

This nerve appears in the buttock below the pyriformis; it extends downwards on the surface of the external rotator muscles of the hip and adductor magnus to the back of the thigh, and divides into the internal and external popliteal nerves. It is covered by the gluteus maximus and hamstring muscles. As it passes down it lies midway between the tuber ischii and great trochanter.

Nerve Stretching.—The sciatic nerve may be reached by an *incision* at the lower border of the gluteus maximus, the nerve is found in the inter-muscular interval, between the gluteus maximus and the biceps,

and is hooked up with the finger. The nerve has also been stretched by *forcibly flexing the hip* with the knee in the extended position; and it may be pointed out that if the knee be flexed and the hip extended the sciatic nerve is flaccid, while in the reverse positions, as mentioned above, the nerve is tightly stretched.

HIP JOINT.

The hip joint is of great strength, due partly to the conformation of the bones (head of femur and acetabulum), and also to the strong capsular ligament with its thickened bands. It should be noticed that the neck of the femur is almost completely enclosed within the capsule, and that the neck is covered by synovial membrane, so that after intra-capsular fractures of the neck the ends of the fragments are bathed in synovial fluid, which may interfere with the process of repair.

The capsule is thickened at certain parts by special bands, of which the ilio-femoral, or Y-shaped ligament is of immense importance, as it usually remains entire in all the ordinary forms of dislocation at the hip, and determines the position of the dislocated bone in a marked manner. The thinnest parts of the capsule are posteriorly, and in front on the inner side of the Y-shaped ligament; in these directions joint effusion tends to show itself.

Notice how the bottom of the acetabulum is separated from the pelvic cavity merely by a thin layer of bone. This may be perforated by the extension of disease from the joint, and the pelvic cavity opened into by the burrowing pus. In front of the capsule is the ilio-psoas muscle; this is separated by a bursa, which

frequently communicates with the joint. Crossing the posterior surface of the joint are the external rotator muscles, gemelli, pyriformis, obturator muscles, and quadratus femoris.

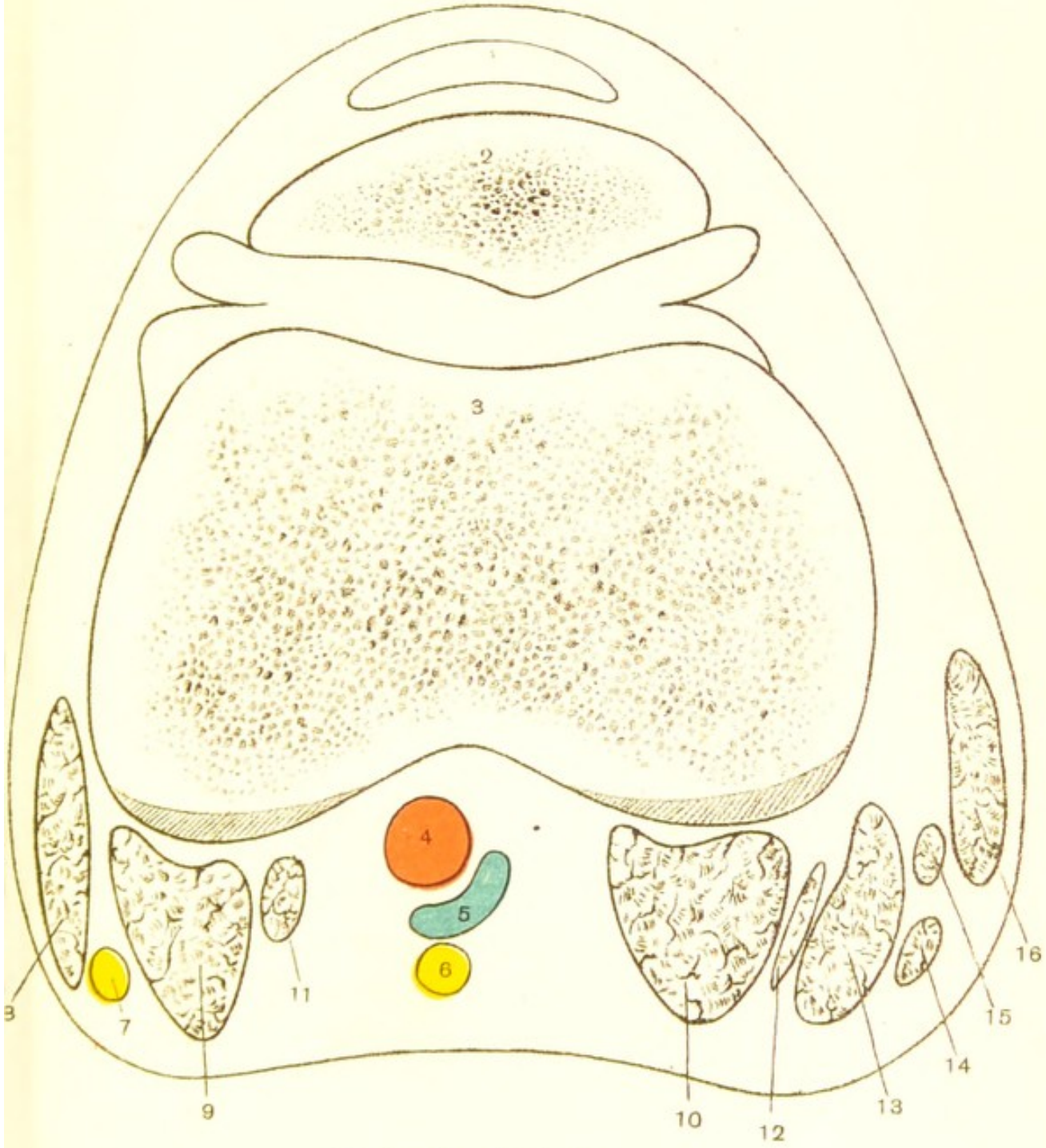
It is interesting to notice that the position (flexion and eversion) which the limb assumes in the early stage of hip disease is that into which it would be placed by contraction of the above muscles, lying in such close contact with the capsule.

DISLOCATION OF THE HIP.

Of the four common dislocations at the hip—viz., pubic, obturator, on the dorsum ilii, into the sciatic notch—it may be noticed that the two former ones are varieties of a forward dislocation, while the two latter are merely varieties of a backward dislocation.

Moreover, all dislocations of the hip are primarily in a *downward* direction, the rent in the capsule being always at its lower and inner part; and probably all dislocations occur when the limb is in the flexed and abducted position, as the head of the femur is then directed towards the weak part of the capsule. The head of the femur is in a line with the inner condyle. This should be borne in mind in attempting to reduce dislocations by manipulation.

Nerve Supply of Hip Joint.—The nerves of the hip joint are derived from the lumbar and sacral plexuses, through the anterior crural, obturator, and great sciatic nerves; and as the knee is supplied by branches from the same nerves, it is easy to explain the pain referred to the knee in cases of hip disease.



1 Bursa patellæ
2 Patella
3 Femur
4 Popliteal artery
5 Popliteal vein
6 Internal popliteal nerve
7 External popliteal nerve
8 Biceps
9 Gastrocnemius (outer head)
10 Gastrocnemius (inner head)
11 Plantaris
12 Bursa
13 Semimembranosus
14 Semitendinosus
15 Gracilis
16 Sartorius

FRACTURES OF THE FEMUR.

Two *fractures of the neck* are described—intra-capsular and extra-capsular. As the capsule of the joint is attached to the anterior inter-trochanteric line, and to the great trochanter, a pure extra-capsular fracture cannot occur without involving the great trochanter or shaft of the femur, or perhaps both.

In these fractures, if not impacted, the lower extremity is everted by the weight of the limb, which naturally tends to roll outwards, and is shortened by the glutei, hamstrings, ilio-psoas, etc.

Fracture of the great trochanter may occur, due to direct violence. The detached fragment is drawn upwards and backwards by the glutei, pyriformis, obturator internus, and gemelli.

In *fractures of the shaft* of the femur (upper and middle thirds), the upper fragment is tilted forwards by the ilio-psoas, and the lower fragment is drawn upwards behind it by the hamstrings.

Fracture of the lower end of the femur (*i.e.*, of the shaft above the condyles) may cause injury to the femoral artery, as it is about to enter, or as it lies in, the popliteal space.

In this fracture the lower fragment may be drawn upwards by the hamstrings, but it should be specially noticed that its upper extremity is tilted backwards by the action of the gastrocnemius, and extension of the limb usually increases the displacement.

Fractures of the Patella.—It should be noticed that these fractures almost invariably involve the joint.

When due to muscular action, as by sudden contraction of the quadriceps extensor, the fracture is transverse; but if due to direct violence, it is starred, vertical, or oblique. The upper fragment is drawn upwards by the quadriceps.

REGION OF THE KNEE.

Anteriorly the patella lies quite superficially. When the limb is extended, and the extensor muscles relaxed, the patella is very moveable, but if the muscles be contracted, the patella is drawn upwards and fixed against the anterior surface of the femur.

