Regional anatomy.

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NOTES ON REGIONAL ANATOMY

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REGIONAL ANATOMY.

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REGIONAL ANATOMY;

CONTAINING A

DESCRIPTION OF THE MOST IMPORTANT

REGIONS OF THE HUMAN BODY;

WITH THE RELATIVE ANATOMY OF THE PARTS COMPRISED THEREIN, DESIGNED AS A GUIDE IN THE PERFORMANCE OF THE

PRINCIPAL OPERATIONS IN SURGERY.

BY

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PREFACE.

THE great fault in most anatomical works is, that parts of little moment are most minutely described, and others of essential importance receive but little consideration. A small nerve, that can with difficulty be distinguished by the naked eye, is traced to its final destination in a most minute description, whilst an important blood-vessel, or a large nerve, or the relations of these, are passed over with but trifling attention; the result is, that the student is induced to burden his memory with minutiæ which he finds it necessary afterwards to discard, and to apply himself to the attainment of knowledge to which his attention should have been especially directed at the commencement of his studies. How many hours are thus lost which can never be recalled, and how much labour wasted, in the acquisition of informa-

tion which can only be useful to the profound anatomist or the deep-searching physiologist.

Regional or relative anatomy has been particularly neglected. There is no work in the English language which supplies a concise and practical description of the human body, and which may be not only useful to the student, but also to the professional man, who seeks employment in the public service by competitive examination, or who is engaged in the arduous discharge of his duty as a practitioner.

This work has been completed with a view to meet these defects, and supply this deficiency. That it will succeed in accomplishing these desirable objects, is the earnest wish and the expectant hope of the Author.

CONTENTS.

REGIONAL ANATOMY.

THE study of *Regional Anatomy* is best suited to the advanced student; it is only when, by the study of descriptive anatomy, a competent knowledge of the muscles, vessels, and nerves has been attained, that these parts may be considered together, and their relative anatomy or relations to each other distinctly understood; then the study of Regional Anatomy becomes useful and profitable; undertaken at an earlier period, the pursuit is vain and unprofitable.

The importance of the study of Regional Anatomy is at once apparent, when we reflect that its knowledge is the great object of all anatomical study; as by it we are enabled to perform our operations with ease, safety, and rapidity; to cut down on an artery with as much certainty as we should follow a turnpike-road, guided by so many finger-posts, and when the vessel has been exposed, to place around it the ligature, without including any of the surrounding parts of importance; to amputate a limb or a breast, or remove a tumour, without hesitation as to our being able to secure the bleeding vessel or to avoid the large arteries or nerves.

Regional Anatomy is also useful in enabling us to explain many of the phenomena presented by disease, and to account for symptoms which would otherwise be unintelligible.

or forms the stylo-maxillary ligament; anteriorly it is lost on the masseter muscle; and posteriorly it is attached to the meatus auditorius externus.

Beneath this layer of dense fascia lies the *parotid gland;* this, the largest of the salivary glands, lies imbedded in the parotid space as described, and thence sinks deep behind the ramus of the lower jaw, sending processes between the pterygoid muscles close to the base of the skull, where it is closely related to the numerous important vessels and nerves in this region.

On cutting carefully into the substance of this gland, the *portio dura* or *facial* nerve is seen; this passes out of the stylo-mastoid foramen, at a depth of an inch and a quarter or a half from the surface, passes forwards through the substance of the parotid gland, and becoming superficial divides into a retiform plexus, the *pes anserinus*, which emerges from the gland, and divides into numerous filaments to supply the side of the temple, face, and neck, anastomosing freely with the branches of the fifth nerve and cervical plexus.

Beneath, and covered by this, is the *external jugular* vein; this vessel is formed here by the junction of the temporal and internal maxillary veins, descends from the lower extremity of the gland, crossing the outer surface of the sterno-mastoid muscle, to terminate in the subclavian vein.

Immediately beneath the external jugular vein is the *external carotid artery;* this vessel enters the lower extremity and deep surface of the gland, ascends outwards, between the ramus of the lower jaw and meatus auditorius externus, and, about midway between the angle of the jaw and zygoma, divides into its two terminating branches, the internal maxillary and temporal arteries; the former of these

passes inwards behind the ramus of the lower jaw, between it and the internal lateral ligament, to terminate in the spheno-maxillary fossa; the former passes upwards in the course of the external carotid trunk, and escapes from the upper margin of the gland, crosses over the zygoma immediately in front of the ear, to terminate in the temporal region.

More deeply seated, the portions of the parotid gland are found between the pterygoid muscles, in the posterior part of the glenoid cavity, round the styloid process, etc., and are here in close relation with the internal carotid artery and internal jugular vein, the eighth and ninth nerves and third division of the fifth.

The parotid gland is the largest of the salivary glands; its secretion, the saliva, is eliminated in the small granules or acini of the gland, and is thence conducted by small ducts to the principal duct, Stenon's or Stenson's duct (ductus Stenonis), which is thus formed by a junction of the smaller ducts, emerges from the anterior edge of the gland, crosses the masseter muscle below the socia parotidis, having also the transversalis faciei artery above, the branches of the facial nerve above and beneath it, and at the anterior edge of the masseter dips in, penetrates the buccinator muscle, and opens in the mouth, opposite the second molar tooth of the upper jaw. A line drawn from the lobe of the ear to midway between the angle of the mouth and ala nasi would indicate the course of the duct, and the centre of the line its point of opening into the mouth. The length of the duct is about two and a half inches, its diameter about a quarter of an inch; its canal is small, and its opening little larger than a bristle. Its structure is fibro-mucous; the fibrous coat, derived from the cervical fascia, is lost on the

buccinator muscle, its mucous perforates this, and is continuous with the membrane of the mouth.

A prolonged portion of the parotid gland, *socia parotidis*, lies on the masseter muscle above the duct; it opens into this by a small duct.

The parotid is supplied with blood from the arteries in its substance; its nerves are derived from the great auricular, the auricular of the fifth and the sympathetic; its absorbents join those of the neck and about the lower jaw.

The parotid gland is the seat of acute inflammation, *cynanche parotidea*, and sometimes of abscess; the matter may burst through the anterior part of the meatus auditorius externus, and be discharged by the external ear. It is also subject to malignant disease, and has been supposed to be removed; but, from the connections of its deep portions, this must be all but an impossibility.

The parotid duct is sometimes wounded where it crosses the masseter muscle, and gives rise to a very troublesome fistulous opening on the cheek.

The external carotid artery in the gland is not the subject of operation, except in the attempt to remove it; in this the vessel should be tied beneath the gland, although this will scarcely prevent secondary hemorrhage, as the anastomosing vessels will soon re-establish the circulation.

The portio dura or facial nerve is sometimes divided for the cure of tic douloureux, as it escapes from the stylo-mastoid foramen; the operation is performed by cutting along the anterior margin of the mastoid process, between that and the parotid gland, to the depth of about one inch and a half; the posterior auricular artery is usually cut across. This operation is now seldom performed, and is still less frequently followed by success.

Section II.

THE TEMPORAL REGION

Is that enclosed by the temporal ridge above, in front, and behind, and beneath by the zygoma; it contains the temporal muscle, covered by the temporal aponeurosis, the superficial and deep temporal arteries, and numerous nerves. On raising the integuments, the course of the temporal vessels and nerves is exposed.

The *temporal artery* arises from the external carotid, in the substance of the parotid gland, crosses the zygoma, and a short distance above this, varying from half an inch to two inches, divides into its three terminating branches—the anterior, posterior, and middle temporal arteries.

The *arteria temporalis anterior* passes upwards and forwards to the side of the temple and forehead, and divides into numerous branches to the integuments, and anastomoses with the supra-orbital artery.

The *arteria temporalis posterior*, larger than the preceding, passes upwards and backwards over the ear, and supplies the integuments in this region, anastomosing with the branches of the occipital artery.

The *arteria temporalis media* perforates the temporal aponeurosis to supply the temporal muscle, and anastomoses with the deep temporal branches of the internal maxillary artery.

Numerous nerves accompany the branches of the temporal artery; they are derived from the great auricular of the cervical plexus, the auricular of the third division of the fifth, the malar branch of the first or ophthalmic division of the fifth and the facial nerve; they all anastomose freely.

The temporal veins terminate in the external

jugular. The anterior temporal artery is usually chosen in arteriotomy, in cases of ophthalmia, meningitis, apoplexy, etc. Having traced the course of the artery, fix the vessel between the two fingers of the left hand, and then open into it without cutting it across.

In cases of hemorrhage from this artery, it should be cut across, and the bleeding stopped by compress and bandage, or, if these fail, by a dossil of lint or sponge passed into the wound. It is difficult to tie any of the arteries of the scalp, as they retract behind this and are not easily discovered. The operation is sometimes followed by neuralgia, painful sores, inflammation of temporal aponeurosis, and abscess.

The *temporal aponeurosis* lies immediately beneath the preceding; it is a dense membrane composed of white shining fibres, attached by its circumference to the temporal ridge on the frontal and parietal bones, and inferiorly by two layers into the edges of the zygoma; its under surface is rough, and affords origin to the temporal muscle.

Beneath the aponeurosis is the temporal muscle, filling the temporal fossa, and radiating from its surface to be inserted into the coronoid process of the inferior maxilla; beneath it lie the deep temporal branches of the internal maxillary artery.

Section III.

THE LATERAL SURFACE OF THE NECK

Is of a quadrilateral shape; bounded above by the lower jaw, and a line drawn from its angle to the mastoid process, beneath by the clavicle, anteriorly by the mesial line, and posteriorly by the trapezius muscle. It is crossed diagonally from the sternum

to the mastoid process by a convex projection, exhibiting the course of the sterno-mastoid muscle, and vertically from the parotid gland, by the external jugular vein. In front of the sterno-mastoid projection is the great anterior triangle of the neck, in which are lodged the common carotid artery and its terminating branches, the external and internal carotids, the internal jugular vein, the pneumogastric and sympathetic nerves, with several branches. Behind the same projection is the great posterior triangle, in which are lodged the cervical plexus and branches and occipital artery, the subclavian artery, in its third stage, and the subclavian vein, the external jugular vein and origins of phrenic nerve.

Along the mesial line of the neck, and best marked in the male, is the irregular convex projection formed by the larynx and trachea, and behind these the pharynx and œsophagus. Beneath the chin is an incline leading backwards to the projection formed by the os hyoides; beneath this is a slight depression, about half an inch in length, corresponding to the thyro-hyoid ligament, then the projection of the thyroid cartilage, the *pomum Adami;* below this a depression, opposite the crico-thyroid membrane; then a fulness, best marked in the female, formed by the thyroid gland, and, lastly, a considerable depression, deepest in the male, immediately above the sternum and over the trachea.

The supra-hyoid and thyro-hyoid spaces are those generally injured in suicides; in the crico-thyroid space the operation of laryngotomy is performed, and in the last, the operation of tracheotomy.

Immediately beneath and closely attached to the integuments is the platysma myoides muscle; a

thin layer of muscular fibres which ascends inwards from the shoulder to the chin, crossing the sterno-mastoid muscle, the external jugular vein, and auricular nerve. On raising this the course of the sterno-mastoid muscle will be observed; this muscle stretches from the sternum and clavicle upwards and backwards, across the lateral surface of the neck to the mastoid process and occipital bone. Inferiorly, the sterno-mastoid muscle consists of two portions, the sternal and clavicular; these unite a little above the centre of the neck, and are here perforated by the spinal accessory nerve.

Crossing the sterno-mastoid muscle, almost vertically, is the external jugular vein, as already described, and, about half an inch above this, crosses the *great auricular nerve*. This is a branch of the cervical plexus; it winds round the posterior edge of the sterno-mastoid, crosses its outer surface, and ascends in front of the ear, over the parotid region, to the side of the head and ear.

The external jugular vein is best opened where it crosses the sterno-mastoid muscle. The incision should be made in the direction of this muscle, so as to cut across the fibres of the platysma myoides, the retraction of which opens the wound.

Covering the lateral surface of the neck is a dense fibrous aponeurosis, the *cervical fascia;* this may be described as commencing posteriorly in the cellular tissue close to the trapezius muscle, it thence passes forwards, becomes strong and aponeurotic, and, at the posterior edge of the sterno-mastoid, divides into two layers, so as to enclose this muscle between them; at the anterior edge of the sterno-mastoid the two layers, *the superficial and deep layers of the cervical fascia*, unite and form the sheath of the carotid artery, at the inner side of which the fascia

terminates, by forming sheaths for the laryngeal muscles, and being continuous with the fascia of the opposite side. Inferiorly, the cervical fascia is badly marked, except in front, where it covers the trachea; it is here very dense, and descends to be implanted into the sternum and interclavicular ligament; it descends along the carotid vessels into the thorax, and becomes continuous with the fibrous layer of the pericardium. Behind the sterno-mastoid it sends in a deep process, which binds down the omo-hyoid muscle, and descends beneath the clavicle, to be attached to this and the sternal end of the first rib. Superiorly, the cervical fascia is dense; it ascends over the parotid region as already described; anteriorly, it covers the digastric or supra-hyoid space, concealing the submaxillary gland and subjacent parts, and is implanted into the inner surface of the inferior maxilla and stylo-hyoid ligament.

The sterno-mastoid muscle, crossing the lateral surface of the neck diagonally, divides this region into two great triangles—the *anterior and posterior great triangles of the neck.*

1. THE ANTERIOR GREAT TRIANGLE

Has its base turned upwards, formed by the body of the lower jaw; its apex is below, at the junction of the sterno-mastoid with the sternum; it is bounded in front by the mesial line, and behind by the anterior edge of the mastoid muscle; it is divided into two lesser triangles by the anterior belly of the omo-hyoid muscle, these are—1, the *anterior inferior*, and 2, *anterior superior triangles* of the neck.

2. THE POSTERIOR GREAT TRIANGLE

Has its base at the clavicle, its apex turned upwards,

is truncated, and corresponds to the interval between the sterno-mastoid and trapezius muscles; it is bounded posteriorly by the anterior edge of the trapezius, and in front by the posterior edge of the sterno-mastoid; it is also subdivided into two triangles by the posterior belly of the omo-hyoid—1, the *posterior superior*, and 2, the *posterior inferior* triangles of the neck; the parts contained in these great triangles will be enumerated in the description of their subdivisions.

1. THE ANTERIOR INFERIOR TRIANGLE.

The apex of this triangle is at the decussation of the sterno-mastoid and omo-hyoid muscles; its base is at the mesial line, and side of trachea and larynx; its boundaries are the sterno-mastoid inferiorly, and the omo-hyoid superiorly. This space scarcely exists until the cervical fascia is divided, and the muscles are separated, this being done it is fully exposed; in it is the carotid sheath.

On the outer surface of the carotid sheath may be seen the terminating branches of the plexus, formed between the descendens noni nerve and a branch from the cervical plexus; these filaments pass to the sterno-hyoid and thyroid muscles. In the interior of the carotid sheath lie the common carotid artery, the internal jugular vein, and the par vagum, or pneumo-gastric nerve; the last behind and between the vessels, of which the artery is internal, the vein external.