From the patella the ligamentum patellæ may be traced to the tubercle of the tibia. Over the patella is the *bursa patellæ*, which is frequently enlarged, forming *housemaid's knee*. Beneath the ligamentum patellæ is another bursa; when this becomes enlarged it assumes an hour-glass shape, its middle being pressed upon by the ligamentum patellæ.

The tuberosities of the tibia should be felt, and on passing the finger backwards over the external tuberosity, the head of the fibula may be felt on a level with the tubercle of the tibia, but *towards the posterior surface* of the bone.

The internal condyle of the femur with its small abductor tubercle is distinct. Notice the small interval between the inner condyle and the tuberosity of the tibia. This corresponds to the line of the knee joint, and is readily distinguished on flexing the leg.

On the outer side, the external condyle is subcutaneous, but not so prominent as the internal. The ilio-tibial band forms a well marked prominence, as it extends down to the external tuberosity of the tibia.

I have frequently seen this mistaken (in certain positions of the limb) for the tendon of the biceps, which lies behind it, and extends to the head of the fibula. The external popliteal nerve lies just under cover of the biceps, and it may in thin subjects be felt in this position.

In performing tenotomy of the biceps, care should be taken lest the nerve be injured.

The skin of the popliteal space is marked by a transverse fold, or crease, which lies some distance above the level of the knee joint.

POPLITEAL SPACE.

If the knee be flexed the lateral boundaries of the space, formed by the hamstrings and gastrocnemius (two heads) may be readily felt.

Boundaries—

Roof, skin and fascia.

Floor, femur, posterior ligament, popliteus.

Internally, semi-membranosus, semi-tendinosus, gracilis, sartorius, gastrocnemius (inner head).

Externally, biceps, gastrocnemius (outer head).

Contents—Popliteal vessels and nerves, lymphatics, articular branch of obturator nerve, fat.

Nerves of Space.—The *internal popliteal nerve* lies in the middle line of the space immediately beneath the deep fascia.

The *external popliteal nerve* lies close to the tendon of the biceps, and can be felt from the surface on the inner side of that tendon.

These nerves are sometimes stretched, and are readily reached by an incision through the skin and fascia over their course.

Popliteal Artery.—This vessel at its upper part lies beneath the inner hamstrings, but it soon reaches the middle line of the space and disappears beneath the gastrocnemius muscle.

Superficial to the artery in the space are the internal popliteal nerve and the popliteal vein—these structures lying external to the artery above, but internal to it at its lower part. The vein is in close contact with the artery, and with difficulty separable from its coats.

The artery lies on the posterior surfaces of the femur and knee joint. Due to these deep relations of the artery, care should be taken in excising the knee joint lest the artery be wounded; but as the bones are thrust well out of the wound, they are removed from the artery, which thus, with ordinary care, escapes the saw or knife.

Popliteal Aneurism.—Of all arteries in the body, excepting the aorta, the popliteal is most frequently the seat of aneurism. This is due to its relation to the knee joint, causing it to be subjected to frequent and extensive movements; also the want of support, as the artery lies in the popliteal space. Moreover, it is the termination of a long undivided trunk, comprising the external iliac, femoral, and popliteal arteries; the trunk here divides into the tibial arteries, and this division increases the peripheral resistance to the blood flow, and thus acts as a factor in the production of aneurism by adding to the local tension.

When the aneurism starts from the deep surface of the artery its progress is slow, due to the resistance offered by the bone, but when it originates on the superficial surface of the artery its growth is rapid.

Aneurism of the popliteal artery may, by pressure, cause absorption or necrosis of the bone, or destruction of the joint.

Ligature of Popliteal Artery.—An incision is made over the line of the artery, and the short saphenous vein which lies in the superficial fascia avoided.

After dividing the deep fascia, the internal popliteal nerve must be found and turned inwards. The popliteal vein is next exposed ; this is separated with difficulty from the artery, which will then come into view, lying on the posterior surface of the joint.

The artery may be reached in its upper third by an incision immediately behind the tendon of the adductor magnus, opposite the lower third of the shaft of the femur. The sartorius and inner hamstrings are turned back, and beneath these the artery is found lying close to the bone.

Bursæ around the Knee.— The bursa over the patella and that under the ligamentum patellæ have been already mentioned (page 134).

In the ham numerous bursæ are found in relation to the several tendons—viz., gastrocnemius, biceps, semimembranous, popliteus, etc. Of these, that which lies beneath the inner head of the gastrocnemius is the one of greatest importance surgically, as it is of large size and frequently communicates with the joint cavity.

KNEE JOINT.

The knee is the largest joint in the body, and is one of the most superficial, and, so far as the bones are concerned, is one of the weakest in the body, as it has no socket as in the hip, and no surrounding processes as in the elbow and ankle; but, by virtue of its strong ligaments, it is the strongest joint in the body, and the one least frequently dislocated. The strength of the joint depends greatly on the crucial ligaments, these being alternately tense during flexion and extension; they also limit rotation and prevent lateral displacements.

The movements of the knee joint are flexion and extension, with some rotation when in the flexed position. Notice especially, that normally neither lateral movement or rotation are allowed when the joint is in the extended position, as the posterior, lateral, and anterior crucial ligaments are tense.

The *synovial membrane* of the knee is the largest in the body, and is arranged in a complicated manner. Thus it covers the intra-articular ligaments, forms folds in the joint, is reflected on the inner surface of the capsule, and is prolonged upwards as a *cul de sac* beneath the extensor tendon.

If the membrane be distended with fluid, it will bulge on each side of the patella where the capsule is thin; and here the synovial sac comes nearest the surface.

In relation to the knee joint it should be noticed that, while the bones of the leg (tibia and fibula) are vertical, the femur is oblique—the obliquity being greater in the female than in the male, due to the greater width

of the pelvis. It is due to this obliquity of the femur that dislocation of the patella is most common in an *outward* direction, and in knock-knee this obliquity is increased.

THE LEG.

From the tubercle of the tibia the anterior border of the bone is to be followed down in its whole length, where it constitutes *the shin*. This border is curved in the upper two thirds, the concavity of the curve being outwards.

The internal surface of the tibia is subcutaneous below the insertion of the sartorius, and may be traced down to the internal malleolus.

The inner border of the tibia should be felt extending from the internal tuberosity to the malleolus; this border is partly obscured below by the tendon of the tibialis posticus.

The subcutaneous position of the head of the fibula has been mentioned. The upper half of the bone is covered by muscles, but the lower half may be felt beneath the skin, while just above the malleolus it is subcutaneous. Notice that the fibula is on a level posterior to that of the tibia, and that while the curve of the tibia is forwards, the fibula curves backwards. This should be remembered in amputating through the leg, lest the knife be locked between the bones.

The fleshy mass in front of the bones of the leg consists of the tibialis anticus, extensor proprius hallucis, and extensor longus digitorum. The anterior tibial artery and nerve lie between the tibialis anticus and the other muscles.

A slight groove may sometimes be made out at the outer border of the tibialis anticus; this indicates the position of the anterior tibial artery. Of the tendons of the above muscles, that of the tibialis anticus may be rendered very prominent by flexing the ankle; those of the extensor longus digitorum are external to it, and less distinct.

On the back of the leg the prominence of the calf is felt, formed by the gastrocnemius and soleus muscles, which terminate below in the tendo Achilles. Midway between the inner border of the tendo Achilles and the inner border of the tibia the pulsations of the posterior tibial artery may be felt.

Aponeurosis of the Leg.—The aponeurosis is attached to all the subcutaneous surfaces of the bones—viz., head and inner surface of the tibia, the head of the fibula, and the two malleoli.

It forms a dense sheath for the muscles, and has three septa, two of which are attached to the fibula, and separate the peronei (longus and brevis) from the muscles of the front and back of the leg. The third septum lies beneath the soleus, and separates that muscle from the deep muscles of the back of the leg. This layer of fascia is important, as beneath it the posterior tibial artery lies, and will be mentioned along with ligature of that vessel.

VESSELS OF THE LEG.

Saphenous Veins.—The saphenous veins may be seen beneath the skin, and are of great interest, due to their being so frequently the seat of varicosity.

Internal or Long Saphenous Vein.—This commences at the inner part of the venous arch on the dorsum of the foot, and passes up *in front of* the internal malleolus. It then lies behind the inner border of the tibia and the inner condyle of the femur, and ascends on the inner and front parts of the thigh to pass through the saphenous opening, and enter into the femoral vein.

External or Short Saphenous Vein.—This extends from the foot to the popliteal space, but in some cases extends upwards to join the long saphenous vein in the upper part of the thigh. It proceeds from the outer part of the arch on the dorsum of the foot, and passes *behind* the outer malleolus, then passing upwards along the middle of the calf, it pierces the deep fascia of the popliteal space to open into the popliteal vein.

Varicose Veins.—These veins frequently become *varicose;* this is due partly to their great length and the long column of blood supported, which tends to distend the veins laterally, and thus render the valves of the veins incompetent. Besides, the veins lie superficially, and are not favourably influenced by muscular compression, this being in general one of the most important factors which assist the venous circulation. Moreover, the long saphenous vein, in which a varicose condition is most commonly met with, lies for a great part of its course between skin and bone, and receives no support at all during walking, when the superficial veins are especially distended, partly due to gravity and partly due to the increased venous return through the superficial veins, which must necessarily occur owing to the muscular compression of the deep veins.

The passage of these veins through small openings in the deep fascia, and being thus liable to construction, has been also mentioned as a cause of varicosity.

ANTERIOR TIBIAL ARTERY.

The position of the anterior tibial artery is indicated by a line from a point, midway between the external tuberosity of the tibia and the head of the fibula, to the front of the ankle, where it lies midway between the malleoli.

In the upper part, the artery lies between the tibialis anticus and the extensor longus digitorum; but lower down the artery lies between the tibialis anticus and the extensor proprius hallucis, which crosses to its inner side at the ankle. The anterior tibial nerve lies superficial to it for some distance, but is usually external to it at its upper and lower parts. Venæ comites accompany it on either side.

The artery lies deeply in the upper part on the interosseous membrane; but near its termination it is superficial and rests upon the tibia, against which it may be compressed.

Ligature of Anterior Tibial Artery. — The artery may be ligatured in any part of its course, an incision being made over the guiding line of the vessel, and then opening up the interval between the tibialis anticus and extensor muscles. In passing the needle care should be taken not to injure the venæ comites, or anterior tibial nerve. The best guide to the artery at its lower part is the outer border of the tendon of the tibialis anticus.

POSTERIOR TIBIAL ARTERY.

The posterior tibial artery extends along the back of the leg, from the lower part of the popliteal space to a point midway between the inner malleolus and the heel, where it divides into the plantar arteries.

In its upper part the artery lies deeply beneath the muscles of the calf, but at its lower part the vessel is superficial and, as it lies between the inner border of the tibia and the tendo Achilles, is covered merely by skin and fascia. The posterior tibial nerve is at first internal to the artery, but soon crosses over the vessel to lie on its outer side. Venæ comites surround the artery.

At its upper part the artery lies on the deep muscles, being covered by their fascia; but near its termination it lies on the tibia and ankle joint. It may easily be compressed at its lower part.

Ligature of Posterior Tibial Artery.—The artery may be tied with ease in its *lower third*, an incision being made midway between the tendo Achilles and the inner border of the tibia; the artery is reached on merely dividing the skin and fascia.

In its *upper half*, where it is deeply placed, the artery is hardly ever tied excepting for a wound. It may, however, be reached in this situation by an incision just behind the inner edge of the tibia, the gastrocnemius being turned aside and the attachment of the soleus to the tibia divided, when a layer of fascia is exposed, beneath which the artery is placed. Care should be taken in dividing the soleus not to wound

the above layer of fascia, for should this happen, the artery would easily be lifted with the muscle.

Another method of reaching the artery is, by a vertical incision between the two halves of the gastrocnemius, and through the fibres of the soleus.

BONES OF THE LEG.

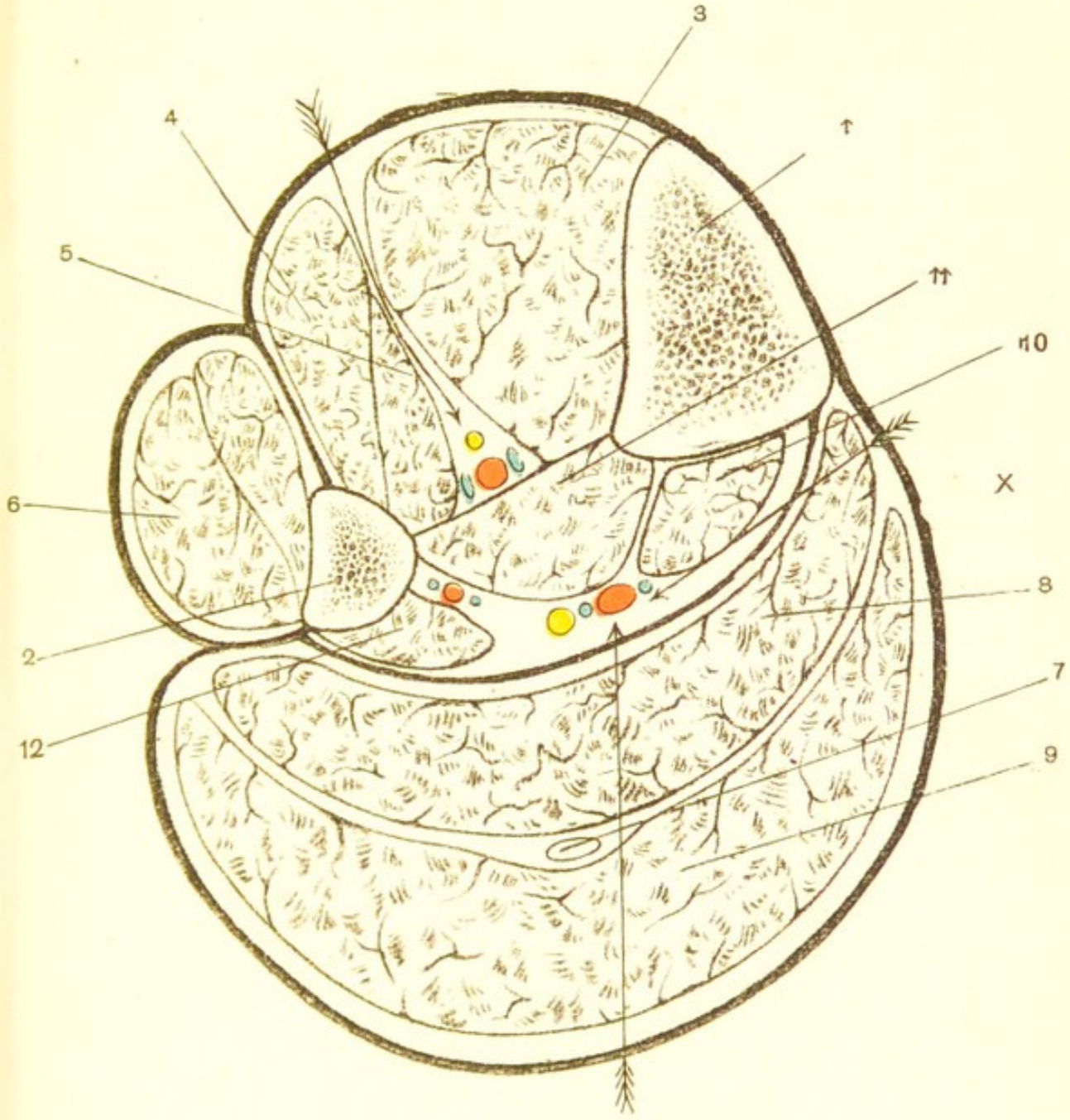
Anatomical Considerations in Relation to Fractures of the Bones of the Leg.—When both bones are broken by indirect violence, the tibia is generally fractured low down, and the fibula at a higher level. This is due to the fibula being stronger inferiorly, while the thinnest and weakest part of the tibia is at the junction of its middle and lower thirds.

Fractures of the tibia are frequently compound, as it is subcutaneous throughout its entire length, and the lower fragment being drawn backwards and upwards by the gastrocnemius, the upper fragment readily perforates the skin under which it projects.

When one bone only is fractured there is but little displacement, as the other bone acts as a splint, and fracture of the tibia is more easily detected than that of the fibula, due to the subcutaneous position of the tibia, while the fibula is clothed by the peronei muscles.

Fracture of the fibula may however, as a rule, be detected by pressing both bones together, when localised pain and crepitus are elicited.

Fracture of the tibia is more common than that of the fibula, for, though a stronger bone, it is more superficial and less protected by muscles than the fibula, and receives more directly shocks transmitted to the foot.



1 Tibia
2 Fibula
3 Tibialis anticus
4 Ext. longus digitorum
5 Ext. proprius hallucis
6 Peronei
7 Plantaris
8 Soleus
9 Gastrocnemius
10 Flexor longus digitorum
11 Tibialis posticus
12 Flexor longus hallucis

In fracture of the fibula about two inches above the malleolus (Pott's fracture), the foot is dislocated outwards; the internal lateral ligament is ruptured, and the upper end of the fragment is driven towards the tibia.

THE ANKLE AND FOOT.

Of the two malleoli, the external projects further down, and its tip lies three-quarters of an inch behind that of the internal malleolus. This is of importance in Syme's amputation, as the incisions are made from the tip of the external malleolus to a point *opposite* on the inner side, and not to the internal malleolus.

The *line of the ankle joint* lies half-an-inch above the level of the tip of the internal malleolus.

The only bony projection on the dorsum of the foot is the astragalus, which may be felt when the foot is extended.