THE COMMON CAROTID ARTERY

Arises on the right side from the arteria innominata, nearly behind the sterno-clavicular articulation, passes upwards and a little backwards, until opposite the upper edge of the thyroid cartilage, where it divides into the external and internal carotid arteries. In the lower part of its course, whilst in the anterior

inferior triangle, the common carotid artery is deep, being covered by the convergence of the sterno-mastoid and the sterno-hyoid and thyroid muscles, a few fibres of the platysma myoides, and the integuments; to its inner side are the trachea and larynx, which separate it from its fellow of the left side; to its outer side is the internal jugular vein, and behind, it rests, with the intervention of the posterior layer of the sheath, on the rectus capitis anticus major and longus colli muscles (which separate it from the vertebral column), the sympathetic nerves, the recurrent or inferior laryngeal nerve, and the inferior thyroid artery. The thyroid gland lies to the inner side of the common carotid artery in this stage, and generally overlaps it a little. A number of lymphatic glands accompany the carotid artery, and lie chiefly to its outer side.

On the left side, the course and relations of the common carotid artery are different. This artery arises distinctly from the arch of the aorta, ascends into the neck, and enters the carotid sheath in the anterior inferior triangle; its coverings are similar to those on the right side, but on opening the sheath, the internal jugular vein lies closer than on the right side, and generally crosses the artery at its lower part; on the inner side and posterior to it lies the œsophagus, and behind and to its outer side is the thoracic duct.

The *internal jugular vein* is the large vein which returns the blood from the brain; it descends from the foramen lacerum posterius into the neck, receiving several branches in its course, and generally communicating with the external jugular; at the lower part of the neck it diverges from the carotid artery, and joins the right subclavian vein, to form the right vena innominata; on the left

side, the vein approaches the artery, crosses it and joins the left subclavian, to form the left vena innominata.

The *par vagum*, or *pneumogastric* nerve, lies in the carotid sheath, on a plane posterior to and between the vessels. This nerve, the largest division of the eighth cerebral nerve, escapes from the foramen lacerum posterius with the internal jugular vein, but separated by a bony or cartilaginous partition, in the same sheath with the spinal accessory nerve, the glosso-pharyngeal having a distinct sheath; the nerve lies here at some distance behind the internal carotid artery, and thence descends into the neck, enters the carotid sheath, and at the lower part crosses in front of the right subclavian artery into the thorax, passes behind the root of the lung, attaches itself to the œsophagus, and terminates in the stomach and solar plexus. On the left side, the par vagum descends nearly parallel to the left subclavian artery, and crosses the arch of the aorta, to descend to the lungs and stomach.

The principal branches of this nerve are, connecting filaments, at the base of the skull, with the spinal accessory, glosso-pharyngeal, lingual, and sympathetic nerves; the pharyngeal nerve, the superior laryngeal, the inferior laryngeal or recurrent, a few cardiac filaments, and its terminating branches to the lungs, œsophagus, stomach, and solar plexus.

Internal to the common carotid artery, and frequently covering it, are the sterno-hyoid and thyroid muscles; these arising from the inner surface of the sternum, pass upwards, the former converging, the latter diverging, to be inserted, one into the os hyoides, and the other into the thyroid cartilage.

The common carotid artery may be tied in the

anterior inferior triangle of the neck; to do so, an incision should be made from three to four inches in length, along the anterior margin of the sterno-mastoid muscle, commencing a little above the sterno-clavicular articulation, in this the integuments and platysma are divided; the fascia being cut through on a director, the muscles are separated, the sterno-mastoid being drawn to the outer, the sterno-hyoid and thyroid to the inner side; the carotid sheath is now opened, having on its front a few filaments of the descendens noni plexus and some thyroid veins; the sheath is gently raised in the forceps or fingers, an opening is made into it, and a director being introduced, the sheath is carefully divided, the carotid artery is now exposed; the internal jugular vein and par vagum being drawn to the outer side, the aneurism needle is passed from without inwards, care being taken not to include the recurrent or sympathetic nerves, which lie behind the vessel.

The operation on the left side is more difficult, as the vessel lies deeper, has the internal jugular vein more close to it, and is intimately related to the œsophagus and thoracic duct, which do not exist on the right side; here, however, the operation should be more successful, as the trunk is longer, and there is more space for the formation of an internal coagulum, and the subsequent obliteration of the vessel.

Behind the carotid artery will be found the sympathetic and recurrent nerves, the longus colli and rectus capitis anticus major muscles.

Immediately above the anterior inferior triangle, the carotid artery is crossed by the anterior belly of the omo-hyoid muscle, and enters the

2. ANTERIOR SUPERIOR TRIANGLE OF THE NECK.

This region is bounded posteriorly by the sterno-mastoid, in front by the omo-hyoid muscle and mesial line; its apex is inferiorly, where the omo-hyoid crosses the sterno-mastoid; its base is above, and is formed by the lower jaw and a line drawn from this to the mastoid process. It is conveniently divided into two lesser regions by the tendon of the digastric muscle, namely, the infra-hyoid region, and the supra-hyoid or submaxillary region.

1. THE INFRA-HYOID REGION

Is small and triangular; it is bounded behind by the sterno-mastoid, in front by the anterior belly of the omo-hyoid muscle; its apex is formed inferiorly by the crossing of these muscles; its base is above, at the os hyoides and digastric tendon. In this are contained the termination of the common carotid artery in its two branches, the external and internal carotids, the descendens noni nerve, the internal jugular vein, pneumogastric and superior laryngeal and sympathetic nerves. In this part of its course the common carotid artery is comparatively superficial, as the sterno-mastoid muscle passes backwards, and leaves it covered only by the skin, platysma myoides, and cervical fascia. On raising these, the carotid sheath is exposed, having the descendens noni nerve lying in front; on opening the sheath the arteries are exposed. Here, the relations of the common artery are, to its outer side, the internal jugular vein and par vagum; to its inner, the larynx and pharynx, the superior laryngeal nerve and superior thyroid artery; and posteriorly, the sympathetic nerve and longus colli and rectus capitis anticus major muscles. In this

space the common carotid divides into its branches, *the external and internal carotid arteries*, opposite the upper margin of the thyroid cartilage. Of these two vessels,

THE EXTERNAL CAROTID ARTERY

Is the larger in the adult; at its origin it lies internal and anterior to the other, but soon curves inwards, then upwards and backwards, and becomes superficial; it passes beneath the tendon of the digastric muscle, and then turning upwards, enters the parotid gland where it divides into its two terminating branches, the temporal and internal maxillary arteries. In this course the external carotid artery forms a curve, the convexity directed inwards towards the pharynx. Beneath the tendon of the digastric, this vessel is comparatively superficial, being covered only by the skin, platysma, and cervical fascia, and crossed by the lingual nerve; behind it is the superior laryngeal nerve and the pharynx; above this it is crossed by the tendon of the digastric and the stylo-hyoid muscles; it here rests over the styloid process, which, with the stylo-glossus and pharyngeus muscles, and the glosso-pharyngeal nerve, separate it from the internal carotid artery. Above this the external carotid lies deep in the parotid gland, beneath the facial nerve and external jugular vein.

The branches of the external carotid artery are ten in number, and are divided into three sets—the anterior, posterior, and ascending.

The anterior are the superior thyroid, lingual, and facial or labial; the posterior are the posterior aural, the muscular, and occipital; the ascending are the pharyngea ascendens, temporal, internal maxillary, and transversalis faciei.

The internal jugular vein leaves the external carotid shortly after its origin, to accompany the internal carotid, from this the artery has two venæ comities.

THE INTERNAL CAROTID ARTERY,

Larger than the external in the child, proceeds from the common carotid almost directly upwards in front of the vertebral column, to the carotid foramen in the petrous portion of the temporal bone; it then traverses the canal in this, and finally enters the cranium across the foramen lacerum anticus in basi cranii, at the side of the sella turcica, and terminates opposite the anterior clinoid process by dividing into the anterior and middle cerebral arteries and posterior communicating branch.

The internal carotid is accompanied throughout by numerous filaments from the sympathetic nerve, forming the carotid plexus; these communicate with all the nerves at the base of the cranium, and at the side of the cavernous sinus with the third, fourth, fifth, and sixth nerves, and the Gasserian ganglion; they are lost in the cerebral membranes. At first the internal carotid lies to the outer side of the external, but as this passes outwards the internal gets to its inner side and much deeper; in the infra-hyoid region its coverings and relations are the same as the external carotid, but above this these vessels are separated by a considerable interval, in which pass the stylo-glossus and pharyngeus muscles and glosso-pharyngeal nerve. To its inner side lie the pharynx and tonsil, to its outer, the internal jugular vein and pneumogastric nerve; behind it is the superior cervical ganglion of the sympathetic.

The internal carotid rarely gives off branches in the neck; in the cavernous sinus, it gives off small

branches to the dura mater nerves and pituitary body, and near its termination the ophthalmic artery.

Any of the three large vessels in the infra-hyoid space may be tied here. The common carotid may be tied here in cases of wounds, or for aneurism of the internal or external carotids. The operation is performed by making an incision along the anterior margin of the sterno-mastoid muscle, corresponding to its middle third; the integuments, platysma, and fascia being divided, the carotid sheath is to be opened on a director, and the artery secured at some distance from its bifurcation. The same incision, a little higher up, will answer for tying either the external or internal carotids; the guide to these vessels will be the tendon of the digastric, near which they will be found. It is more difficult to tie the internal than the external carotid, as it lies so much deeper, even in this region; higher up the operation would be more serious, and the propriety of tying the common carotid in preference should be considered. The very free anastomosis of the carotids, especially the internal, will be found to modify considerably the success of all operations performed on these vessels.

THE SUPRA-HYOID OR SUBMAXILLARY REGION

Is situated immediately beneath the inferior maxilla, and contains the external and internal carotid, the lingual and labial arteries, the submaxillary and sublingual glands, the Whartonian duct, the gustatory and lingual nerves, some lymphatic glands, and several muscles.

This region is also triangular in shape; its base above is formed by the body of the lower jaw, and

a line from its angle to the mastoid process; its apex beneath is formed by the tendon of the digastric, and its anterior and posterior boundaries are formed by the two bellies of this muscle.

Beneath the integuments will be found the fibres of the platysma myoides strong and well marked; they ascend inwards to be attached to the inferior maxilla, in front of the masseter, the only bony attachment of the muscle, and here assist in forming the risorius Sanctorini muscle. On raising these the cervical fascia is exposed; this is dense, and consists of two layers, which enclose the submaxillary gland between them, and pass to be inserted into the inner surfaces of the jaw and stylo-maxillary ligament.

The *submaxillary gland* lies in this space, in the hollow beneath the inferior maxilla; its boundaries are, in front, the anterior belly of the digastric, behind, the stylo-maxillary ligament, which separates it from the parotid gland; it is covered by the skin, platysma, and cervical fascia; it rests on the mylo-hyoid muscle, and sends a prolonged portion round its posterior margin to join the sublingual gland. The submaxillary gland is traversed obliquely by the labial or facial artery, which, entering its lower margin, escapes from its upper and anterior edge, and thence winds round the inferior maxilla. This gland is the second in size of the salivary glands; its duct—the Whartonian duct—arises from the prolonged portion, crosses the hyoglossus muscle, and opens on the side of the frænum linguæ; it is supplied with vessels from the labial artery; its nerves are derived from the ganglion or plexus formed by the chorda tympani and gustatory nerves.

On raising the gland the mylo-hyoid muscle is exposed; this muscle unites on the mesial line with

its fellow of the opposite side, so as to form a species of diaphragmatic muscle; its posterior margin is free.

Beneath the mylo-hyoid will be found the hyo-glossus, crossed on its outer surface by the lingual and gustatory nerves and Whartonian duct, and prolonged portion of the submaxillary gland; along the mesial line are the genio-hyoid muscles, and posteriorly the stylo-glossus muscle mixing its fibres with the hyo-glossus.

The *lingual nerve* crosses the hyo-glossus muscle a little above the os hyoides; here the nerve and lingual artery are separated, the latter passing beneath or between the fibres of the hyo-glossus; at the anterior margin of this they join, and are lost together in the muscles and substance of the tongue. The *gustatory nerve* lies beneath the angle of the jaw; it thence descends, crosses the outer surface of the hyo-glossus, where it anastomoses freely with the lingual nerve; it here passes below the Whartonian duct, but soon ascends above it, to terminate in the conical and fungiform papillæ of the tongue. A few filaments from this nerve are distributed to the mucous membrane of the mouth and gums, and one or two assist in forming, with the chorda tympani, the submaxillary ganglion. The lingual is the motor nerve of the tongue, the gustatory is the nerve of special sense, the taste.

Wharton's duct, or the duct of the submaxillary gland, proceeds from the prolonged portion of the gland; it crosses the hyo-glossus muscle, as already described, to open on the frænum linguæ; this duct is about two inches in length, and consists of two coats—a fibrous and mucous; the fibrous is the outer, and is remarkably thin, so that the duct resembles a vein; muscular fibres have been de-

scribed in it by Kolliker. The prolonged portion sometimes joins.

The *sublingual gland* is the smallest of the salivary glands; it lies above the hyo-glossus muscle, close to the mucous membrane of the mouth; its ducts are numerous, from ten to twenty, and open, some into the mucous membrane beneath the tongue, others into the Whartonian duct.

The *lingual artery* is a branch of the external carotid; it arches above the os hyoides, runs along its upper border, passes beneath the hyo-glossus muscle, and at its anterior margin terminates in the sublingual and ranine arteries. The branches of the lingual artery are the ramus hyoideus and the dorsalis linguæ. Its terminating branch, the ranine, runs along the under surface of the tongue, from the base to the apex, on each side of the mesial line, and separated from its fellow by the genio-hyo-glossus muscle.

The *facial* or *labial artery* arises from the external carotid, above the lingual, passes into the submaxillary gland, forming a remarkable curve, and then winds round the inferior maxilla, to be distributed to the face. It gives off in this region the inferior palatine artery, the ramus tonsillaris, glandular branches, and the submental artery. The facial vein collects the blood from these arteries, and passing over the submaxillary gland, terminates in the internal jugular vein.

The remaining muscles found in this region are the genio-hyoid, genio-hyo-glossus, lingualis, and stylo-glossus.

The genio-hyoid occupy the mesial line, one on each side, and extend from the chin to the os hyoides.

The genio-hyo-glossus is a fan-shaped muscle, and stretches from the inner surface of the chin, to

be attached along each side of the mesial line of the tongue and to the body, cornu, and appendix of the os hyoides.

The lingualis lies between the preceding and the hyo-glossus, and consists of a few muscular fibres, which stretch from the base towards the apex of the tongue.

The stylo-glossus arises from the apex of the styloid process and stylo-maxillary ligament, and passes forwards to the side of the tongue and hyo-glossus muscle.

The submaxillary gland is subject to carcinoma, and may be removed, although the prolonged portion will add much to the difficulty of the operation. The labial artery, or the external carotid, will require to be secured before removing the gland. The lingual artery may require the ligature in cases of wounds of the tongue, or hemorrhage from this organ, in cases of ulcers, etc. This artery will always be found a little above the tendon of the digastric.

In dividing the frænum linguæ in children, the ranine artery or vein may be wounded, if the point of the scissors be not directed downwards as well as backwards.

1. THE POSTERIOR SUPERIOR TRIANGLE

Is the largest of the subdivisions of the neck ; its base is posteriorly, formed by the anterior margin of the trapezius muscle ; its apex anteriorly, where the posterior belly of the omo-hyoid decussates with the sterno-mastoid muscle ; its superior edge is formed by the posterior margin of this muscle, and its inferior by the posterior belly of the omo-hyoid. It contains the cervical plexus, the spinal accessory nerve, the transversalis colli, and occipital arteries, the splenius capitis and levator-anguli

scapulæ, and middle and posterior scaleni muscles, a number of lymphatic glands, and some veins.

This space is covered by the skin and cervical fascia, here badly marked, and inferiorly by a few fibres of the platysma myoides.

THE CERVICAL PLEXUS.

The first of the large plexuses formed by the spinal nerves, lies superficial. It is formed behind the sterno-mastoid muscle by the anterior branches of the first, second, third, and part of the fourth cervical nerves, and soon divides into numerous branches, which are usually divided into an ascending and a descending set.

The *ascending* are, the posterior occipital, the great auricular, and the superficial cervical. The *posterior occipital* arises from the second cervical nerve, ascends along the posterior edge of the sterno-mastoid muscle, which conducts it to the scalp, in which it is lost behind the ear. The *great auricular* nerve arises from the centre of the plexus, turns round the posterior edge of the sterno-mastoid, ascends along its outer surface, a little above the external jugular vein to the parotid region, where it terminates, as already described.

The *descending branches* of the cervical plexus are divided into the supra and sub-clavicular. They arise from the lower part of the plexus, and are uncertain in number; some pass over, a few beneath the clavicle, and are distributed to the integuments covering the chest and shoulders; one branch joins the descendens noni nerve, and forms the plexus of the same name.

The *spinal accessory* nerve perforates the sterno-mastoid muscle a little below the point of junction of its two portions, and is lost in the trapezius muscle.

The *occipital artery* lies deep in the upper part of this space; it arises from the external carotid artery, a little below the digastric muscle, turns backwards, passes round the lingual nerve, as this gives off the descendens noni, ascends to the inner side of the mastoid process, beneath the sterno-mastoid and digastric muscles, and across the internal carotid, the internal jugular vein, the spinal accessory and hypo-glossal nerves, and passes above the transverse process of the atlas, to the occipital bone; it here becomes superficial, and is lost in the integuments of the scalp, along with the nervous filaments from the cervical plexus. The occipital artery gives off one or two posterior meningeal arteries, which enter the foramen lacerum posterius, as the internal jugular vein passes out, to supply the dura mater.

The transversalis colli artery is met with in the lower part of the space, and is a branch of the thyroid axis of the subclavian artery; it crosses this space, and then sinks downwards beneath the trapezius muscle, to terminate in the superficial cervical and posterior scapular arteries.

The lymphatic glands in this space are very numerous, especially in the young subject; they communicate with the lymphatics of the scalp superiorly, and those of the lower part of the neck inferiorly, and terminate in the thoracic duct.

2. THE POSTERIOR INFERIOR TRIANGLE

Is the smallest of the triangles of the neck; its base is below, at the clavicle; its apex is formed by the decussation of the posterior belly of the omo-hyoid and the sterno-mastoid muscles; it is bounded superiorly by the omo-hyoid, and anteriorly by the sterno-mastoid, and more deeply by

the scalenus anticus muscle; in size it varies considerably, being modified by the extent of the sterno-mastoid muscle, the height of the clavicle, and the position of the posterior belly of the omo-hyoid, with regard to this. It contains the subclavian artery in its third stage, and subclavian vein, the transversalis colli and humeri arteries, the external jugular vein, the brachial plexus, and some lymphatic glands. Beneath the integuments covering this space is a quantity of loose cellular tissue, containing veins, lymphatic glands, and descending filaments from the cervical and brachial plexuses; the veins proceed from the lower and back part of the neck, to terminate in the external jugular, which is here large, and sinks in at the posterior edge of the sterno-mastoid, to join the subclavian vein. Next in order is the subclavian vein, which lies anterior and inferior to the artery. Next, is the subclavian artery, which rests here on the upper surface of the first rib, having the brachial plexus above and posterior to it.

THE SUBCLAVIAN ARTERY

Arises on the right side, from the arteria innominata, along with the common carotid, nearly behind the sterno-clavicular articulation; it thence ascends into the neck behind the sternal end of the sterno-mastoid, then arches downwards behind the anterior scalenus muscle, and at the lower edge of the first rib terminates in the axillary artery. In this course the subclavian artery is divided into three stages.

The *first* or *ascending* stage is from its origin to the inner edge of the scalenus; it lies deep here, being covered by the skin, platysma, sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles, and a process of the cervical fascia; the junction of the

internal jugular and subclavian veins lies in front of it, and to the inner side of this is the pneumogastric nerve, its recurrent branch, and a few cardiac filaments of the sympathetic; behind it are the sympathetic and the recurrent nerves, which last hooks round the artery to ascend behind the common carotid to the larynx.

This stage of the artery gives origin to three large branches—the vertebral, internal mammary, and thyroid axis.

The *vertebral artery* is generally the first and largest branch of the subclavian artery, from the upper and posterior surface of which it arises; it perforates the foramen in the transverse process of the sixth or fifth cervical vertebra, and ascends to supply the brain, by passing through the foramen magnum, and joining its fellow of the opposite side, forms the basilar artery.

The *internal mammary artery* arises from the lower side of the subclavian, nearly opposite the preceding, and passing downwards beneath the clavicle and subclavian vein; it is crossed by the phrenic nerve, enters the anterior mediastinum, descending close to the junction of the cartilages of the ribs and the sternum, and finally enters the sheath of the rectus muscle, and terminates by anastomosing with the epigastric artery.

The *thyroid axis* is a short trunk, which arises from the upper and anterior part of the subclavian artery, close to the scalenus anticus, and soon divides into four branches—the inferior thyroid, ascendens colli, transversalis colli, and transversalis humeri arteries. The *inferior thyroid* artery passes inwards behind the common carotid, the internal jugular vein, and par vagum, in front of the longus colli muscle and inferior recurrent nerve, and enters

the lower margin of the thyroid body, in which it anastomoses with its fellow of the opposite side and the superior thyroid branch of the external carotid.

The *ascendens colli* is a small branch, which ascends along the origin of the scalenus anticus, and anastomoses with branches from the occipital and muscular arteries.

The *transversalis colli* crosses the front of the scalenus anticus muscle and phrenic nerve, the posterior inferior triangle, and then enters the posterior superior, to terminate in the posterior scapular and ascending cervical arteries.

The *transversalis humeri* crosses a little beneath the preceding, the scalenus anticus, and phrenic nerve, the posterior inferior triangle of the neck, and sinks into the suprascapular fossa with the suprascapular nerve, the latter passing beneath the ligament and through the notch, the former over the ligament, and supplies the supraspinatus and other muscles on the scapula.

The *left subclavian artery* differs essentially from the right; it arises from the arch of the aorta, and thence ascends into the neck, first behind, then in front of the pleura, to pass, as on the right side, behind the scalenus anticus muscle; the par vagum descends nearly parallel to it, and gives off the recurrent branch, which hooks round the arch of the aorta; the thoracic duct ascends posterior to it, and between it and the left carotid, and finally gets in front, to terminate in the left subclavian vein.

It follows, from these differences in the anatomy of the right and left subclavian arteries, that the operation of tying this in its first stage must be extremely difficult, whereas, on the right side, the operation is not attended with much difficulty; here there is a portion of the vessel lying between the com-

mon carotid on the inner, and the internal jugular vein on the outer side, in which the ligature may be applied with comparative facility.

The operation of tying the subclavian artery on the right side, in its first stage, may be performed as follows:—Make an incision along the anterior margin of the sterno-mastoid, extending upwards from the sternum about three inches; make a transverse incision from the commencement of this outwards, parallel to and a little above the clavicle, to the same extent; reflect back the integuments, cut across the sterno-mastoid muscle; dividing the cervical fascia, draw the sterno-hyoid and sterno-thyroid muscles to the inner side, or divide them, if necessary; by a little dissection, the conflux of the internal jugular and subclavian veins will be exposed, and behind and internal to this, the artery crossed by the par vagum and recurrent nerve; draw the par vagum to the inner side, and pass the aneurismal needle from below upwards, avoiding the pleura and sympathetic nerve posteriorly.

In the second stage, the subclavian artery lies behind the scalenus anticus muscle; it is here also covered by the clavicular portion of the sterno-mastoid, fascia, platysma, and skin. On raising these latter, the subclavian vein is seen crossing the scalenus anticus on its anterior surface, and at a short distance above the clavicle, and behind this, the transversalis colli and transversalis humeri arteries; behind these, the *phrenic nerve* descends vertically along the scalenus anticus, and in close contact with it, to enter the thorax, sometimes crossing the first stage of the subclavian artery; it here descends in front of the root of the lung, along the side of the pericardium, to terminate in the diaphragm and solar plexus; this nerve arises from the

fourth and fifth cervical and sympathetic nerves. The subclavian artery, in the second stage, lies behind the scalenus anticus muscle, which thus separates it from its vein; it here completes its curve, the convexity turned upwards, and thence descends to its third stage. The subclavian artery here rests on the cone of the pleura. Its branches are the superior intercostal and the deep cervical.

The *superior intercostal* artery arises from its lower surface, descends in front of the neck of the first rib, to supply the first two or three intercostal spaces.

The *deep cervical* (*cervicalis profunda*) is a large branch; it passes from the upper part of the artery backwards, between the transverse processes of the last cervical vertebra and first rib, and terminates in supplying the deep muscles of the neck.

This is not a favourable stage for tying the subclavian artery, as the vessel lies deep, and is in close contact with the pleura; the separation from the vein is not sufficient to counterbalance these and other disadvantages attendant upon this operation.

The subclavian artery, in its third stage, extends from the outer edge of the scalenus anticus muscle to the lower border of the first rib. It is here covered by the skin, a few fibres of the platysma, the cervical fascia, badly marked, and, occasionally, the clavicular portion of the sterno-mastoid muscle. It lies in the anterior inferior triangle of the neck, on the first rib, the external jugular and subclavian veins being in front, the latter lower down, the brachial plexus being above, and on a plane posterior to it. From this stage no branch usually proceeds.

In this stage the subclavian artery is most frequently tied, and with success, either in cases of

aneurism of the axillary artery or of the brachial, high up, or in wounds. The first incision is made along and immediately above the clavicle, to the extent of from three to four inches, and reaching from the junction of its inner and middle third towards its scapular extremity. In this the skin, a few fibres of the platysma, the superficial nerves, and cervical fascia are divided, and, if necessary, a portion of the clavicular origin of the sterno-mastoid. By a little dissection, the external jugular vein will be exposed, and with it, frequently, a plexus of veins from about the shoulder and lower part of the neck; avoiding these, and tearing through the loose cellular tissue, the subclavian vein is brought into view, and, most probably, the transversalis humeri artery, and the posterior belly of the omo-hyoid; by passing the finger along the outer margin of the scalenus anticus muscle, the artery will be found resting on the first rib; the aneurism needle is to be passed from below upwards, avoiding the vein inferiorly, and the branches of the brachial plexus superiorly.

Here, also, the artery may be advantageously compressed against the first rib, so as to command the circulation, in cases of amputation of the shoulder-joint, hemorrhage, etc.

THE BRACHIAL PLEXUS

Is formed by the anterior branches of the fourth, fifth, sixth, and seventh cervical and first dorsal nerves, the first and last of these communicating respectively with the cervical plexus above, and the second dorsal nerve inferiorly; the fourth and fifth cervical soon join, as do also the seventh cervical and first dorsal nerves, but the sixth cervical runs some distance before joining the plexus; this lies in

the upper part of the posterior inferior triangle of the neck, above and behind the subclavian artery, and passes out from behind the scalenus anticus muscle to descend into the axilla, and supply the principal nerves of the upper extremity.

The brachial plexus gives off in the neck—one or two filaments to form the phrenic nerve, two or three subclavicular or anterior thoracic nerves to supply the subclavian and pectoral muscles; one or more of these will sometimes pass round the subclavian artery and rejoin the plexus: lastly, the *posterior thoracic;* this is a large branch (inferior external respiratory of Bell) arising from the upper and back part of the plexus, behind which it descends to the serratus magnus muscle, and chiefly to its lower part. The terminating branches of the brachial plexus are the supra-scapular, the internal and external cutaneous, circumflex, ulnar, musculo-spiral, or radial and median nerves, all of which supply the upper extremity, and will be described with it.

Section III.

DEEP VESSELS AND NERVES OF THE NECK.

On raising the common carotid artery, internal jugular vein, and other more superficial parts, the deep vessels and nerves of the neck will be more clearly seen; the former have been already described, and may be traced to their destination. The principal nerves met with in the neck are branches of the third division of the fifth; the eighth pair, viz., the par vagum, or pneumogastric, the spinal accessory, and the glosso-pharyngeal; the

ninth or hypo-glossal nerve, the cervical and brachial plexuses, and the sympathetic.

The *third division of the fifth or inferior maxillary* nerve is the largest of the three nerves given off from the Gasserian ganglion; it also receives the motor portion of the nerve, and thus this is a compound nerve, resembling those from the spinal marrow. The motor and sensitive filaments pass out through the foramen ovale and then unite, and soon after the trunk divides into two, an anterior smaller or muscular nerve, and a posterior larger or sensory nerve.

The anterior or smaller nerve gives off two *temporal filaments* to the deep surface of the temporal muscle; a *masseteric branch*, which passes through the sigmoid notch to the masseter muscle; *pterygoid branches* to the external and internal pterygoid muscles, and the buccal nerve to the buccinator muscle.

The larger or sensory portion of the nerve gives off three considerable nerves, the auricular, inferior dental, and gustatory. The *auricular* nerve, the smallest, passes backwards and outwards, behind the temporo-maxillary articulation, and terminates by sending branches to this joint, the ear, and the parotid gland, communicating with the facial and sympathetic nerves.

The *inferior dental* nerve, the largest of these branches, descends to the outer side of the gustatory, crosses the external pterygoid muscle, and then enters the inferior dental foramen, between the internal lateral ligament and the ramus of the jaw, it traverses the inferior dental canal, and supplies the teeth of the lower jaw; a branch, the *mental* or *labial* nerve, passes out of the mental foramen to the muscles and integuments of the lower lip, anastomosing with filaments from the facial nerve

and the branches of the superior maxillary nerve. Just before entering the dental foramen, the inferior dental nerve gives off its mylo-hyoidean branch, which runs in a groove in the inferior maxilla to the mylo-hyoid and digastric muscles.

The *gustatory* nerve, concealed at first by the external pterygoid muscle, crosses the internal pterygoid muscle, passing between it and the mucous membrane of the mouth, and thence runs forwards, as already described, to terminate in the tongue. The gustatory nerve, as it passes to the inner side of the lower jaw, is joined by the chorda tympani nerve, a branch of Meckel's ganglion, and which again leaves the gustatory to terminate in the submaxillary ganglion or plexus.

Of the eighth pair of cerebral nerves met with in this dissection, the pneumogastric or par vagum has been already described with the carotid artery. The *spinal accessory* branch passes out of the foramen lacerum posticus along with the par vagum, communicates with the other nerves at the base of the cranium, descends outwards, perforates the sterno-mastoid muscle, crosses the posterior superior triangle of the neck, and is lost in the trapezius. The *glosso-pharyngeal* is the smallest of the three; it passes out of the same foramen, but in a distinct sheath of the dura mater, forms two ganglions, from which proceed communicating filaments to the other nerves at the base of the cranium; it then passes forwards between the internal jugular vein and internal carotid artery, and applies itself to the stylo-pharyngeus muscle, winds round it, so as to form one of the nervous arches of the neck, and finally enters beneath the hyo-glossus muscle, to be distributed to the pharynx, the tongue, and the tonsil.