Of the tendons on the dorsum of the foot, that of the tibialis anticus should be carefully felt. It extends from the front of the ankle to the internal cuneiform bone, and is rendered prominent by flexing the foot at the ankle.

Along the inner side of the foot several important bony points are to be made out.

Commencing posteriorly, the internal tuberosity of the os calcis may be felt. An inch below the inner malleolus is the sustentaculum tali. An inch and a half in front of the malleolus, the tubercle of the scaphoid is prominent; and passing from behind the malleolus to this tubercle is the tendon of the tibialis posticus.

In front of this the base of the first metatarsal bone forms a marked ridge, and the rounded head of the

bone may be felt further forwards. The head of the metatarsal bone is frequently unduly prominent, due to the toe having been pushed outwards by ill-fitting boots (*hallux valgus*); and a bursa, which lies over the metatarso-phalangeal joint, frequently becomes enlarged and constitutes a *bunion.*

On the outer side of the foot the os calcis is subcutaneous, and on its surface a small tubercle (peroneal tubercle) may sometimes be felt. It lies a little below and in front of the external malleolus. In relation to this tubercle are the tendons of the peronei muscles.

In front of the tubercle is the tendon of the peroneus brevis, which may be traced to its insertion into the base of the fifth metatarsal bone.

The tendon of the peroneus longus lies behind the tubercle, and reaches the groove in the cuboid. It then crosses the sole of the foot to reach the base of the first metatarsal bone—thus assisting in maintaining the arched form of the foot.

The base of the fifth metatarsal bone forms a distinct projection about two and a half inches in front of the outer malleolus. The anterior edge of the os calcis may be felt by inverting the foot.

Posteriorly, the tendo Achilles is prominent as it passes to be inserted into the os calcis. Between the tendon and the os calcis, close to its insertion, a bursa is placed; this sometimes becomes inflamed, and may suppurate.

JOINTS OF THE FOOT.

Mid Tarsal Joint.—Formed by the os calcis and astragalus behind, with the scaphoid and cuboid in

front. This lies opposite a line drawn across the foot, from a point on the inside immediately behind the tubercle of the scaphoid, to a point midway between the external malleolus and the base of the fifth metatarsal bone. At this joint the foot is removed in *Chopart's amputation.*

Tarso-Metatarsal Joint.—This joint lies opposite a curved line, with its convexity towards the toes, extending from behind the base of the fifth metatarsal bone to a point immediately behind the base of the first metatarsal bone. It should, however, be borne in mind that the base of the second metatarsal bone projects backwards between the cuneiform bones. At this joint the anterior part of the foot is removed in *Hey's* or *Lisfranc's amputation.*

The *metatarso-phalangeal* articulations are placed about an inch behind the webs of the toes.

Fascia in the Region of the Ankle.—The deep fascia around the ankle is specially thickened, and forms the annular ligaments.

The *anterior annular ligament* consists of two portions—an upper, which passes transversely between the malleoli, and a lower oblique portion, which extends over the upper part of the tarsus. Beneath this the tendons of the tibialis anticus, extensor proprius hallucis, extensor longus digitorum, and peroneus tertius pass, lying in the above order from within outwards.

The anterior tibial vessels and nerves reach the dorsum of the foot beneath this ligament, lying external to the tibialis anticus, and being crossed here by the tendon of the extensor proprius hallucis.

Beneath the upper portion, the tibialis anticus only has a synovial sheath; and beneath the lower one there are three synovial sheaths, one being common to the extensor longus digitorum and the peroneus tertius.

External Annular Ligament.—This band extends from the external malleolus to the outer surface of the os calcis, and binds down the tendons of the peroneus longus and brevis. These have a common synovial sheath.

Internal Annular Ligament.—This extends from the internal malleolus to the inner tuberosity of the os calcis. Beneath this the tendons of the tibialis posticus, flexor longus digitorum, and flexor longus hallucis pass to the sole of the foot.

The tibialis posticus lies immediately behind the internal malleolus. The posterior tibial vessels and nerve lie between the tendons of the flexor longus digitorum and flexor longus hallucis.

Each of these tendons has a separate synovial sheath. That for the tibialis posticus lies in very close relation to the ankle joint, as the tendon passes behind the internal malleolus.

The Plantar Fascia.—The plantar fascia, like that of the palm of the hand, consists of three portions—a central and two lateral. The central portion, which is very thick and somewhat triangular, extends from the os calcis to the metatarso-phalangeal joints, and its arrangement closely resembles that in the hand. This fascia assists in maintaining the arch of the foot, and is one of the structures which give way in flat-foot.

In *talipes varus* certain bands of the plantar fascia are found thickened and contracted. These are divided where felt tense. With ordinary care there is no risk of wounding the plantar arteries, as they are separated from the fascia by the superficial layer of muscles. This contraction is usually only an adaptive shortening, and occurs secondarily to the deformity of the foot.

In *pes cavus*, where the foot is abnormally arched, the plantar fascia is very markedly contracted, and may require division in its entire breadth. This is most easily performed near the os calcis.

THE ARCHES OF THE FOOT.

The foot is arched in two directions, longitudinally and transversely. The transverse arch gives elasticity to the anterior part of the foot, but surgically is less important than the longitudinal arch.

When a normal foot is placed on the ground it rests on the heel, the outer border, and the heads of the metatarsal bones, these parts forming the *tread of the foot.* This may be demonstrated by placing the wet foot on a dry board. Part of the inner border and sole do not touch the ground, but form an arch over which the skin is thin and delicate, while the skin over the points of pressure is markedly thickened. This arch may be increased, diminished, or entirely lost.

When it is markedly increased, *pes cavus* or hollow claw-foot results. In this, the outer border of the foot does not reach the ground in its entire length, and the weight is borne by the heel and the heads of the metatarsal bones.

When the arch is diminished, or lost, as in *flat-foot*, the entire sole touches the ground.

Of the bones which enter into the construction of this arch, the astragalus forms the key-stone, and receives the weight of the body from the tibia.

The astragalus rests mainly on the os calcis, to which the weight is mostly transmitted; but the head of the astragalus is not completely supported by the os calcis, a portion of it overhangs the interval between the os calcis and scaphoid. In this position it rests on the upper surface of the *inferior calcaneo-scaphoid ligament*, which extends from the sustentaculum tali to the scaphoid. This ligament, which thus partly supports the key-stone, or astragalus, is of great importance in maintaining the arched form of the foot. In flat-foot this ligament becomes stretched and allows the head of the astragalus to drop, thus destroying the arch; and the head of the astragalus, which in the normal foot is barely recognisable, now forms a marked projection on the inner side and sole of the foot; its under surface, which is coated with cartilage, and normally plays on the upper surface of the calcaneo-scaphoid ligament, is now subjected to pressure and is frequently the seat of intense pain.

Other structures in the foot assist in maintaining the integrity of the arch, such as the other plantar ligaments, the tendons which pass behind the inner ankle and thus sling the arch as they pass forwards beneath it, while the plantar fascia and superficial plantar muscles, extending from one extremity of the arch to the other, act as a tie comparable to a bow-string. All these structures are stretched in flat-foot and yield to pressure.

Of the various tendons which support the arch, that of the tibialis posticus requires special mention. This tendon extends from behind the inner malleolus to the tubercle of the scaphoid—passing on its way beneath the calcaneo-scaphoid ligament and head of the astragalus, which it supports. Moreover, some of the fibres of the tendon spread outwards beneath the astragalus to be attached to the os calcis and cuboid.

The tibialis anticus also acts materially in supporting the arch, for not only is it attached to the internal cuneiform, but its tendinous sheath is attached to the inner border of the foot opposite the summit of the arch. According to Professor Sayre this muscle is the main one concerned in the support of the arch.

A recognition of the part played by the muscles, in supporting the arch of the foot, led to the adoption of that successful method of treating flat-foot by means of tip-toe exercises.

In *talipes valgus* the same deformity occurs as in flat-foot, but the deep muscles of the back of the leg are frequently paralysed while the peronei are rigidly contracted.

In *talipes varus* the inner border of the foot is drawn upwards by the tibial muscles (anterior and posterior). The heel is usually drawn upwards also, by the tendo Achilles *(equino-varus)*. The part of the foot which lies in front of the mid-tarsal joint is bent inwards, the scaphoid being thus approximated to the internal malleolus; the head of the astragalus is bent inwards at the neck, so that instead of being directed forwards it is directed forwards and inwards, in order to articulate with the displaced scaphoid.

The ligaments and fascia on the inner border of the foot are much contracted. The foot rests on the outer border, or even on the dorsal surface in extreme cases.

In *talipes equinus* the heel is drawn upwards by the tendo Achilles. The astragalus is displaced downwards and forwards, and projects on the dorsum of the foot.

Talipes calcaneus is very rare. In it (congenital form) the anterior part of the foot is held up by the rigid contraction of the muscles of the front of the leg.