The *hypo-glossal* or ninth cerebral nerve passes out of the ante-condyloid foramen, behind the internal jugular vein and carotid artery; it then crosses forward between these two vessels, descends into the neck beneath the tendon of the digastric; it is here superficial, and turns inwards, so as to form a curve, which hooks round the occipital artery. At this point the ninth nerve gives off its descendens noni branch; it then crosses the internal jugular vein, par vagum, and carotid arteries, and ascending above the os hyoides, joins the lingual artery; the nerve crosses the outer surface of the hyo-glossus muscle, the artery passing beneath it, and is finally distributed to the muscles and muscular tissue of the tongue. The ninth nerve communicates, at its exit from the cranium, with the other nerves at the base of the skull.

The cervical portion of the sympathetic nerve consists of three ganglia, the communicating nerve, and their branches. The ganglia and trunk of the nerve lie immediately in front of the vertebral column, and are connected with the first dorsal ganglion by a branch of communication. The three cervical ganglia are named the first, second, and third.

The *first* or *superior cervical* ganglion is the largest, and is described as the first of the sympathetic ganglia; it is of a reddish grey colour, of fusiform shape, and extends along the first two vertebræ, resting on the rectus capitis anticus major muscle, behind the carotid sheath.

The *middle* cervical ganglion is generally small, and is found at the lower part of the neck, opposite the fifth or sixth cervical vertebra, and frequently resting on the inferior thyroid artery.

The *inferior* cervical ganglion, irregular in shape,

is found between the transverse process of the last cervical vertebra and the neck of the first rib.

The branches given off by these ganglia, and especially the first, are extremely numerous, they communicate with all the cerebral and spinal nerves in the neck, and send plexuses around the several arteries and their principal branches; a minute description of these is quite unnecessary. The most remarkable is the *carotid plexus*, which is derived chiefly from the superior cervical ganglion, and proceeds upwards in the *carotid* canal, surrounding the artery, and at the side of the cavernous sinus sends filaments to communicate with the third, fourth, ophthalmic, and sixth nerves, and the lenticular ganglion; a few small filaments enter the petrous portion of the temporal bone, and are called petrosal nerves; the filaments which accompany the blood-vessels are termed nervi molles, some of these occasionally form ganglia; the pharyngeal plexus receives numerous filaments.

The *cardiac* nerves are three in number on each side, and proceed one from each of the cervical ganglia. The superior cardiac nerve from the superior cervical ganglion proceeds downwards in the neck behind the carotid sheath, enters the thorax in front of or behind the subclavian artery, and terminates in the cardiac plexus. The second cardiac nerve proceeds from the second cervical ganglion, is of considerable size, and descends with the preceding. The third cardiac nerve also descends with the preceding. All these nerves communicate with the superior and inferior laryngeal nerves, and the cardiac branches of the pneumogastric nerve.

Section IV.

THE POSTERIOR CERVICAL REGION.

This region extends from the occiput downwards, to the superior border of the scapula, although, in its description, it may be necessary to allude to parts immediately beneath this; anteriorly, it is continuous with the anterior cervical region, as just described; and, posteriorly, it is bounded by the spinal column, which separates it from its fellow of the opposite side.

The skin covering this region is remarkably dense, and is connected to the subjacent parts by a quantity of loose cellular tissue, through it the projection of the spines of the vertebræ may be noticed, and especially of the last cervical, which frequently projects so much as to be mistaken for disease.

Beneath the skin there is no aponeurotic structure resembling the cervical fascia, as this terminates here, by expanding over the surface of the trapezius muscle, and is implanted on the mesial line into the posterior cervical ligament, or ligamentum nuchæ; on raising this we have exposed the *trapezius muscle*. This large triangular-shaped muscle covers the whole of this region, and extends downwards into the dorsal region, as far as the spine of the last dorsal vertebra. This muscle has a very extensive attachment; it arises on the mesial line from all the dorsal spines, the spine of the last cervical vertebra, and the ligamentum nuchæ, and superiorly, from the inner third of the superior transverse ridge of the occipital bone; its fibres converge from these different points to be inserted into the external third of the clavicle, the inner edge of the acromion, and the superior edge of the spine of the scapula. The origin of this

muscle from the sixth cervical to the third dorsal vertebra is by tendinous fibres, which, with those of the opposite side, form an oval sheet of tendon, of considerable strength.

The action of this muscle is complicated and interesting, and influences the head, shoulder, scapula, and spinal column, as one or other of these happens to be fixed. Acting from the spinal column and shoulder, its superior fibres will depress the occiput, so as to elevate the face directly, if the two muscles act; but to one side if only one act; its anterior fibres, if acting at the same moment, will rotate the head to the opposite side. If the whole spinal and occipital attachments be fixed, the trapezius muscle will then act on the shoulder, so as to raise this, draw the scapula backwards, and by means of its inferior fibres, this bone will rotate on its axis, and the glenoid cavity will become elevated. If, however, these parts be fixed, the muscle will then act on the spinal column, so as to steady it, or draw it a little to one side; this effect of the muscle is well seen in blacksmiths, porters, pressmen, and others who use one arm more than the other.

The trapezius muscle, in addition to several filaments from the posterior cervical nerves, receives a nervous supply from the *spinal accessory*, or *superior external respiratory* nerve of Sir Charles Bell, and is thus associated with the other respiratory muscles in the compound action of respiration. In the respiratory act the use of the trapezius is to fix the shoulder and scapula, and on analysis it will be found that this must first be done before any one of the other great respiratory muscles can act efficiently in inspiration. Let us trace the action through the principal of these—namely, the diaphragm, serratus magnus anticus, and trapezius ; if

this last be first thrown into action, the base of the scapula being fixed, the serratus magnus anticus will, from this, elevate the lower ribs; these will then afford a fixed attachment to the diaphragm, which, contracting its muscular fibres, descends towards the abdomen, and causes inspiration. It is clear, that if the trapezius do not first fix the scapula, the action of these muscles will be reversed, and the diaphragm will rather depress the ribs, and thus contribute to expiration. This beautiful combination of muscular action is secured by the three great respiratory nerves, arising from nearly the same point of the spinal marrow. Thus the spinal accessory, or superior external respiratory, the posterior thoracic, or inferior external respiratory, and the phrenic, or inferior internal respiratory, derive their origin from the spinal marrow, opposite about the fourth and fifth cervical vertebræ. It follows that a paralysis of any one of these nerves will produce a similar result to that caused by a paralysed condition of the other, or that a paralysis of the spinal accessory nerve will produce similar symptoms to those caused by a paralysis of the inferior external respiratory, or phrenic nerve.

The *spinal accessory nerve* is one of the divisions of the eighth pair; it arises from the respiratory tract on the lateral surface of the spinal marrow, opposite the fourth and fifth cervical vertebræ, and by a few accessory filaments from the medulla oblongata, immediately beneath the origin of the par vagum; the spinal portion of the nerve ascends in the spinal sheath, between the ligamentum denticulatum and the posterior roots of the spinal nerves, and joins the accessory portion; the spinal accessory nerve ascends into the cranium, through the foramen magnum, and joins the other portions of

the eighth nerve; the accessory filaments unite with the par vagum, the nerves escape through the foramen lacerum, and the spinal accessory traverses the neck obliquely backwards, to lose itself in the trapezius.

The *ligamentum nuchæ* has but little existence in man; it consists of a band of irregular fibres of condensed cellular tissue, which are placed on the mesial line, and are attached to the spines of the inferior six cervical vertebræ; its principal use is to afford attachment to muscles.

Beneath, and mostly covered by the trapezius, are the deep muscles of this region—namely, the splenius, complexus, trachelo-mastoideus, semi-spinalis dorsi, inter-spinalis, and the continuation upwards of the lumbar mass of muscles, or the sacro-spinalis muscle of Chaussier, which will be found in all works on descriptive anatomy.

Most deeply seated, between the atlas and occipital bone, the vertebral artery is met with; it lies here within a triangular space, bounded by the posterior small recti and oblique muscles. The apex of this triangle is at the transverse process of the atlas; the base is formed by the posterior recti muscles; its superior ooundary is formed by the obliquus capitis superior, and its inferior by the obliquus capitis inferior. Here the vertebral artery, having passed through the foramen in the transverse process of the atlas, winds backwards round the articular process of this bone, and then turning inwards, perforates the posterior broad ligament, to ascend through the foramen magnum and form the basilar artery; at the same time the sub-occipital nerve passes out, to supply the small recti and oblique muscles, and a small branch to the complexus. This nerve communicates with a filament from the first cervical nerve.

In the deep dissection of this region will be found also the terminations of the occipital and cervicalis profunda arteries; the first is lost on the occiput; the last runs between the transverse and spinous processes, sends branches to the deep muscles, and anastomoses freely with the occipital, vertebral, and spinal arteries. The deep nerves of this region are derived principally from the posterior branches of the cervical spinal nerves; much smaller than the anterior, they do not form any regular plexus, but anastomosing with each other are lost in the muscles. The sub-occipital is sometimes named as the *first cervical*, and hence some confusion in the description of these nerves; it is better to consider the cervical nerves as only seven in number, corresponding to the number of vertebræ.

There are no surgical operations of importance performed in this region; tumours occasionally form in it, and are removed; carbuncles frequently show themselves here, and require to be opened early, to prevent their extending to the deep cellular tissue, and to relieve the severe constitutional symptoms usually present. Setons are inserted in the lower part of this region, as the integuments are more loose about this part, and if inserted too high up they produce unpleasant and dangerous head symptoms.

CHAPTER II.

OF THE UPPER EXTREMITY.

The upper extremity is connected to the trunk by means of the clavicle and several powerful muscles, as the pectoralis major, the trapezius, deltoid, and it is by these means endowed with a much greater degree of mobility than the lower, this being connected to the lower part of the trunk by means of the pelvis, but which, unlike the scapula, is firmly fixed, and incapable of any motion.

Section I.

THE PECTORAL REGION

Is that on the anterior surface of the thorax, and is described by some with this region; it is occupied by the pectoral muscles, the serratus magnus anticus, several vessels and nerves, and in the female, by the mammary gland.

On raising the integuments from this region, a few fibres of the platysma may be seen to descend below the clavicle, and in the superficial fascia, a few of the supra-clavicular filaments of the cervical plexus of nerves. Beneath these is the

Pectoralis major muscle, of a triangular shape; this muscle arises by its base from the anterior surface of the sternum, and from the cartilages of all the true ribs except the last, also from the sternal half of the clavicle; from these the muscular fibres converge, the superior descending, the inferior ascending, the middle taking a transverse course, and end in a tendon, which passes to be inserted into the outer edge of the bicipital groove. A cel-

lular line separates the sternal from the clavicular origins of this muscle, and a similar line, but much larger, separates the latter from the inner edge of the deltoid muscle. In this last is the cephalic vein, the thoracica humeraria artery, and in the upper larger portion the costo-clavicular ligament, the thoracico-acromialis artery, and more deeply the axillary artery and vein. As the pectoral muscle crosses the axilla it forms the anterior boundary of this cavity, and its lower margin forms the anterior fold of the axilla. Beneath this is the

Pectoralis minor, much smaller; it arises by slips from the third, fourth, and fifth ribs, external to their cartilages, and passes upwards and outwards, to be inserted into the inner edge of the coracoid process of the scapula. As this muscle crosses to its insertion, it passes over the axillary artery, vein, and nerves, and divides the artery into its three stages. The pectoral muscles derive a large supply of blood from the thoracic branches of the axillary, and from the internal mammary and intercostal arteries; their nerves are derived from the cervical and brachial plexuses, and from the intercostal nerves.

In the female, the *mamma*—the *mammary gland*, or *breast*—lies upon the outer surface of the pectoralis major muscle, to which it is attached by loose cellular tissue; nearly circular in shape, this gland varies much as to size; its anterior surface is convex, and has nearly in its centre, but somewhat nearer the inner side, the *nipple*, or *mammilla*, a conical projection formed of the integuments and extremities of the lactiferous ducts; this is surrounded by a circular zone of integuments of a darkish colour, from one to two inches in diameter, the *areola*. The skin of both of these parts is pro-

vided with a number of papillæ and oleaginous glands. The mammary gland is made up of a number of lesser glands, about twenty altogether, which are separated, so as to form lobes, by cellular tissue; each of these is formed by a number of lobules, which in their turn are formed of a congeries of vesicles or cells, in which the milk is secreted; from each vesicle a small duct proceeds, and the several *ducts* unite into one duct, which proceeds from the lobe and opens on the nipple; these ducts are composed of fibrous tissue externally, lined by mucous membrane, not continuous with the rest of the mucous membrane of the body, except through the skin; a prolongation of the epithelium invests the inner membrane. The mammary gland is supplied with blood from the thoracic, the internal mammary, and intercostal arteries; its veins terminate in the corresponding veins; its nerves are derived chiefly from the anterior branches of the third, fourth, and fifth intercostal nerves.

The lymphatics are extremely numerous, and communicate above with the cervical, externally with the axillary, and internally with the thoracic glands in the anterior mediastinum. The deep surface of the mammary gland is nearly plane, although irregular. This gland has no distinct capsule; the cellular tissue passes into its interior, and separates the lobules from each other; it follows that inflammation and abscess are usually confined to one or more lobules. This gland is very liable to carcinoma, and is frequently removed, with but partial success. The cellular tissue of the gland, and that beneath it, may also be the seat of inflammation and abscess, without the gland participating.

The outer and lateral surface of the thorax is covered by a layer of muscular fibres, the *serratus*

magnus anticus muscle, which stretches from the nine superior ribs, except the first, and lies in close contact with them, and passes to be inserted into the base of the scapula.

Beneath the clavicle is a small muscle, the *subclavius*, which, arising from the cartilage of the first rib, is inserted into the under surface of the clavicle.

Section II.

THE AXILLA, OR AXILLARY REGION.

This important region, in which are lodged the axillary vessels and nerves, numerous lymphatic glands, and cellular tissue, should be examined from below upwards—that is, from its base towards its apex—and again from its anterior surface.

Examined from below it forms a deep fossa, covered in the adult with hairs and sebaceous follicles. On raising the integuments, one or more lymphatic glands are met with; beneath these is a dense fascia, the *axillary fascia*, which covers the cavity, and forms the floor of the axilla; anteriorly and posteriorly this fascia is connected to the anterior and posterior folds of the axilla, the former formed by the pectoralis major, the latter by the latissimus dorsi and teres major muscles; internally the fascia is gradually lost in the side of the thorax, and externally it is continuous with the brachial aponeurosis. The fibres of the axillary fascia interlace with each other; some well-marked fibres cross from one fold to the other, and bind these in their places. On removing the fascia, the axillary cavity is found to be filled with a quantity of cellular tissue, containing some fat and a number of lymphatic glands; these being removed, the shape and boundaries of the axilla are seen.

The *axillary cavity* is pyramidal in shape; the apex may be referred to the coracoid process, near which this cavity communicates with the cellular tissue of the neck, along the blood-vessels and nerves, and more particularly with the posterior inferior triangle. The base of the axilla is turned downwards, and is formed by the axillary fascia; its anterior wall is formed by the pectoralis major and minor, its posterior by the subscapularis, the latissimus dorsi and teres major. Externally, these two boundaries converge so as to leave but a small interval, in which are lodged the axillary vessels and nerves in their lower stage. The internal wall of the axilla is formed by the side of the thorax, covered by the serratus magnus anticus muscle. Crossing from this are two or three branches of nerves, the *nerves of Wrisberg*, or the *intercosto-humeral* nerves; these arise from the second and third intercostal nerves, cross the floor of the axilla within the fascia, and descend along the inner surface of the arm, becoming cutaneous, as far as the bend of the elbow. Posteriorly, the subscapular artery and nerve run along the inferior border of the scapula; the external mammary artery lies in front, and runs inwards along the inferior edge of the pectoralis minor; along the upper border of the same muscle is the thoracica suprema artery. The *posterior thoracic*, or inferior external respiratory nerve of Bell, lies deep, and descends along the inner wall of the axilla to the lower part of the serratus magnus muscle.

The anatomy of the anterior wall of the axilla has been described in the preceding chapter.

THE AXILLARY ARTERY

Is the continuation of the subclavian; this vessel enters the axilla, accompanied by its vein and the brachial plexus, through a triangular space, bounded in front by the clavicle, internally by the first rib, and externally by the scapula, thus forming a communication between the cellular tissue of the neck and axilla. The artery commences at the lower border of the first rib, from which it descends forwards and outwards, across the cavity of the axilla, and arriving at the outer wall, rests on the arm, and terminates at the lower margin of the teres major muscle in the brachial artery. In this course, the axillary artery is crossed by the pectoralis minor muscle, which thus divides it into three stages.

The *first stage* is that, above this muscle, the artery is here covered by the integuments, a few fibres of the platysma, a part of the clavicular origin of the pectoralis major, and the costo-clavicular ligament. The axillary vein lies anterior and internal to it, the brachial plexus superior and posterior to it; and behind it are the first layer of intercostal muscles, the first portion of the serratus magnus muscle, and the posterior thoracic nerve.

In its *second stage*, the axillary artery lies behind the pectoralis minor muscle, which, with the pectoralis major and superficial coverings, form its anterior relations; it is surrounded by cellular tissue, the brachial plexus of nerves envelopes it, and the vein lies to its inner side.

The *third or last stage* of the axillary artery extends from the lower border of the pectoralis minor, to the inferior margin of the teres major. It has in front of it the lower edge of the pectoralis

major and the origins of the coraco-brachialis and short head of the biceps, but towards the axilla is covered only by the integuments and fascia; it rests on the insertion of the subscapularis, and tendons of the latissimus dorsi and teres major muscles; in this stage the nerves begin to separate from the artery, which lying between the two heads of the median, has to its outer side the external cutaneous, to its inner the internal cutaneous and ulnar, and behind it the musculo-spiral and circumflex: this division of the nerves frequently takes place in the second stage. The veins form a plexus round the artery, but the principal vein lies to its inner side.

The principal branches of the axillary artery are:

The *thoracica suprema* is the first branch of the axillary; it runs inwards, along the upper margin of the pectoralis minor muscle to the thoracic parieties, in which it is lost.

Thoracica acromialis is a short but large axis, which arises a little below the preceding, and in the triangular space between the deltoid and pectoralis major divides into numerous branches to the surrounding parts.

Thoracicæ alares, or *glandulares*, are small irregular branches, distributed to the axillary glands.

Thoracica longa, or *external mammary*, is a large branch which passes inwards, along the lower margin of the pectoralis minor muscle, to be distributed to the thoracic parieties and the mammary gland.

Arteria subscapularis is also a large branch; this passes backwards, along the inferior margin of the subscapularis muscle, and terminates in supplying the muscles of the scapula and neighbourhood; a large branch, the *posterior*, passes off from it, winds round the edge of the scapula, to its dorsum, and

is there lost; it passes through a triangular space, bounded above by the subscapular muscle, below by the teres major, and in front by the long head of the triceps; the subscapular artery is accompanied by a large branch of nerve from the brachial plexus.

Arteriæ circumflexæ, anterior and *posterior*, wind round the neck of the humerus, and are lost in the deltoid muscle. The anterior is the smaller; the posterior, accompanied by the circumflex nerve, passes backwards through a quadrilateral space, bounded in front by the neck of the humerus, behind by the long head of the triceps, above by the lower edge of the scapula, and subscapularis muscle, below by the teres major.

The free anastomosis of these and other vessels which exist around the scapula exerts much influence on all the operations in this region, and especially on the tying of the principal arteries, either in the neck or in the arm. A large artery runs along each border of the scapula, and not only anastomoses freely with the others, but also with the surrounding vessels, and thus is established a free communication between the carotid, subclavian, axillary, and brachial arteries. By these means the occipital of the external carotid, the superior and posterior scapular branches of the subclavian, and the subscapular of the axillary, are united together, so that, in case of any of these trunks being tied, the circulation is at once established through the other channels.

The brachial plexus and its principal branches have been described with the preceding, and need not be again considered.

In addition to the pectoralis major and minor, the serratus magnus, and subclavius, the following

muscles are chiefly connected with this region. Posteriorly, the trapezius, latissimus dorsi, teres major, levator-anguli scapulæ and rhomboideus major and minor, supra-spinatus, infra-spinatus, and teres minor; internally, the subscapularis; anteriorly and externally, the deltoid, coraco-brachialis, and biceps; and behind the arm, the triceps.

The axillary artery is tied in its first and third stages only. To tie this vessel in the first stage, make a transverse incision immediately below the clavicle, from three to four inches in length, and extending from the inner edge of the deltoid muscle inwards; the integuments and platysma being divided, a portion of the clavicular origin of the pectoralis major muscle must be cut across; the costo-coracoid ligament being next carefully divided, the vein will first be met with, and then the artery. The presence of the cephalic vein, the thoracica acromialis artery, and its numerous branches, tend to embarrass the surgeon in this operation; it is seldom to be preferred to the operation of tying the subclavian above the clavicle.

The axillary artery is tied without difficulty in its third stage. The arm being separated from the side, an incision is made, from three to four inches in length, nearly in the centre of the axilla, but nearer its anterior wall, this being carried downwards and outwards, towards the head and neck of the humerus, in the course of the vessel. The skin and fascia being divided, the artery will be soon exposed, having the veins and nerves closely related to it, as just described.

Section III.

THE BRACHIAL REGION.

The study of this region comprises that of the brachial artery and accompanying veins and nerves, and several muscles.

Immediately beneath the skin of the arm lies the subcutaneous cellular tissue, or *superficial fascia;* in this are contained the superficial veins and nerves.

On the inner side is the *basilic vein;* this ascends along the inner edge of the biceps, and usually perforates the brachial aponeurosis, about the centre of the arm, to join the venæ comites, and form the brachial vein; in some cases, the basilic vein ascends into the axilla before joining the deep veins; this vein is accompanied by some superficial branches of the internal cutaneous nerve and the nerves of Wrisberg. On the outer side of the biceps muscle the *cephalic* vein ascends, until it arrives opposite the insertion of the deltoid muscle; it here crosses inwards, ascends in the space between this muscle and the pectoralis major, and finally sinks into the triangular space below the clavicle, to terminate in the axillary vein; in the latter part of its course this vein is accompanied by a small artery, a branch from the thoracica acromialis; one or two cutaneous branches of the musculo-spiral and external cutaneous nerves are to be found in close relation to this vein, from about the middle of the arm to a short distance below the elbow-joint.

Beneath the foregoing is found the *brachial aponeurosis*, or *fascia of the arm*. This aponeurosis is best marked on the inner side of the arm, where it covers

the brachial artery; on the outer side it is badly marked; it envelopes the limb, and sends processes inwards between the muscles, and, at different points, is attached to the various tendons; superiorly, it scarcely exists over the deltoid muscle, but internally it is denser, and is continuous with the axillary fascia; the brachial aponeurosis is here closely connected to the tendons of the pectoralis major, latissimus dorsi, and teres major muscles; inferiorly, it is attached, on either side, to the intermuscular septa and condyles of the humerus; it here descends into the fore-arm, to be continuous with the fascia of this region.

On dividing the brachial aponeurosis along the inner edge of the biceps, and separating this muscle from the triceps, the brachial vessels and nerves will be exposed.

THE BRACHIAL ARTERY

Is the continuation of the axillary; it commences therefore at the lower edge of the tendon of the teres major muscle, and thence passes downwards and forwards, until it arrives at a short distance below the elbow-joint; it here sinks into a triangular fossa, and, opposite the coronoid process of the ulna, divides into the radial and ulnar arteries, to supply the fore-arm and hand, and thus terminates. In this course, the brachial artery is comparatively superficial, and may be felt beneath the integuments, except at a little above its termination.

In the *upper* third of the arm the brachial artery lies to the inner side of the humerus; it has posterior to it the long and second heads of the triceps, with the intervention of the superior profunda artery and musculo-spiral nerve; in front of it, lie the coraco-brachialis muscle and short head of the

biceps; it is covered by the skin, superficial fascia, and brachial aponeurosis.

In the *middle third* of the arm the brachial artery rests on the insertion of the coraco-brachialis muscle, and is covered, in addition, by the inner edge of the biceps. In the *lower* third it rests on the brachialis anticus muscle to near its termination.

The brachial artery is accompanied by two venæ comites, one on each side; these unite and receive the basilic and other veins, generally about the middle third of the arm, to form the brachial or axillary vein; it is also accompanied by the median nerve, which first lies to its outer side, and then crosses it to its inner side; several cutaneous filaments of nerves, from the internal cutaneous and nerves of Wrisberg, lie superficial to it. The branches of the brachial artery are four in number—the superior and inferior profunda, the anastomotica magna, and the nutritious artery.

The *superior profunda* is the first and largest branch, and arises immediately beneath the tendon of the teres major from the back part of the brachial artery; it runs immediately backwards, winds round the humerus, between the second and third heads of the triceps muscle, accompanied by the musculo-spiral or radial nerve, and gets to the outer and anterior surface of the arm: it here lies in the fossa between the supinator longus and brachialis anticus muscles beneath the nerve, and terminates by anastomosing with the radial recurrent artery. The superior profunda artery sends off numerous branches to the muscles of the arm, particularly to the triceps. A little above the external condyle, a large branch runs backwards, sinks into the anconeous muscle, and here anastomoses with the posterior interosseous recurrent artery.

The *inferior profunda* arises opposite the insertion of the coraco-brachialis muscle, runs backwards and inwards, accompanied by the ulnar nerve, to the interval between the internal condyle and olecranon process, and here terminates by anastomosing with the posterior ulnar recurrent. This artery gives off numerous branches to supply the surrounding muscles.

The *anastomotica magna* arises about two inches above the elbow, and descends inwards in front of the brachialis anticus to the joint, where it anastomoses with the anterior radial recurrent; a considerable branch perforates the internal intermuscular septum, and terminates by anastomosing with the posterior ulnar recurrent artery.

By means of these three branches and their communications with the vessels of the fore-arm, a chain of anastomosing vessels is formed around the elbow-joint, and thus a free communication is established between the vessels of the arm and those of the fore-arm, which exerts considerable influence on the operations of tying the brachial and other arteries in this region, in cases of wounds, aneurisms, etc.

The nutritious artery arises near the inferior profunda; it enters the aperture in the middle of the humerus to supply the bone and the medullary canal.

The nerves of the arm are derived from the *brachial* or *axillary plexus;* this is formed in the lower part of the neck, as already described (see page 30), and enters the axilla with the artery and veins; it first gives off to the shoulder, the suprascapular, subscapular, and circumflex nerves, and then divides into the branches to supply the arm, fore-arm, and hand.

The *supra-scapular* nerve arises generally above the clavicle; it accompanies the supra-scapular artery to the notch in the upper border of the scapula, passes through this, and enters the supra-scapular fossa to supply this muscle, and send branches to the supra and infra spinatus and teres minor muscles.

The *subscapular nerve*, in like manner, accompanies the subscapular artery, and terminates with it in the subscapular muscle and dorsum of the scapula. The *circumflex* nerve passes backwards with the posterior circumflex artery, through the quadilateral space, and supplies the deltoid muscle.

The branches given off by the brachial plexus to supply the upper extremity, are the internal and external cutaneous, ulnar, median, and musculo-spiral or radial nerves.

The *internal cutaneous* is the smallest branch of the plexus, from the internal part of which it arises; at first, it lies to the inner side of the artery, but soon gets superficial to it, and descends towards the elbow, where it divides into an anterior and posterior branch, which descend on the front and back of the fore-arm towards its ulnar side as far as the wrist, where they are lost.

The *external* or *musculo-cutaneous* nerve arises from the upper part of the plexus; it first lies to the outer side of the brachial artery, and soon perforates the coraco-brachialis muscle; it then runs outwards between the biceps and brachialis anticus, appears on the outer side of the arm, beneath the cephalic vein, in the depression near to the external edge of the biceps muscle; from this it descends into the fore-arm along the radial side, and, sending off several cutaneous branches to its anterior and posterior surfaces, terminates in the integuments of

the wrist. This nerve, as its name implies, supplies the muscles as well as the integuments; the coraco-brachialis, biceps, and brachialis anticus muscles receive numerous filaments from it.

The *ulnar nerve* arises from the inner side of the brachial plexus; it first lies to the inner side of the brachial artery; about the middle of the arm it begins to separate from this vessel, and passing backwards through the internal intermuscular septum, it becomes imbedded in the fibres of the triceps muscle, gets between the internal condyle and the olecranon process, and thus enters the fore-arm, to accompany the ulnar artery as far as the palm of the hand and fingers.

The *median nerve* arises by two heads from the brachial plexus, one from the inner, the other from the outer cord; between these two the axillary artery lies; after a short course, these heads unite, and form the nerve which first lies to the outer side of the artery, then crosses the brachial artery about the centre of the arm, generally superficial to, but sometimes beneath it, gets to its inner side, and lies with it on the front of the brachialis anticus muscle; it then sinks into the triangular fossa, in front of the elbow-joint, and passes between the two heads of the pronator teres to descend along the centre of the fore-arm beneath the annular ligament of the wrist, to the palm of the hand and fingers.

The *musculo-spiral* nerve is the largest branch of the brachial plexus, from the posterior part of which it arises, behind the artery and other nerves; it soon joins the superior profunda, passes backwards and outwards with it, between the second and third heads of the triceps, winds round the back of the humerus, gets to its outer side, and crosses for-

wards; a little above the elbow, it lies in the fossa between the supinator longus and brachialis anticus muscle, along with the anastomosis between the superior profunda and anterior ulnar recurrent arteries, and thence passes into the fore-arm; a little below the bend of the elbow, the musculo-spiral nerve divides into two branches, an *anterior* and *posterior*, to supply the radial side of the fore-arm. The *anterior* accompanies the radial artery, in the central third of the fore-arm, but turns from it and winds round the radius to get to the back of the fore-arm; the *posterior* branch perforates the supinator brevis muscle to form the posterior interosseous nerve. The musculo-spiral nerve gives off, throughout its course, numerous branches to supply the muscles; those to the triceps are particularly numerous, and are distributed to the three heads of this muscle. One or two large branches proceed from it, as it appears on the outer side of the arm, and passing backwards behind the external condyle of the humerus, are lost in the anconeus muscle and integuments on the back part of the fore-arm.