In the treatment of these deformities the contracted tendons sometimes require division. The tendons most frequently divided are those of the tibialis anticus and posticus, and the tendo Achilles, and more rarely the peronei. The positions of these tendons have been previously indicated.

The *tibialis anticus* may be divided on the dorsum of the foot, between the ankle and its insertion, into the internal cuneiform bone.

The *tibialis posticus* is usually divided behind the tibia, an inch above the inner malleolus. In the normal foot the tendon may be divided between the malleolus and the tubercle of the scaphoid; but in talipes varus (for which the operation is usually performed) this is difficult, due to the approximation of the scaphoid to the malleolus, which occurs in that deformity.

The *tendo Achilles* is usually divided one inch above its insertion into the os calcis. Care should be taken in dividing the tendo Achilles, or tibialis posticus, lest the posterior tibial artery be wounded.

The *peronei tendons* are divided as they lie behind the external malleolus.

Some of the tendons around the ankle occasionally slip out of their grooves, due to rupture of their sheath by a sudden twisting of the foot. The one most frequently displaced is that of the peroneus longus; it may be noticed that while the posterior surface of the external malleolus is deeply grooved for the peronei, the groove is occupied by the peroneus brevis, on the surface of which the peroneus longus lies; it thus readily slips out of position. The tendon slips over the external malleolus, behind which it passes as round a pulley.

BLOOD-VESSELS OF THE FOOT.

The superficial veins have been previously mentioned.

Dorsalis Pedis Artery.—This artery passes from the middle of the front of the ankle to the posterior part of the first interosseous space. It lies on the inner row of the tarsal bones and their ligaments, and is crossed by the dorsal venous arch and the innermost tendon of the extensor brevis digitorum. It lies between the extensor proprius hallucis and the extensor longus digitorum, and is accompanied on its outer side by the anterior tibial nerve.

Plantar Arteries.—These commence at the bifurcation of the posterior tibial artery, midway between the inner malleolus and the os calcis.

The *internal plantar artery* is of small size and is distributed mainly to the great toe.

The *external plantar artery* crosses the foot obliquely to reach the base of the fifth metatarsal bone, where it bends inwards and passes to the posterior extremity

of the first interosseous space; here it is joined by the dorsalis pedis, forming the *plantar arch*. In the first part of its course it lies beneath the flexor brevis digitorum, but its second part (or plantar arch) lies deeply on the bases of the metatarsal bones.

Bones and Articulations of the Foot. — Fractures of the bones of the foot are caused by direct violence, and are not usually accompanied by great displacement, due to the firm ligamentous union of the bones.

Fractures of the astragalus are, however, more commonly due to indirect violence—as by a person falling from a height and alighting on his feet; but in such accidents fractures of the tibia are more apt to occur than of the bones of the foot.

Excepting the astragalus the bones of the foot are very rarely dislocated. When the astragalus is dislocated—as by falls upon or twists of the foot—the bone is, due to its shape and connections, usually dislocated forwards.

Synovial Membranes. — In the foot there are six distinct synovial membranes:—

1. Posterior calcaneo-astragaloid.
2. Anterior calcaneo-astragaloid, which extends to the astragalo-scaphoid joint.
3. Calcaneo-cuboid.
4. Between the cuboid and the fourth and fifth metatarsal bones.
5. Between the internal cuneiform and the first metatarsal bone.
6. Anterior tarsal synovial membrane. This extends between the scaphoid, cuboid, three cuneiform, and the

metatarsal bones, and is the largest and most important of all, for while tarsal diseases usually commence in the bones, the synovial membranes quickly become secondarily affected. If disease commence in the os calcis it may remain localised for a very considerable time, due to the limitation of the synovial membranes in relation to that bone; but if it commence in the scaphoid or cuneiform bones the disease will rapidly extend through the anterior part of the tarsus.

THE SPINE.

CURVATURE OF THE SPINE.

In the adult the spine has normally four curves—viz., convex forwards in the cervical and lumbar regions, and convex backwards in the dorsal and sacral regions.

At birth the spine has one simple curve with its convexity backwards. The curves with their convexity forwards appear later, that in the cervical region being the first to form.

These antero-posterior curvatures are in some cases exaggerated, constituting the deformities known as kyphosis and lordosis, having their convexities backwards and forwards respectively.

Kyphosis usually affects the upper dorsal and lower cervical regions, where the spine naturally curves backwards.

Lordosis is usually met with in the lumbar region, in which there is naturally a curve forwards.

Lordosis and kyphosis are usually associated the one with the other, for when one part of the spine is in the condition of lordosis, the remaining part exhibits a compensatory kyphotic curve. A certain amount of lordosis is almost invariably present during the course of a case of hip disease, and in many cases remains as a permanent condition.

In *lateral curvature*, or *scoliosis*, the spine usually presents two curves—a primary and a compensatory curve. In the most common form, the convexity is towards the right in the dorsal region, and towards the left in the lumbar region.

It should be noticed that any obliquity of the pelvis, such as would be due to inequality of the lower limbs, causes a lateral deviation of the spine in the lumbar region, the convexity of this curve being towards the side on which the pelvis is lowest, and this is followed by a compensatory curve in the dorsal region in the opposite direction.

Lateral curvature is almost always accompanied by a rotation or twisting of the spine, so that the spinous processes look towards the concavity of the curve, and thus the amount of lateral deviation of the spinous processes is rather misleading, as it does not show the true amount of deviation of the vertebral bodies. This rotation produces a marked change in the shape of the ribs, their angles being much more prominent on the convex side of the curve. This increased convexity of the ribs renders the scapula more prominent (hence the term "shoulder growing out"); the interval between the angles of the ribs and the spinous processes is diminished on the convex side of the curve, and the transverse processes, which lie towards the convexity of the curve, are approximated to the spines. The cause of the rotation is still *sub judice*.

Angular Curvature.—Angular curvature is due to the destruction of one or more of the bodies of the vertebræ, by which the weight supporting part of the spine gives way and the bodies become compressed

against each other, so that a prominence is formed by the spines which thus project posteriorly—the apex of the projection being formed by the spine of the vertebra, which is primarily or most extensively destroyed.

Movements of the Spine.—The spine is capable of extensive movement, in antero-posterior and lateral directions, together with a considerable amount of rotation on a vertical axis.

The dorsal region is the least moveable part of the spine, this being due to the overlapping of the spinous processes and laminæ.

The lumbar region is the most freely moveable part of the spine—antero-posterior, lateral, and rotatory movements being allowed in this part.

In the cervical region, while the antero-posterior movements are not very extensive, the lateral and rotatory movements are very free.

From what has been mentioned above, it will be readily understood why *sprains of the spine* are most common in the cervical and lumbar regions, where the vertebral column is most freely moveable.

DISLOCATIONS AND FRACTURES OF THE SPINE.

From the complexity of the articulations of the spine, a dislocation without fracture is very rare. It occurs, however, in the cervical region, where the articular processes are more horizontal than in any other part of the spine.

Here it may occur—(1) between the occiput and atlas; (2) between the axis and atlas (due either to rupture of the transverse ligament or fracture of the

odontoid process); and (3) towards the lower part of the cervical region, usually between the fifth and seventh vertebræ.

This last position is the most common site of dislocation, probably because it is the junction of a very moveable with a comparatively fixed portion.

Dislocation without fracture can scarcely occur in the dorsal region, and there is no recorded case of a pure dislocation in the lumbar region (Erichsen).

Fracture of the spine may occur at any part, but is met with chiefly in the cervical region; the effects of such an accident depend upon the amount of injury to or compression of the cord. (See page 160).

THE SPINAL CORD.

In the adult the cord extends from the foramen magnum to the first lumbar vertebra. At birth the cord extends as far as the third lumbar vertebra; and in the fœtus the length of the cord corresponds to that of the spinal canal.

The spinal dura mater has not the same intimate relation to the bones surrounding it as the cranial dura mater has, consequently injuries to the vertebræ are not always followed by injury to or inflammation of the spinal membranes, as is so frequently the case in head injuries.

The cord and its membranes may be injured by punctured wounds in the cervical region, where the laminæ are horizontal, and separated by slight intervals; or the cord may be reached in the space between the occiput and atlas. In this situation the *vertebral artery* crosses inwards to reach the foramen magnum, and a stab in this region may injure that vessel.

In the *dorsal region* the laminæ overlap each other, so as to form a shield, which, in the absence of fracture, effectually protects this part of the cord from being punctured.

Cases are on record (Holmes) in which punctured wounds in the lumbar region had reached the dura mater; but as the spinal cord only reaches the first lumbar vertebra, such injuries are confined to the membranes and nerves.

EFFECTS OF INJURY TO SPINAL CORD.

These vary according to the site of the injury. The following are the most frequent:—

Lower Dorsal and Lumbar Regions.—Injuries in this region may cause paralysis of the lumbar and sacral plexuses; or if low down, the sacral plexus only is affected. There is not only paralysis of the whole or part of the lower extremities, but the sphincter ani and muscles of the bladder are paralysed, resulting in incontinence of urine and fæces.