The muscles of the arm are, in front, the biceps and brachialis anticus; internally, the coraco-brachialis; and posteriorly, the triceps. The biceps is the only one of these not attached to the humerus.

The brachial artery may be tied in any part of its course without difficulty, by making an incision, from three to four inches in length, along the inner edge of the biceps muscle; the skin, cellular tissue, and fascia have only to be divided, and the artery will be found with the relations already described. In the centre of the arm the artery is frequently overlapped by the inner margin of the biceps, which must be raised to expose the vessel. Whenever this vessel is tied, the circulation is sure

to be rapidly established by means of the collateral branches, which anastomosing with the vessels of the shoulder and scapula above, and the profunda and other vessels inferiorly, soon carry the blood to the lower part of the limb.

THE POSTERIOR BRACHIAL REGION

Does not merit a distinct description, it has been sufficiently considered in the preceding; it is occupied by one muscle, the triceps, which is covered by the integuments and fascia only, and is largely supplied with blood-vessels and nerves. A bursa mucosa of considerable size lies over this tendon, immediately behind the olecranon process, and another large bursa lies between its tendon and the back part of the humerus, a little above the elbow-joint, with which it frequently communicates.

Section IV.

THE ANTERIOR HUMERO-CUBITAL REGION, OR ANTERIOR REGION OF ELBOW-JOINT.

This region occupies the anterior surfaces of the lower third of the arm and upper third of the fore-arm, and presents for consideration many important points connected with the brachial artery and its relations, as regards the operations performed upon it in this part of its course and that of venæsection, or bleeding.

Beneath the integuments may be observed, in general, the projection of the different muscles, the course of the brachial artery, and that of the principal veins.

At the upper part, and nearly in the centre, is the projection formed by the lower end of the biceps muscle, which here descends, contracting in

size, becomes tendinous, and sinks into the hollow between the muscles of the fore-arm to its insertion.

On the outer side of this projection is a depression, in which are lodged the cephalic vein and the external cutaneous nerve, and, more deeply seated, the musculo-spiral or radial nerve and the anastomosis between the terminating branch of the superior profunda and the radial recurrent artery.

On the inner side is a similar depression, but more distinct, in which are lodged the internal cutaneous nerve, the basilic vein, the brachial artery and venæ comites, and the median nerve. On this side projects the internal condyle, offering origin to the principal pronators and flexors of the fore-arm; and on the outer side, the external condyle, less prominent, from which arise the principal supinators and extensors.

From these eminences the heads of the muscles descend to the fore-arm, and converge so as to form in the centre a triangular fossa, into which the tendon of the biceps, the brachial artery, and the median nerve sink to their several destinations.

The course of the principal veins may be recognised beneath the integuments, and should be particularly noted.

Of these, the *cephalic* vein lies on the outer side, the basilic on the inner, and, crossing obliquely to each of these, is a branch of the median vein; the *median cephalic* passes upwards and outwards, and joins the cephalic vein; the *median basilic* ascends inwards, crossing the brachial artery and tendon of the biceps to join the trunk of the basilic.

The median basilic is the most prominent of these, being thrown forwards by the brachial artery, which lies immediately behind it, with the intervention of

a little cellular tissue and the semilunar fascia of the biceps. This vein is sometimes selected, from its superficial course, for the operation of venæsection; but it is not to be recommended, as, if care be not taken, the brachial artery may be punctured, and an aneurism result.

On raising the integuments from the anterior humero-cubital region, the subcutaneous cellular tissue or superficial fascia is exposed; in it may be seen the superficial nerves and veins.

The nerves on the outer side are filaments from the external cutaneous nerve; those on the inner are derived from the internal cutaneous nerve and nerves of Wrisberg; some pass in front of the median basilic vein, some behind this vessel, to the fore-arm.

The *cephalic* vein lies on the outer side; this vessel arises from the outer and back part of the hand, near the root of the thumb, from which it ascends along the front of the fore-arm, on the radial or outer side, until it arrives in front of the external condyle; it is here much increased in size by the addition of several branches, and receives the median cephalic from the median vein; it then passes upwards along the outer side of the biceps, to terminate in the axillary vein.

A few filaments of the external cutaneous nerve lie in front of the cephalic vein, but the principal nerve lies behind this, and descends with it to the fore-arm.

The *basilic* vein arises from the inner side of the hand, ascends along the front of the fore-arm to its ulnar side, passes in front of the internal condyle, receives the median basilic vein, ascends into the brachial region, and here joins the venæ comites, to form the brachial vein, by penetrating the fascia

generally about the middle of the arm, but frequently above or below this point.

The *median cephalic* and *median basilic* are branches of the *median* vein; this vein arises more deeply than the preceding from the centre of the hand and wrist, ascends on the mesial line of the fore-arm, and a little below the elbow terminates in three branches—the median cephalic and median basilic, just described, and the *deep median*, which sinks to join the venæ comites of the brachial artery.

On raising the superficial fascia, and removing the cellular tissue in the anterior humero-cubital fossa, the principal vessels and nerves of this region are exposed, together with the semilunar fascia of the biceps, the tendon of this muscle, and the fascia of the fore-arm.

The tendon of the biceps muscle, before it sinks into the fossa to its insertion, gives off from its anterior surface a dense layer of fascia, the *semilunar fascia of the biceps*, which passes downwards and inwards, to be implanted into the fascia of the fore-arm and the internal condyle; in its course it crosses over the brachial artery and median nerve, and has in front of it the median basilic vein.

This fascia is of considerable influence in protecting the brachial artery, and in the formation of aneurisms of this vessel.

On raising this, the anterior humero-cubital fossa is distinctly seen; this is triangular in shape, and bounded on each side by the heads and bellies of the muscles arising from the condyles of the humerus, and especially by the supinator longus on the outer, and the pronator teres on the inner side; its apex is, inferiorly, formed by the convergence of these muscles; its base is above, formed by a line

drawn across the biceps to either condyle and by the brachialis anticus muscle. In this are seen the tendon of the biceps, the brachial artery, and the median nerve.

The *tendon of the biceps* sinks deep into the triangular fossa, and, passing backwards, is inserted into the posterior edge of the tubercle of the radius.

The *brachial artery* enters the humero-cubital region, along the inner side of the biceps muscle, accompanied by two venæ comites, one on each side, having the median nerve to its inner side, and more posteriorly the ulnar nerve; it rests here on the brachialis anticus muscle, and is covered by the integuments, superficial fascia, and brachial aponeurosis; from this the brachial artery advances forwards in front of the elbow-joint, and becomes so superficial as to be easily felt pulsating in the living subject; it here rests on the brachialis anticus muscle, having the median nerve to its inner side, the tendon of the biceps to its outer, and is covered by the skin, superficial fascia, and the semilunar fascia of the biceps; it is here also crossed, as just described, by the median basilic vein.

The brachial artery now descends into the fore-arm, sinks into the triangular fossa, and terminates opposite the coronoid process of the ulna, by dividing into the radial and ulnar arteries.

The median nerve descends with the brachial artery, lying on its inner side, to the triangular fossa, into which it sinks, and passing between the two heads of the pronator teres, descends to the fore-arm and hand.

On separating the outer edge of the biceps muscle from the heads of the muscles arising from the external condyle, a deep fossa is exposed, in which

are lodged the musculo-spiral or radial nerve and the anastomosis between the terminating branch of the superior profunda and radial recurrent arteries.

The brachial artery gives off but one branch in this region, the *anastomotica magna;* this vessel arises in the lower third of the arm, descends inwards in front of the brachialis anticus muscle, and terminates by anastomosing with the anterior ulnar recurrent artery.

The other arterial branches found in this region are, on the outer side of the biceps muscle, the superior profunda, anastomosing with the radial recurrent, and on the inner side the inferior profunda, which anastomoses with the posterior ulnar recurrent between the internal condyle and olecranon process.

In amputation of the arm in this region, the muscles divided are the biceps and brachialis anticus in front, the triceps posteriorly, and on the outer side the origin of the supinator longus muscle, and probably a few fibres of the extensor carpi radialis longior.

The arteries divided are the brachial, the superior and inferior profunda, and the anastomotica magna; the nerves divided are the internal and external cutaneous, the median, the musculo-spiral or radial, and the ulnar; the veins divided are the cephalic, basilic, and venæ comites.

The brachial artery is frequently wounded in this region in the performance of venæsection. As the median basilic vein is the most prominent, it is frequently selected by the inexperienced person; but as this vessel is only separated from the brachial artery by the semilunar fascia of the biceps, the slightest accident may lead to a wound of the artery, and to the formation of an aneurism. In

such cases, when pressure and other means have been resorted to, and found ineffectual, the brachial artery must be tied above and below the wounded point.

The cephalic and median cephalic veins are sufficiently removed from the brachial artery, and these should therefore be preferred, and especially by the inexperienced person. But as the most experienced cannot guard against the sudden starting of the patient, or other such accident, the median basilic should never be opened if another vein may be operated upon with equal effect.

Section V.

THE ANTE-BRACHIAL REGION, OR FORE-ARM.

This region extends from the elbow to the wrist-joint, and includes several vessels, nerves, and muscles; many of which arise in the brachial region, and have been considered with the preceding regions.

The ante-brachial region is divided into two—1, *the anterior;* and, 2, the *posterior ante-brachial regions.*

1. THE ANTERIOR ANTE-BRACHIAL REGION.

This region is somewhat tapering in shape, being larger superiorly than inferiorly; it is also flattened in the centre, and a little depressed towards the upper part. As we approach the wrist the region contracts, and is marked by the numerous tendons proceeding to the wrist and hand. Of these, three are the most remarkable, one to the outer, or radial side, is the flexor carpi radialis tendon; along its outer edge lies the radial artery. The second, nearly in the centre, and very prominent, is the

tendon of the palmaris longus; beneath this is the median nerve; the third tendon lies to the inner or ulnar side; it is that of the flexor carpi ulnaris; the ulnar artery and nerve descend along its outer margin. Beneath the integuments will be found the *superficial fascia*, and in it the *superficial nerves* and vessels. On the outer or radial side is the cephalic vein, accompanied by filaments of the external cutaneous nerve; on the inner is the basilic vein, and with it filaments of the internal cutaneous nerve; these veins are seldom distinctly formed as trunks, until near to the elbow. A little above the wrist the median nerve gives off a small branch, which becomes superficial, and descends into the palm of the hand over the annular ligament.

Beneath these is the fascia of the fore-arm; this is a strong aponeurotic structure, which invests the muscles of the fore-arm, affords them origin, and sends in between them various septa. *Superiorly*, this fascia is continuous with the fascia of the arm; it is here attached, on either side, to the condyles of the humerus, intermuscular septa, and ligaments, and in the centre to the tendon of the biceps and brachialis anticus, from which it receives fibres especially from the former; a deep layer descends, from the latter, to cover the deep muscles of the fore-arm and form the deep fascia; near the wrist the fascia becomes weak, and is attached to the anterior annular ligament. Beneath this fascia lie the muscles and principal vessels and nerves of the fore-arm.

The muscles of the fore-arm form on each side, at the upper part, a projecting mass of muscular fibres, terminating in numerous tendons as they approach the wrist. On the *inner* or *ulnar* side lie the principal flexors and pronators, arising from the internal condyle; and on the *outer* side, and arising

from the outer condyle, lie the supinators and extensors.

Between them is a triangular fossa, described in the preceding chapter, in which are lodged the brachial artery, the tendon of the biceps, and median nerve, the tendon lying to the outer, the nerve to the inner side, and the artery between; the musculo-spiral nerve lies more to the outer side, close to the supinator brevis muscle.

The mass of muscles on the inner or ~~radial~~ ulnar side are the pronators and flexors of the fore-arm; they are divided into a *superficial* and *deep*. The *superficial* are five in number, and arise in common from the internal condyle of the humerus, intermuscular septa, and fascia of the fore-arm; their order from without inwards is, pronator radii teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, and flexor digitorum sublimis perforatus: this last lies on a deeper plane than the others. The *deep* muscles are but three in number, viz., the flexor digitorum profundus perforans, the flexor longus pollicis, and the pronator quadratus. Of the superficial muscles, the pronator teres arises by two heads, between which passes the median nerve; the tendon of the flexor carpi radialis indicates the course of the radial artery; the tendon of the palmaris longus that of the median nerve; that of the flexor carpi ulnaris the course of the ulnar artery. The deep muscles have no direct attachment to the humerus; the pronator quadratus is the only muscle whose action is direct and limited, all the others have the combined actions of pronation and flexion; those which arise from the humerus affect the elbow-joint, the others only the wrist, fingers, and radio-ulnar articulations.

The arteries found in the ante-brachial region are

the radial, ulnar, and interosseous. These are offsets from the brachial, which divides opposite the coronoid process of the ulna into the radial and ulnar arteries; the latter gives off the interosseous.

The *radial artery* is the smaller branch, but is the continuation of the brachial; it runs downwards along the radial side of the fore-arm to the end of the radius; it here winds round the outer side of the wrist, enters the interosseous space between the metacarpal bones of the thumb and forefinger, and sinks deep into the palm of the hand, where it terminates by forming the deep palmar arch of arteries.

In the fore-arm, the radial artery is superficial, but in the hand it is deep; the reverse of the ulnar artery, which lies deep in the fore-arm, but superficial in the palm of the hand. The radial artery in the fore-arm is covered only by the integuments and fascia, except in the upper third, where it is slightly overlapped by the bellies of the muscles; it here lies between the supinator longus and pronator teres, but in the rest of its course, between the tendon of the supinator longus and flexor carpi radialis. In its course it *rests upon* the tendon of the biceps, the supinator brevis, the pronator teres tendon, the radial origin of the flexor sublimis, flexor longus pollicis, pronator quadratus, and the bone; it is accompanied by two venæ comites, one on each side, and in the middle third of its course only by the anterior branch of the musculo-spiral or radial nerve.

The radial artery gives off in the fore-arm numerous branches to the muscles; its principal branches are the radial recurrent and the superficialis volæ.

The *radial recurrent* is the first branch, and

arises immediately after the origin of the trunk; it turns upwards and outwards, giving off branches to the muscles, and gets between the supinator longus and brachialis anticus, where it terminates by anastomosing with the superior profunda artery.

The *superficialis volæ* artery arises a short distance above the wrist, descends to the palm of the hand, in front of the annular ligament, but frequently covered by a prolongation from it, and terminates by anastomosing with the superficial palmar arch.

The radial artery is accompanied only on its middle third by the anterior branch of the musculo-spiral or radial nerve; after this, the nerve winds round the radius, beneath the tendon of the supinator longus, and gets to the back of the fore-arm; but generally one or more filaments of the external cutaneous nerve will be found taking a superficial course over the artery as far as the wrist.

The *ulnar artery* is the larger of the two branches into which the brachial divides; it descends inwards along the ulnar side of the fore-arm, crosses the wrist to the radial side of the pisiform bone, and between the divisions of the annular ligament, and enters the palm of the hand, where it terminates by forming the *superficial palmar arch of arteries.* In the upper part of the fore-arm the ulnar artery lies deep, between the superficial and deep layers of muscles, being covered by the pronator teres, flexor carpi radialis, flexor sublimis, palmaris longus, and flexor carpi ulnaris, and resting on the brachialis anticus and flexor profundus; in the lower third, the artery is more superficial; it lies here between the tendons of the flexor carpi ulnaris and flexor sublimis, covered by skin and fascia of the fore-arm, and by an aponeurotic structure derived from

the tendon of the flexor carpi ulnaris. The *ulnar nerve* joins the artery at the junction of the upper and middle thirds of the fore-arm, and descends along its inner side to the palm of the hand, where its place is taken up by the median nerve, which forms the *superficial palmar arch of nerves.* Crossing the wrist, the ulnar nerve lies on a plane posterior to the artery.

The ulnar artery gives off three important branches in the fore-arm, the anterior and posterior ulnar recurrent and the interosseous arteries.

The *anterior ulnar recurrent* turns upwards, in front of the brachialis anticus muscle, to anastomose with the anastomotica magna artery.

The *posterior ulnar recurrent*, larger than the preceding, turns upwards and inwards beneath the flexor sublimis to the fossa between the internal condyle and olecranon process, and terminates here by anastomosing with the inferior profunda artery.

The interosseous *artery* is a large branch; it arises a little below the coronoid process, runs backwards to the interosseous membrane, and soon divides into two branches, the *anterior* and *posterior* interrosseous arteries.

The *anterior interosseous* artery descends along the front of the interosseous membrane, between the flexor longus pollicis and deep flexor, and at the lower part passes backwards between the radius and ulna to the posterior surface of the carpus, where it terminates by anastomosing with the carpal branches of the radial and ulnar arteries and the posterior interosseous branch. This artery is accompanied by a branch of the median nerve, the *anterior interosseous nerve.*

The *posterior interosseous artery* passes backwards through the interosseous space, between the ante-

rior oblique ligament and interosseous membrane, gets to the back of the fore-arm, and is lost here.

Besides the foregoing, the ulnar artery gives off a small branch, the metacarpal artery, which runs along the metacarpal bone of the little finger, forming its dorsal branch; and two carpal branches, which run along the anterior and posterior surfaces of the carpus, and ramify with similar small branches from the radial, so as to form an arterial circle round the carpus.

The *ulnar nerve* passes into the fore-arm between the internal condyle and olecranon process, and between the two heads of the flexor carpi ulnaris; after a short course it joins the ulnar artery, and descends along its inner side to the wrist; it here passes with the artery in front of the carpus and between two portions of the annular ligament, and enters the palm of the hand, where it terminates. The ulnar nerve, in the fore-arm, gives off branches to the flexor carpi ulnaris and flexor profundus muscles, and one or two cutaneous filaments above the wrist, which descend to the integuments of the palm of the hand; one branch of considerable size arises about two inches above the wrist, passes backwards beneath the tendon of the flexor carpi ulnaris, and terminates on the back of the hand and fingers.

The *median nerve* is met with in the centre of the fore-arm; it enters between the two heads of the pronator teres, and then descends between the superficial and deep layer of muscles, until at a short distance above the wrist it becomes more superficial, and lies behind the tendon of the palmaris longus; it now passes beneath the annular ligament of the wrist, and enters the palm of the

hand, where it terminates in forming the *superficial palmar arch of nerves.*

The median nerve gives off numerous branches in the fore-arm to supply the muscles; one branch, the *anterior interosseous*, accompanies the artery of the same name, and supplies the deep flexor muscles; a considerable branch arises a short distance above the wrist, perforates the fascia, crosses the annular ligament, and enters the palm of the hand to supply the integuments.

The *musculo-spiral* or *radial nerve*, a little beneath the elbow, divides into two branches, an anterior and posterior. The *anterior branch* only accompanies the radial artery, which it joins at the junction of its upper and middle thirds; it lies to the radial side of the artery during its middle third, and then winds round the radius beneath the tendon of the supinator longus muscle, gets to the back of the fore-arm and descends to the dorsum of the wrist and hand, sending filaments to the thumb and two adjoining fingers. The *posterior branch*, the larger of the two, perforates the supinator brevis muscle, and gets to the back of the fore-arm to form the *posterior interosseous nerve.*

The *deep layer of muscles* on the anterior surface of the fore-arm are three in number, namely, the flexor profundus perforans, flexor longus pollicis, and the pronator quadratus; these lie on the interosseous membrane. The tendons of the first two pass beneath the annular ligament to the hand; the last has no distinct tendon, and passes almost transversely from the ulna to the radius; it is the only direct pronator, and has no action as a flexor. In the dissection of these muscles are found the interosseous artery and anterior interosseous nerve, already described.

2. THE POSTERIOR ANTE-BRACHIAL REGION, OR BACK OF THE FORE-ARM.

This, like the anterior surface, is covered by a dense fascia, which is attached on either side to the condyles of the humerus, the olecranon process, and nearly the whole length of the ulna, having but little attachment to the radius; it also affords origin to most of the muscles, sending partitions or septa in between them. This fascia is stronger than that on the anterior surface of the fore-arm; inferiorly, it becomes condensed by some transverse fibres, and assists in forming the *posterior annular ligament;* this proceeds from the lower extremity of the radius, passing downwards and inwards, and expands upon the posterior surface of the cuneiform and unciform bones; in this course it forms sheaths for several tendons which pass beneath it, and are thus bound down to their position and action. There are six of these, and each is lined by synovial membrane; in the most external are the extensores metacarpi pollicis and primi internodii pollicis; next to this is a space for the tendons of the extensores carpi radialis longior and brevior, and a small space for the tendon of the extensor secundi internodii pollicis. Internal to these is the space for the tendon of the extensor communis and extensor indicis; still more internally is a separate fossa for the tendon of the extensor minimi digiti; and most internal of all is the space for the tendon of the extensor carpi ulnaris, which is bound down to the groove in the posterior surface of the ulna.

The muscles of this region lie beneath the fascia, and are with difficulty separated from it; at the upper part, they consist of two layers, a super-

ficial and deep. The superficial are seven in number, namely, the supinator longus, extensores carpi radialis longior and brevior, extensor communis digitorum, extensor minimi digiti, extensor carpi ulnaris, and anconeus; with the exception of the supinator longus, which arises from the humerus above the condyle, these have a common origin from the external condyle of the humerus, intermuscular septa, and fascia. The supinator longus is inserted into the radius, the anconeus into the ulna; all the other tendons pass to the hand. The tendons of the extensor metacarpi pollicis and extensores carpi radialis are inserted into the base of the metacarpal bones of the thumb first, and middle finger respectively; the tendon of the extensor carpi ulnaris into the metacarpal bone of the little finger, so that the ring is the only finger which has not a separate tendon attached to its metacarpal bone.

The extensor communis digitorum ends in three tendons a little above the wrist, the inner of which divides into two, thus forming four tendons, which are prolonged on the dorsum of the fingers to be inserted into the two last phalanges; these tendons unite with those of the interossei and lumbricales, and thus form a tendinous covering which invests the dorsal surfaces of the phalanges; the fore and little fingers have, in addition, their special extensor tendons.

On raising these muscles, without disturbing the anconeus, the vessels and nerves on the back of the fore-arm and the deep layer of muscles will be seen.

The deep layer of muscles are five in number, namely, the supinator brevis, the extensores metacarpi, primi internodii, and secundi internodii pollicis, and the extensor indicis, or indicator. Of

these, the supinator brevis is inserted into the radius; the rest are implanted into the hand, passing through grooves beneath the annular ligament, as already described.

The *posterior interosseous* artery is the principal vessel on the back of the fore-arm; it is a branch of the anterior interosseous, from which it passes backwards through the interosseous space, and running between the superficial and deep layer of muscles, descends to the wrist, where it terminates by anastomosing with the carpal branches from the radial and ulnar and the anterior interosseous artery. Its principal branch is the *interosseous recurrent*, which ascends, and in the substance of the anconeus and around the elbow-joint anastomoses with the posterior branches of the superior profunda artery.

This artery is accompanied by the posterior interosseous nerve, which is the larger branch of the musculo-spiral or radial nerve, and perforates the supinator brevis muscle to reach the back of the fore-arm, and accompany the posterior interosseous artery; this nerve sends numerous filaments to the extensor muscles, and finally terminates on the back of the hand.

The operations on the arteries of the fore-arm are so connected with wounds of the palm of the hand that they will be better considered after this has been examined.

Section VI.

PALMAR REGION, OR PALM OF THE HAND,

Unlike most parts of the body, the skin of the palm of the hand is not connected to the subjacent

parts by a layer of loose cellular tissue, but by a quantity of granular fat, which passes into the interstices between the muscles and fascia, and renders the dissection more difficult. On carefully raising the integuments and fat, *the palmar fascia*, or *aponeurosis*, the palmaris brevis muscle, the principal muscles of the thumb, and the superficial vessels and nerves, are exposed.

The superficial palmar vessels are derived from the superficialis volæ and superficial palmar arch. The cutaneous nerves are two or three in number, and are small branches derived from the median and ulnar nerves.

The palmaris brevis muscle consists of a few irregular muscular fibres, which, arising from the palmar aponeurosis, run inwards to be implanted into the integuments on the inner edge of the hand beneath the pisiform bone.

The *palmar fascia*, or *aponeurosis*, is a dense layer of fibres which covers the deep vessels and tendons of the palm of the hand, and preserves them from pressure; it is strongest in the centre, but is remarkably thin over the muscles of the little finger and thumb; triangular in shape, it is attached, at its smaller extremity, to the annular ligament of the wrist, whence it proceeds forwards, spreads out and enlarges, and finally divides into four processes, one for each finger; these processes subdivide each into two, which pass forwards, and are implanted into the lateral ligaments of the metacarpo-phalangeal articulation, leaving intervals through which the digital vessels and nerves pass; posteriorly, the fibres of the palmar fascia are longitudinal, and continuous with the fibres of the palmaris longus tendon; anteriorly they are crossed by transverse fibres. The cutaneous surface

of the aponeurosis is smooth and polished; the deep surface is rough, and affords origin to some of the muscular fibres beneath ; a few of the superficial fibres are attached to the skin, and assist in forming the depressions in the palm of the hand.

The *anterior annular ligament* of the wrist is a dense layer of fibres, which pass transversely above the preceding, and extend from the hook-like process of the unciform bone and from the os pisiforme on the inner or ulnar side, to be attached externally to the front of the os naviculare and the ridge on the os trapezium. The anterior surface of this ligament is flat, and is covered by the skin and crossed by the superficialis volæ artery, and a cutaneous branch from the median and ulnar nerves, also by a few fibres of the palmaris brevis muscle ; its posterior surface is concave, lined by synovial membrane, and has passing beneath it the tendons of the flexor sublimis digitorum perforatus, flexor profundus digitorum perforans, flexor carpi radialis, and flexor longus pollicis muscles, the median nerve, and the termination of the interosseous artery. To its upper border is attached the palmaris longus tendon, a few of the fibres crossing it, and to its lower, the palmar fascia. The relation of the ulnar artery and nerve has been variously stated as passing above and beneath this ligament ; the correct relation is that these pass between two portions of the annular ligament, superficial to its principal portion, but covered by some fibres which stretch from the os pisiforme to cover them.

On the back part of the wrist is the *posterior annular ligament;* it is much less strong than the preceding, being only a condensation of the fascia with which it is continuous; it proceeds from the posterior surface of the radius downwards and in-

wards, and is implanted into the posterior surfaces of the cuneiform and unciform bones; it forms sheaths for the extensor tendons, as described.

Beneath the palmar aponeurosis lie the principal vessels, nerves, tendons, and muscles of the hand and fingers.

On the *outer* side lie the muscles of the thumb, forming the fleshy mass of the ball of the thumb; they are four in number, namely, the abductor pollicis, the opponens, or flexor ossis metacarpi pollicis, the flexor brevis pollicis, and the adductor pollicis; all these are inserted into the base of the first phalanx except the opponens, which is implanted into the metacarpal bone of the thumb; this muscle is so named from its possessing the most important action of *opposing* the thumb to the other fingers, and this renders it the most useful of the different parts of which the hand consists: the loss of the thumb is therefore more serious than any one of the other fingers. The flexor brevis consists of two portions, between which runs the tendon of the flexor longus pollicis, to be inserted into the extreme or ungual phalanx of the thumb.

On the inner side of the hand lie the short muscles of the little fingers; they are three in number, namely, the abductor minimi digiti, the flexor brevis, and the adductor minimi digiti; the two former are inserted into the base of the first phalanx, the last into the whole length of the metacarpal bone.

In the centre of the palm of the hand are the long flexor tendons, the lumbricales muscles, and the principal vessels and nerves, consisting of the superficial and deep palmar arches of arteries and nerves, and, more deeply, the interossei muscles.

The flexor sublimis muscle divides a little below the middle of the fore-arm into four tendons; two of these become anterior, and belong to the middle and ring fingers; two posterior to the fore and little finger; in this order, but approaching to a level, they pass beneath the annular ligament and enter the palm of the hand; each tendon soon splits, so as to allow of the passage forwards of the corresponding tendon of the flexor profundus; the divided portions pass forwards to the second phalanx of each finger, into the sides of which they are implanted, about the centre, and thence continue to the dorsum of the phalanges, where they assist in forming the tendinous aponeurosis covering this surface.

The tendon of the flexor profundus divides at a lower point into four tendons, which pass between the divided portions of the flexor sublimis until they arrive at the base of the ungual or last phalanges, into which they are implanted.

These tendons are bound down to the phalanges by a strong band of ligamentary transverse fibres, the *digital sheaths;* these are strongest opposite the centre of each phalanx, but opposite the articulations the fibres spread out on the joint; they are lined internally by synovial membrane, which is reflected on the tendons and the bones beneath.

The *lumbricales* muscles are attached to the radial side of the tendons of the deep flexor, from which they pass forwards to be inserted into the sides and posterior surfaces of the first phalanges.

The *superficial palmar arch of arteries,* and its accompanying arch of nerves, lie between the palmar fascia and the flexor tendons. This arterial arch is formed by the ulnar artery, which enters the palm of the hand between the two portions of

the annular ligament, runs forwards and outwards towards the radial side, and there communicates with the superficialis volæ branch of the radial artery. The course of this artery is indicated by the groove at the root of the thumb; it is arched, the convexity turned downwards and inwards towards the base of the little finger; its concavity embraces the muscles of the thumb. From the convexity proceed the *digital branches*, which. four in number, run forward to supply the sides of the three inner fingers, and the inner side of the fore-finger; a separate branch supplies the ulnar side of the little finger, but the opposite sides of the other fingers are supplied by one branch, which divides into two at the cleft between the fingers. These vessels run along the sides of each finger, accompanied by the *digital nerves*, but nearer the palmar surface, and finally terminate in the pulp of the fingers by forming a vascular network; throughout their course they anastomose freely with each other, and with branches from the radial artery or deep palmar arch.

From the concavity of the superficial palmar arch a few small branches proceed to supply the adjoining soft parts.

Soon after entering the palm of the hand the ulnar artery sends off a *deep* or communicating branch, which, with a branch of the ulnar nerve, sinks deep into the palm of the hand, between the abductor and flexor brevis minimi digiti, and joins the radial artery or deep palmar arch.

The *superficial palmar arch of nerves* is not so distinctly marked as that of the arteries; it is formed principally by the median nerve, with a branch from the ulnar and lies beneath the arterial arch.