Upper Dorsal Region.—If the cord be injured about the third dorsal vertebra, the intercostal and abdominal muscles are paralysed, causing great disturbances of respiration in addition to the symptoms detailed above as occuring in injuries in the lower dorsal region.

Lower Cervical Region.—When the cord is injured in the lower cervical region, not only are all the symptoms mentioned above present, but a part or the whole of the upper extremities are paralysed, according to the level of the injury. If, at the level of the fifth

cervical vertebra, the whole of the brachial plexus is paralysed; but if on a lower level, a part of the plexus may escape—thus the ulnar and internal cutaneous nerves, which arise from a lower part of the plexus than the other nerves, may be involved while the remainder are intact.

Not only is there paralysis of the upper extremities, but respiration is seriously affected, as all the muscles which move the ribs are paralysed, and inspiration is entirely diaphragmatic.

Upper Cervical Region.—When the cord is injured above the origin of the phrenic nerves—*i.e.*, at the level of or above the third cervical vertebra, the diaphragm is paralysed, and death results from stoppage of respiration.

N.B.—The symptoms detailed above are those produced by severe injury to or division of the cord at the points mentioned. Slight injuries will probably only partially produce the various symptoms detailed.

SPINA BIFIDA.

This is a congenital malformation due to incomplete development of the laminæ and spinous processes of some of the vertebræ, allowing of the protrusion of some of the contents of the vertebral canal in the form of a fluctuating tumour.

In the fœtus the vertebral canal exists in the form of an open groove. This is eventually closed in by the backward growth of the laminæ, which coalesce and form the spinous processes.

This coalescence of the laminæ occurs first in the dorsal region, next in the cervical region, and last of all in the lumbar region.

Spina bifida is most commonly met with in the lumbar or lumbo-sacral region of the spine, this being the latest part to unite. Its coverings vary in different cases; in some forms there is merely a protrusion of the membranes (dura mater and arachnoid)—*spinal meningocele*, the contents being cerebro-spinal fluid.

In another and common form the sac contains the spinal cord and nerves which are usually spread out on the inner surface of the sac *(meningo-myelocele)*.

Another rare form *(syringo-myelocele)* is that in which the central canal of the cord is distended, and the expanded and thinned cord is spread out over the wall of the sac. It will be readily understood that, when the nerves are involved in the tumour, other deformities, as club-foot, are usually present.

APPENDIX.

SYNOPSIS OF THE JOINTS.

TEMPORO-MAXILLARY JOINT.

Condyle of jaw, with glenoid cavity, and eminentia articularis of temporal bone.

Capsular Ligament.

Fibro-cartilage or meniscus (complete).

External Lateral Ligament—Tubercle of zygoma to condyle and neck of jaw.

Internal Lateral Ligament—From spine of sphenoid to inner margin of inferior dental foramen.

Stylo-Maxillary Ligament—Styloid process to angle of jaw.

Synovial Membranes—Two in number.

Movements—

Jaw depressed { Weight of jaw. / Digastric, mylo-hyoid, genio-hyoid. / Genio-hyo-glossus, platysma.

Jaw elevated { Temporal, masseter. / Internal pterygoid.

Jaw drawn forwards—External pterygoids.

Jaw drawn backwards—Temporal (posterior fibres).

Grinding movements—External pterygoids (alternately).

Dislocations — *Forwards*, complete, bilateral, and unilateral.

STERNO-CLAVICULAR JOINT.

Sternum, clavicle, first rib.

Fibro-Cartilage, complete.

Anterior and *Posterior* ligaments—Former strong.

Inter-Clavicular ligament—Clavicles and epi-sternal notch.

Costo-Clavicular, or *Rhomboid* ligament—Clavicle to first rib.

Synovial Membranes—Two.

Movements—

Shoulder *upwards* { Sterno-mastoid, levator angulæ scapulæ. / Trapezius, (omo-hyoid).

Shoulder *downwards*—Weight of arm, subclavius, pectoralis minor.

Shoulder *forwards*—Pectoralis minor and serratus magnus.

Shoulder *backwards*—Trapezius, rhomboidei.

Dislocations (in order of frequency) — Forwards, backwards, and upwards.

ACROMIO-CLAVICULAR JOINT (Arthrodial).

Bony surfaces oblique, clavicle slightly overlaps acromion process.

Fibro-Cartilage—Incomplete.

Superior and *Inferior* acromio-clavicular ligaments.

Coraco-Clavicular ligament (conoid and trapezoid).

Movements—

Rotation of scapula.

Inferior angle *forwards* { Serratus magnus. Trapezius.

Inferior angle *backwards* { Rhomboideus major. Pectoralis minor.

Dislocations—Clavicle upwards, downwards (rare).

SHOULDER JOINT (Enarthrodial).

Ligaments—

Capsule—Loose, weakest inferiorly.

Coraco-Humeral Ligament—Thickening of capsule—coracoid to great tuberosity.

Glenoid Ligament—Around glenoid cavity.

Elastic Ligament—Tendon of biceps.

Movements—

Arm *forwards*—Pectoralis major, deltoid (anterior fibres).

Arm *backwards* { Latissimus dorsi, teres major. Deltoid (posterior fibres).

Arm *abducted*—Deltoid, supra-spinatus, biceps.

Arm *adducted*—Weight, pectoralis major, latissimus dorsi, teres major, coraco-brachialis.

Arm *rotated in* — Subscapularis and muscles of bicipital groove.

Arm *rotated out*—Teres minor and infra-spinatus.

Arm *circumducted*—All.

Dislocations—Sub-glenoid, sub-coracoid, sub-clavicular, sub-spinous.

ELBOW JOINT (Ginglymus).

Trochlear surface and capitellum of humerus, with greater sigmoid cavity of ulna and head of radius.

Ligaments—

Anterior—Humerus to coronoid process and orbicular ligament.

Posterior—Humerus to olecranon.

Internal Lateral—Internal condyle to olecranon and coronoid process.

External Lateral—External condyle to orbicular ligament.

Movements—

Flexion—Biceps, brachialis anticus, supinator longus, extensor carpi radialis longior, and muscles of internal condyle.

Extension—Triceps, anconeus, muscles of external condyle.

Dislocations—

Radius and Ulna, *backwards*, outwards, inwards, forwards.

Radius, *forwards*, backwards, outwards.

Ulna, *backwards*.

RADIO-ULNAR JOINTS.

SUPERIOR—Head of radius and lesser sigmoid cavity of ulna.

Ligament—Orbicular.

Synovial Membrane continuous with that of elbow.

MIDDLE—Oblique ligament and interosseous membrane.

INFERIOR—The head of ulna and sigmoid cavity of radius.

Ligaments—Anterior and posterior, and triangular fibro-cartilage.

Synovial membrane very loose (membrana sacciformis).

Movements—

Supination—Biceps, supinator longus, supinator brevis.

Pronation—Pronator radii teres, pronator quadratus.

WRIST JOINT.

Radius and fibro-cartilage, with scaphoid, semilunar, and cuneiform.

Ligaments—

Anterior and Posterior—Between above bones.

Internal Lateral—Styloid of ulna to cuneiform.

External Lateral—Styloid of radius to scaphoid.

Movements—

Palmar Flexion—Flexor carpi ulnaris, flexor carpi radialis, palmaris longus, and flexors of fingers and thumb.

Dorsal Flexion—Extensores carpi radialis longior and brevior, extensor carpi ulnaris, and extensors of fingers and thumb.

Radial Flexion—Flexor and extensor carpi radialis, extensors of thumb.

Ulnar Flexion—Flexor and extensor carpi ulnaris.

Dislocations (rare)—Forwards and backwards.

HIP JOINT (Enarthrodial).

Ligaments—

Capsular { Ilio-femoral. Pubo-femoral. Ischio-femoral.

Capsule attached around acetabulum, and below to anterior inter-trochanteric line, base of great trochanter, and middle of posterior surface of the neck.

Ligamentum Teres—Head of femur to acetabulum.

Cotyloid Ligament—Transverse ligament.

Ligamentum Reflexa—Deep fibres of capsule reflected on to neck of femur.

Movements—

Flexion—Psoas, iliacus, pectineus, sartorius, rectus femoris.

Extension—Glutei and hamstrings.

Abduction—Glutei and tensor fascia femoris.

Adduction—Three adductors, pectineus, gracilis.

Rotation Outwards—Gluteus maximus, psoas and iliacus, obturator internus and externus, gemelli, pyriformis, quadratus femoris.

Rotation Inwards—Gluteus medius and minimus, tensor vaginæ femoris.

Circumduction—All.

Dislocations—To dorsum ilii, sciatic notch, pubic, thyroid.

KNEE JOINT.

Condyles of femur, tibia and patella.

Ligaments—

(*a*) Extra-Articular.

Anterior—Ligamentum patellæ.

Posterior—Ligamentum posticum Winslowii.

Internal Lateral—Internal condyle to tibia, upper two inches of shaft.

External Lateral—External condyle to fibula—*long* to head of fibula, *short* to styloid process of fibula.

(*b*) Intra-Articular.

Anterior Crucial—From front of spine of tibia to external condyle.

Posterior Crucial—From back of spine of tibia to internal condyle.

Semilunar Cartilages—Internal and external.

Transverse and *Coronary* ligaments.

Synovial Membrane very extensive, and having three folds, ligamentum mucosum and ligamenta alaria.

Movements—

Flexion—Hamstrings, gastrocnemius, popliteus, and plantaris.

Extension—Quadriceps extensor.

Rotation Inwards—Semi-membranosus, popliteus, semi-tendinosus, gracilis.

Rotation Outwards—Biceps, quadriceps extensor.

Dislocations—Outwards, inwards, forwards, backwards.

ANKLE JOINT.

Tibia, fibula, and astragalus.

Ligaments—

Anterior (thin)—Tibia to astragalus.

Posterior—Place taken by transverse ligament.

Internal Lateral (deltoid)—From internal malleolus to scaphoid, sustentaculum tali, and astragalus.

External Lateral—Three bands from external malleolus—two to astragalus, and one to os calcis.

Movements—

Flexion—Tibialis anticus, peroneus tertius, extensors of toes.

Extension—Muscles of calf, tibialis posticus, peroneus longus and brevis, flexors of toes. (Slight lateral movement in the extended position).

Dislocations—Outwards, inwards, backwards, forwards, and upwards.

OSSIFICATION OF EPIPHYSES.

The following Table, which shows *approximately* the various periods when the epiphyses join the shafts of the long bones, may be found of use in showing up to what age separation of epiphyses may occur:—

CLAVICLE — Epiphysis at sternal end joins shaft about 25th year.

SCAPULA ... { *Coracoid process* joins body of scapula about puberty.
Acromion process joins spine of scapula about 22nd to 25th year.

HUMERUS..	*Lower Extremity*	joins shaft about	16th year.
	Internal Condyle	" "	18th year.
	Upper Extremity	" "	20th year.
RADIUS.....	*Upper Epiphysis*	" "	17th year.
	Lower Epiphysis	" "	20th year.
ULNA	*Olecranon process*	" "	17th year.
	Lower Epiphysis	" "	20th year.
FEMUR.....	*Upper Epiphysis*	" "	18th year.
	Lower Epiphysis	" "	20th year.
TIBIA.....	*Lower Epiphysis*	" "	18th to 19th year.
	Upper Epiphysis	" "	21st to 22nd year.
FIBULA.....	*Lower Epiphysis*	" "	21st year.
	Upper Epiphysis	" "	24th year.

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THE Topographical Anatomy of the Child

BY

JOHNSON SYMINGTON, M.D.,

F.R.S.E., F.R.C.S.E.,

Professor of Anatomy, Queen's College, Belfast; formerly Lecturer on Anatomy, School of Medicine, and Examiner in Anatomy, University of Edinburgh.

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The vertical medial sections and some coronal sections of the thorax are the most valuable. Sections are given of all parts of the trunk; of the skull, to show the orbits and nasal fossæ; of the neck, to show the position of the larynx; of the thorax, abdomen, and pelvis.

The First Part of the work is devoted to a critical explanation of the Plates. The Second Part deals systematically with the more conspicuous results of the author's investigations. The topographical anatomy of the auditory meatus and tympanum, the condition of the spinal curve in children, the topography of the brain, and the relational anatomy of the male and female genital organs, are all dealt with in an able and original manner.

Dr Symington's book abounds in original material. It is a work that no anatomist can afford to overlook. It adds materially to our knowledge of the most practical branch of anatomy, and is a credit to modern scientific research. —*The International Journal of the Medical Sciences*, October 1887.

While the anatomy of the human subject, during the earlier months of intra-uterine life, has been investigated with great care and minuteness, and while our knowledge of the topographical anatomy of the adult has been enriched by the labours of numerous investigators, comparatively little attention has been paid to the peculiarities in the anatomy of the infant, and the changes that occur from the time of birth up to that of adult life."—In these words Dr Symington gives the reasons that have moved him to undertake and carry through the investigation of which this volume forms the very tangible result. Not only is it true that very little has been published on the subject, but it is also true that no inconsiderable part of that little was erroneous; and there is scarcely a page of this book but corrects some common error, or throws new light on anatomical relations as they occur in the child.

The mode of investigation pursued has been mainly that by sagittal, horizontal, and coronal frozen sections of the body made at different levels, but supplemented by other methods where fuller information was required. The work is divided into two Sections, the First forming a running commentary on the Plates, and the Second a formal discussion of the points wherein differences are observable between the anatomy of the adult and that of the child.

Hitherto, anatomists have had no very clear ideas as to the date of formation of the air cavities in the mastoid, frontal, and superior maxillary bones, in all of which, but more especially the first, accurate knowledge as to their presence or absence at a given age might be of essential importance in a surgical aspect. Dr Symington has brought much evidence to bear on the subject, and if he has not settled the question, has done much to elucidate it. He found that the *antrum mastoideum* (a cavity, as he remarks, generally overlooked by anatomists) was present at the time of birth in all the specimens examined by him; but he is of opinion that the pneumatic cavities generally are not formed in the lower part of the mastoid till about the time of puberty. This it will be seen is an important observation in connection with the question of trephining the mastoid for suppuration of the middle ear. The frontal sinuses he found in his specimens to be absent at six years of age and present at nine, so that we have thus pretty clearly indicated the date at which they commence to form. In regard to the antrum of Highmore, he notes that, as a rule, it opens into the infundibulum, and not, as is commonly stated, into the middle meatus, although sometimes a second opening is found leading directly into the latter.

On the much disputed point as to the position of the heart in children, he dissents from the view that in them the base of the heart is higher than in adults. He calls attention, however, to the greater relative size of the heart, and the narrowness of the front of the chest in children, and remarks that as a consequence the apex of the heart reaches to, or even beyond, the nipple line, and may be felt in the fourth intercostal space as well as the fifth.

We would note as especially worthy of careful perusal, the section on the position and growth of the larynx, that on the production of the lumber curve of the vertebral column, and the elaborate account of Dr Symington's researches into the development of the jaws and teeth.

The numerous references at the bottom of each page testify to the painstaking care with which the author has studied the subject, as well as displaying a praiseworthy anxiety to give full credit to all fellow-workers in the same field.

We must not omit to express our high appreciation of the clearness, accuracy, and artistic finish of the coloured Plates. The numerous reference lines crossing their surface do to some extent mar their beauty, but these lines greatly simplify the understanding of the plates, and render unnecessary the usual reference tables, and to obtain so desirable a result even greater sacrifices might have been excused. We congratulate Dr Symington on the successful termination of his important investigation.—*The Glasgow Medical Journal*, November 1887.

To the study of sections of the frozen human body we owe most of the recent great advances in our knowledge of Topographical Anatomy. The older method of dissection causes a certain amount of displacement, and often destroys the relations of important deep parts to their superficial landmarks; and, therefore, until this new method enabled us to check the results of dissection, many false views were current concerning the actual situation of organs. Dr Symington's work is one of the most valuable contributions to the literature of Sectional Anatomy; and is one of the most creditable pieces of original research in this department that have been produced in Britain within the last few years. He has illustrated the topography of a number of parts which are of the deepest interest to the practical surgeon and physician as well as to the anatomist, such as the relative positions of the heart, lungs, and liver at different levels, the relations of the larynx and trachea, and the pelvic viscera in children of the two sexes. All of these are points concerning which the practitioner requires to have the most precise knowledge, on account of their bearing on tracheotomy, lithotomy, &c. . . . .

The letterpress has been written with much care, and shows an extensive acquaintance with the literature of the subject. We note with special interest the sections on the Topography of the Ear, the Jaws and Teeth, the Heart, and the Bladder, as worthy of particular attention. Altogether we can commend the work as an excellent and trustworthy guide, and one which the practical physician and the operating surgeon will do well to consult.—*The Practitioner*, August 1887.

The book before us is probably one of the most important contributions to our knowledge of human Anatomy that the Edinburgh School has furnished for many years, and Dr Symington may be congratulated on the completion of a work of such sterling worth. The task which the author set before him was the investigation of those peculiarities of structure which are to be seen between the time of birth and the attainment of maturity. These two extremes of the period have been often fully discussed, but not so the intermediate stages; hence the importance of trying to trace the steps of change from one to the other. Although it might have been possible to infer the association of peculiarities of structure from some that are well known, the method would have been a dangerous one, and unscientific; and Dr Symington has carefully and methodically followed the safer plan of original investigation. Since the differences to be expected are chiefly questions of the relative size and position of various parts and organs, no method of research was likely to yield such good results as that of frozen sections—the one adopted in the present instance.

The work is divided into two Parts. The First Part consists of a series of Plates, illustrating sections of the bodies of children cut in various directions, with sufficient explanatory text to make clear all peculiarities of structure, and with the addition of Woodcuts where considered advisable. The general plan of the sections is much the same as that carried out by Braune and other investigators of adult structure. The first Plate represents a mesial section of a girl, æt. 13; the next, a similar one of a boy, æt. 6. The third and fourth Plates represent various sections of the head; while from Plates V. to X. inclusive, serial cross sections of the trunk are represented. Plate XI. has one cross section, and one in the mesial plane illustrating the lower part of the abdomen and pelvis. Plate XII. consists of two most valuable figures, illustrating the relation of internal viscera to the abdominal and thoracic walls constructed synthetically from cross

sections. One is from the body of the girl, æt. 6, from which the series of cross sections has been figured; and the other is from the body of a boy, æt. 5, which was used to illustrate several doubtful points, and from which several woodcuts were drawn. Both views are from the front, and, of course, represent the thorax in extreme expiration. An extra view from behind might have been an advantage. On the figure of the female child's body are marked delicate lines, indicating the sections and a reference to the Plate where the view of the section itself may be found. This will prove of great service in the study of the Plates. Corresponding references to the woodcuts in the other built-up figure serve a similar purpose. Plates XIII. and XIV. are from vertical transverse sections of the thorax and abdomen. The execution of the Plates is excellent, and gives evidence of care no less than of artistic skill.

In the explanatory text Dr Symington has entered as much into detail as each Part seems to require. It would have been better had he mentioned the thickness of each section, so as to enable the reader to follow the series more easily, but the need for this is less since the synthetical figure has been given on Plate XII.

The Second Part is perhaps the more valuable portion of the work. Here, under separate sections, the peculiarities of structure of the child are systematically discussed. After an introductory sketch of the literature of the subject, the author takes up the Brain, and points out the important differences in its topographical relations to the skull in children and adults. The Ear is next discussed, and many facts either hitherto unknown or almost forgotten are brought under our notice. The Frontal Sinuses having been briefly referred to, a most interesting Essay follows on the Mode of Eruption of the Permanent Teeth, which will repay careful study. In like manner are treated the Vertebral Column and its Curves, the Spinal Cord, the Neck, Thorax, Abdomen, Male Pelvic Viscera, and Female Genitals. In all of these there is evidence of the same honest and careful investigation; while references to the work of others show that this department of inquiry has not been neglected. Some of the Sections have already appeared as original papers, but they are not less welcome when combined with much that seems quite new in a connected form.

"The Topographical Anatomy of the Child" will undoubtedly remain a standard work on the subject; and, while adding very distinctly to Dr Symington's reputation as an anatomist, will reflect credit on the School to which he belongs.—*The Edinburgh Medical Journal*, August 1887.

In der Bearbeitung der theoretischen Grundlagen liegt die Zukunft der Kinderheilkunde. Nur wenn durch immer neue Forschungen die Besonderheiten des wachsenden Menschen erforscht werden, muss die Berechtigung der Pädiatrie als Fachwissenschaft allseitig anerkannt werden. Natürlich darf solches Studium nicht allein dem Theoretiker überlassen bleiben. Auf dem Gebiete der Physiologie des Kindesalters haben auch thatsächlich die Kinderärzte wacker mitgeholfen, weit weniger auf dem der Anatomie (z. B. Fleischmann). Aber auch die Anatomen haben dieses Feld selten betreten, und als Henke für die erste Auflage des Gerhardt'schen Handbuches die Anatomie schreiben sollte, konnte er sich nicht auf eine Zusammenfassung des bisher Bekannten beschränken, sondern musste an allen Punkten neue Untersuchungen anstellen, die für die zweite Auflage bedeutend erweitert wurden, aber noch immer kein vollständiges Bild liefern. Seither hat Dwight (Frozen Sections of a Child, New York, 1881) fünfzehn aufeinanderfolgende Horizontalschnitte durch ein 3 jähriges Mädchen abgebildet und erläutert, die uns über einige Verhältnisse aufklären. Dieses Buch wird durch das vorliegende, dessen Erscheinen wir mit besonderer Freude begrüssen, bei weitem übertroffen. S., Lecturer der Anatomie in Edinburgh, hat bereits durch einige anatomische Arbeiten (The External Auditory Meatus in the Child, Journal of Anatomy and Physiology, 1885; Position of the Empty and Distended Bladder in the Male Child, Das. 1885; On the Relations of the Larynx and Trachea to the Vertebral Column in the Fœtus and Child, Das. Vol. IX. u. a. m.) den Dank der Kinderärzte verdient, im vorliegenden, W. Braune in Leipzig gewidmeten, prachtvollen Werke vereinigt er eigene und frembe Studien auf diesem Gebiete zu einem Ganzen.

Auf die wichtigen Ergebnisse können wir leider nicht im Einzelnen eingehen, empfehlen dagegen allen Fachleuten das Buch aufs wärmste und hoffen, dass es auch ausserhalb des Gebietes der englischen Zunge zahlreiche Käufer finden werde. Der erste Theil enthält in grossen farbigen Tafeln: Sagittalschnitt durch ein 13 jähriges Mädchen, den gleichen durch einen 6 jährigen Knaben, drei Frontalschnitte durch den Kopf eines 5 jährigen Mädchen, einen Horizontalschnitte durch den Kopf eines 4½ jährigen Knaben, 13 Horizontalschnitte durch den Rumpf eines 5 jährigen Mädchens, Sagittalschnitt durch den Unterleib desselben Kindes, zwei schematische Bilder über die Lage der Bruste—und Baucheingeweide bei einem 6 jährigen Mädchen und einem 5 jährigen Knaben, zwei Frontalschnitte durch einem 4½ jährigen Knaben. Einzelheiten sind in besonderen Holzschnitten erklärt. Jede Tafel wird von einer Erläuterung begleitet, welche auf die Unterschiede gegenüber dem Erwachsenen eingeht.

Der zweitt Theil Enthält die Literatur der anatomischen Abbildungen des Kindes und geht dann systematisch auf die Anatomie desselben ein. Es werden nacheinander besprochen: Gehirn, Ohr, Stirnbeinhöhlen, Kiefer und Zähne, Wirbelsäule, Hals, Brustkorb, Unterleib, männliche und weibliche Beckenorgane. Auch hier helfen sehr deutliche schematische Zeichnungen zum Verständniss der Worte. Auch auf praktische Fragen (Tracheotomie, Steinschnitt) wird Rücksicht genommen. Der einzige Fehler dieses Werkes scheint uns die geringe Berücksichtigung des ersten Lebensjahres zu sein. Im Uebrigen können wir nur den Wunsch wiederholen, das Buch möge unter den Kinderärzten die verdiente Verbreitung finden.—Für die Ausstattung verdient die Verlagsbuchhandlung ein besonderes Lob, und es läge vielleicht in ihrem Interesse, wenn sie die Tafeln auch mit deutscher Erklärung erscheinen lassen würde, umsomehr als die englische Auflage, wie wir erfahren, eine sehr niedrige ist.—RAUDNITZ (Prag).—*Centralblatt für Kinderheilkunde*, 3rd September 1887.

Dr Johnson Symington has well filled a gap in our Topographical Anatomy. This department of anatomical science has been worked at most extensively and ably by Pirogoff, Braune, Luschka, and others, in the adult; but the method of frozen sections has hitherto been systematically applied to the child, in one case only, by Professor Dwight. Dr Symington has added to our knowledge by presenting us in this work with fourteen coloured lithographic illustrations, all life-size, and thirty-three woodcuts taken from sections of male and female children, aged four years and a half, five years, six years, and thirteen years, and has given us a large number of very accurate observations on the position of the various organs and viscera, and the changes which they undergo in the earlier periods of life. The horizontal sections have been taken from a girl six years of age, whilst the vertical sections (both coronal and sagittal) are from children of both sexes and various ages. In addition to the illustrations, the work is most valuable for excellent letterpress, treating very fully and minutely of the position of structures at all periods of early life, and it is evident that many of the views generally held in regard thereto will have to undergo considerable alteration. For example, Dr Symington shows that the external auditory meatus is relatively as long in the child as in the adult, when examined in the fresh state in subjects with the entire head frozen; that the spinal cord in the newly-born child ceases at much the same point as in the adult; that the child's neck is not relatively short, but that it is higher in relation to the vertebral column than in the adult. The common assumption that the position of the stomach in the child is vertical is also shown to be erroneous, and is proved by figures taken from an infant four days old, and from a girl six years of age. The portion of the book devoted to the position of the pelvic viscera in male children is of great importance to surgeons, and will be carefully studied in view of operations on the urinary organs in early life. Too much praise cannot be bestowed upon the author for the obvious care and industry with which he has pursued his investigation, and the accuracy and fidelity with which he has reproduced its results. Its dedication to Professor Braune is a most graceful compliment to an anatomist who has done more to advance the knowledge of Topographical Anatomy than any other worker in this special branch.—*The Lancet*, 22nd October 1887.

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