The *median nerve*, on entering the palm of the hand, presents a flattened appearance, and divides into two nearly equal portions, from which branches proceed to supply three and a half fingers from without inwards; that is, the thumb, first, second, and one-half of the ring finger.

The external division supplies the thumb and the radial side of the fore-finger; the internal supplies the remainder. Besides these, the median nerve sends filaments to the muscles of the thumb, and the lumbricales muscles. The digital branches are distributed with the arteries, and follow the same course, lying rather superficial to the vessels; their terminal filaments end in the pulp of the fingers by forming expansions resembling ganglia, in which are seated the sense of touch. The motor filaments of the nerve, doubtless, do not extend so far. The fifth or last branch of the median nerve joins a similar branch from the ulnar nerve.

The *ulnar nerve*, on entering the palm of the hand, divides into two branches, a *superficial* and *deep;* the former, the smaller, supplies the palmaris brevis and integuments, and forms two digital nerves, one of which supplies the inner side of the little finger; the other divides opposite the cleft between this and the ring-finger, and supplies their opposed surfaces, accompanying the digital arteries; the last joins the fifth branch of the median nerve.

The *deep* or *communicating* branch of the ulnar nerve, entering into the palm of the hand, accompanies the deep palmar arch of the radial artery, and is lost in the adductor pollicis, inner head of short flexor, and abductor indicis muscles.

Beneath the long flexor tendons and superficial arches of arteries and nerves lies the *deep palmar arch* of arteries, with its accompanying nerves, and the interossei muscles.

The *deep palmar arch of arteries* is formed by the radial. This branch enters the palm of the hand from its dorsal surface, through the cleft between the metacarpal bones of the thumb and forefinger, and the two heads of the abductor indicis muscle; it here sends a branch to the thumb, the *princeps pollicis*, which runs forwards, and divides into two digital branches, to supply each side of the thumb in the same manner as the other digital arteries; and a similar branch, the *radialis indicis*, to the radial side of the forefinger, to supply it and anastomose with the digital branch from the superficial palmar arch.

The *radial artery* now proceeds across the palm of the hand, lying on the metacarpal bones and interossei muscles, to the base of the metacarpal bone of the little finger, and thus forms the deep palmar arch; this, however, is but slightly curved, having its convexity towards the fingers; its branches are the recurrent, which are distributed upwards to the carpus, and anastomose with the other carpal branches of the radial and ulnar arteries; three perforating arteries, which pass through the interossei muscles to the dorsum of the hand, where they anastomose with the other interosseous arteries; and three palmar interosseous arteries, which run along the interosseous spaces, supplying the muscles, and anastomose at the metacarpo-phalangeal articulations with the digital arteries.

The deep palmar arch is accompanied by the *deep arch of nerves* formed by the ulnar, as described.

The interossei muscles fill up the interval between the metacarpal bones, the anterior projecting into the palm of the hand. The insertions of the flexor carpi radialis and flexor longus pollicis are seen in this dissection.

The *order of parts* in the palm of the hand are skin, adipose tissue, palmar fascia, superficial palmar arch of arteries, superficial arch of nerves, tendons of flexors sublimis and profundus, and lumbricales, deep palmar arch of nerves, deep palmar arch of arteries, interossei muscles.

Wounds of the palm of the hand are dangerous and troublesome, from the delicate parts injured, and from the numerous vessels which exist in it and anastomose freely with each other. Where profuse hemorrhage results, it is better to tie the ulnar or radial artery in the fore-arm, or both these vessels, than to attempt to secure the bleeding vessel amongst the numerous tendons and nerves which surround it. In most cases the application of a dossil of lint or sponge, with pressure on the trunk of the artery, will arrest the hemorrhage.

The ulnar artery should be first secured immediately above the wrist; this is done by making an incision, about three inches in length, along the radial side of the flexor carpi ulnaris tendon, the skin, superficial fascia, and fascia of the fore-arm being divided, the ulnar artery will be found slightly overlapped by the tendon, having the nerve to its inner side.

The radial artery is secured in a similar manner, by making an incision along the ulnar side of the flexor carpi radialis tendon.

Inflammation and abscesses forming in the palm of the hand require active treatment, as the resistance of the fascia gives rise to acute suffering and much destruction, if not speedily arrested, or in case of matter opened early. If neglected, the mischief will extend to the fore-arm, and may lead to the loss of the limb. Whitlow, or paronychia, is a frequent source of these abscesses.

CHAPTER III.

THE THORAX, OR THORACIC REGION,

Is a large conical cavity, in which are lodged the heart and lungs, and through which pass to their destinations the œsophagus, aorta, and other important parts. It is formed by the sternum and costal cartilages in front; the ribs and intercostal muscles in front, on each side, and posteriorly; the spine, on the mesial line posteriorly; inferiorly, by the diaphragm, which separates it from the abdomen; and superiorly, it communicates with the neck.

Internally, the thorax is divided into five compartments, or lesser cavities, by the reflections of the pleura; the two largest, one on each side, contain the lungs; the three central are the anterior mediastinum, the cavity of the pericardium, and the posterior mediastinum. None of these, however, are exactly on the mesial line; they all incline to the left side, especially the pericardium and anterior mediastinum.

Section I.

THE ANTERIOR MEDIASTINUM

Extends from the root of the neck downwards, and to the left side to the diaphragm, where it termi-

nates at the xiphoid cartilage, and communicates with the cellular tissue of the abdominal parieties; it is bounded on each side by the pleura, and in front by the sternum and a portion of the costal cartilages; its transverse section is triangular, the base being turned forwards, the apex backwards, at the convergence of the pleuræ, in front of the pericardium.

The anterior mediastinum contains in its upper part the remains of the thymus gland and the origins of the sterno-hyoid and thyroid muscles; in its lower part, the triangularis sterni muscle; and close to its outer edge, the internal mammary arteries.

Section II.

THE PLEURAL CAVITIES

On each side contain, respectively, the right and left lung. Each lung is conical in shape, and fills exactly, in the living subject, the cavity in which it is lodged. The apex is turned upwards, and fills the cone of the pleura; the base is concave, and rests on the upper convex surface of the diaphragm; its posterior, lateral, and anterior surfaces are convex, to correspond to the concavity of the chest internally; the internal surface is concave, and rests on the lateral surface of the pericardium. Anteriorly, the lung presents a thin margin, which overlaps the pericardium, and approaches the anterior mediastinum; inferiorly is another margin, but more rounded, which fits into the space between the ribs and diaphragm; this descends considerably towards the back part.

Each lung is divided into two lobes by the *great fissure*, which passes downwards and forwards; the *superior* lobe, the smaller, forms most of the anterior surface of the lung; the *inferior*, larger, forms most of its posterior surface. The right lung is further subdivided by a horizontal fissure, which cuts off a triangular portion from the upper lobe, and forms the third lobe of this lung.

The right lung is altogether larger, though somewhat shorter than the left, the last being encroached upon by the heart and pericardium, and the other by the liver, inferiorly.

The lungs are attached internally to the spinal column by their roots; in the rest of their extent they are free.

The *root of each lung* is formed by the several structures passing into or out of the substance of the lung, to perform their several functions or offices. Thus by

1. The *bronchial tubes*, to convey the atmospheric air during respiration into and out of the air-cells.
2. The *pulmonary artery*, to convey the black blood from the heart to the lungs to be oxidized.
3. The *pulmonary veins*, to return the oxidized blood from the lung to the heart.
4. The *bronchial arteries and veins*, to nourish the bronchial tubes and lungs with blood.
5. The *pulmonic plexuses of nerves*, lymphatics, and investing cellular tissue.
6. The pleura.

The *order of parts* in the root of each lung, from above downwards, is, in the right lung—

1. Bronchial tube.
2. Pulmonary artery
3. Pulmonary veins.

In the left lung—

1. Pulmonary artery.
2. Bronchial tube.
3. Pulmonary veins.

The order from before backwards is the same in both lungs, viz.:—

1. The pulmonary veins.
2. The pulmonary artery.
3. The bronchial tube.

In front of the root of each lung are the phrenic nerve and anterior pulmonic plexus; behind is the par vagum and posterior pulmonic plexus; the arch of the aorta curves round the root of the left lung, and then this vessel descends behind it; in like manner, the vena azygos ascends behind the root of the right lung, and then curves round it to descend in front, and join the superior vena cava. Below each root is the *ligamentum latum pulmonis*, formed by the pleura.

The function of the lungs being that of changing the venous blood into arterial by contact with the atmospheric air, their structure includes the parts necessary to this object; these are, the bronchial tubes and air-cells, the pulmonary vessels, arteries and veins, nerves, lymphatics, and cellular tissue, invested by the pleura.

The bronchial tubes, two in number, are the continuations of the trachea, which is, itself, a continuation of the larynx. The trachea reaches from the fifth cervical to the third dorsal vertebra, nearly on the mesial line, but a little to its right side; at the last point, it terminates by dividing into the right and left bronchial tubes, to supply the lungs.

In the neck, the *anterior relations* of the trachea are the skin, fascia, the sterno-hyoid and sterno-

thyroid muscles, the isthmus or neck of the thyroid gland and the thyroid plexus of veins; its *posterior relations* are the œsophagus, which inclines to its left side, and the spinal column; its *lateral relations* are the common carotid artery, the lobes of the thyroid gland, the pneumogastric, sympathetic, and recurrent nerves, and on the left side, the thoracic duct.

In the thorax, the *anterior* relations of the trachea are the sternum, anterior mediastinum, the left vena innominata, the transverse portion of the arch of the aorta which rests upon it, the origins of the arteria innominata, and left carotid and the cardiac plexus of nerves; its *posterior* is the œsophagus; its *lateral* are, on the right side, the right vena innominata, arteria innominata, and par vagum—on the left side, the left carotid par vagum, and recurrent branch.

The tissues entering into the formation of the trachea are cartilage, muscular fibres, fibrous and cellular tissues, mucous membrane, glands, blood-vessels, nerves, and lymphatics.

The right bronchial tube is larger, but shorter, than the left, and takes a more transverse course; the left bronchus descends obliquely to the left side, passes through the arch of the aorta, and in front of the descending aorta, œsophagus, and thoracic duct.

The tissues forming the bronchial tubes are the same as those of the trachea.

The bronchial tubes terminate in the *air-cells* of the lungs; these are supposed to be slightly expanded, and are exceedingly numerous; they are connected into lobules by the corresponding stalk of the bronchial tube, and these lobules are connected by fine reticular cellular tissues, forming the *inter-*

lobular cellular tissue of the lungs, and a large portion of their substance.

The tissues forming the air-cells are fibrous or condensed cellular tissues, muscular fibres, and mucous membrane; neither these nor the minute subdivisions of the bronchial tubes contain cartilage.

The use of the air-cells is to admit the air, and expose it to the venous blood in the pulmonary veins, which ramify on their opposite surfaces.

The *interlobular cellular tissue*, besides investing the lobules, admits of the passage of the blood and other vessels of the lungs; it is continuous with that of the opposite lung along its root and across the mediastinum.

A number of *lobules* form each *lobe;* these form the lung.

The lungs possess a double set of vessels, namely, the pulmonary and bronchial.

The *pulmonary arteries* are two in number, and proceed from the trunk of the pulmonary artery, which arising from the right ventricle of the heart bifurcates a little below the bifurcation of the trachea, into its right and left pulmonary branches, to supply each lung. The arteries break down in the cellular tissue of the lungs into extremely small branches, which form a vascular network on the pulmonic surface of the air-cells, and, by these means, expose the black or venous blood which they contain to the oxygen of the atmospheric air. The pulmonary veins commence in this network by similar small branches, which uniting form the trunks of the pulmonary veins; these proceed, two in number on each side, from the root of the lung to the left auricle, and thus conduct the red or oxidized or arterial blood back to the heart.

The pulmonary vein in the adult and the umbi-

lical vein in the fœtus are the only veins which convey arterial or pure blood. The vena porta, although performing the functions of an artery, carries black blood. In like manner, the pulmonary and umbilical are the only arteries which convey venous or impure blood.

The *bronchial arteries* accompany the bronchial tubes to their terminations; they arise from the descending aorta; the *bronchial veins* return their blood and open, the right into the vena azygos, the left into the left superior intercostal vein; their use is to nourish the lungs, although they anastomose freely with the pulmonary vessels.

The *nerves* of the lungs are derived from the pulmonic plexuses, formed by the par vagum with filaments from the sympathetic, and a few from the recurrent nerves. The lymphatics terminate in the bronchial glands.

The colour of the lungs varies in the different periods of life. In the fœtus, they are of a dark red; in the child, a bright red; in the adult, a mottled grey. Where there is much dark colour, there is generally disease, the blackness being induced by an irregular deposit of carbon into the lungs, which should have been carried off by respiration.

The pleuræ investing the lungs are serous membranes; they are not continuous with, nor do they touch each other. Their sacs or cavities do not communicate.

Section III.

THE PERICARDIUM

Occupies what is sometimes called the *middle mediastinum*, and lies between the two pleuræ on either side, the anterior mediastinum in front, and the

posterior behind. It is a fibro-serous structure, its fibrous coat being external, the serous internal; it is partially covered on each side by the pleura, from which it is separated by the phrenic nerve. It contains the heart and large blood-vessels proceeding from or to this organ.

The following parts are seen on opening the pericardium: of the heart, the greater portion of the right auricle and ventricle; a small portion of the left ventricle, and the left auricular appendix; between the ventricles, the anterior coronary vessels and nerves; the superior and inferior vena cava, the origin of the pulmonary artery, and the upper part of the ascending portion of the arch of the aorta. To see the remaining portions of the heart, this organ must be raised from its natural position.

The *right auricle* receives the venous blood from the vena cava and coronary veins, and discharges it into the *right ventricle*. This propels the blood into the pulmonary artery, and thence into the lungs. The blood is here oxidized, and is conveyed back by the pulmonary veins into the *left auricle;* this propels the blood into the *left ventricle;* and this, by means of the aorta and its numerous branches, diffuses it over the whole body, whence it is returned by the veins.

The heart is supplied with blood by the coronary arteries, which arise, two in number, from the aorta, immediately after its origin from the left ventricle. The coronary veins receive the blood from these, and empty it into the right auricle.

The heart is supplied with nerves from the *cardiac plexus*. This is formed by the cardiac filaments of the sympathetic and pneumogastric, and a few from the recurrent nerves; the filaments of

the plexus accompany the arteries and are lost in the muscular tissue.

The tissues forming the heart are muscular fibres, serous membranes, fibrous, cellular, and fatty tissue, blood-vessels, nerves, and lymphatics.

Section IV.

THE POSTERIOR MEDIASTINUM

Is situated behind the preceding, immediately in front of the spinal column, extending from the second to the tenth dorsal vertebra; triangular in shape; its sides are formed by the pleuræ; its base is posteriorly at the spine, its apex in front at the convergence of the right and left pleuræ. It contains the descending aorta, œsophagus, thoracic duct, vena azygos, pneumogastric, and great splanchnic nerves. Of these, the œsophagus is most anterior; the aorta lies to the left side; the vena azygos to the right; the thoracic duct between these, in front of the spinal column; the pneumogastric nerves are in contact with the œsophagus; the splanchnic nerves are in the lower part.

The *trunk of the sympathetic nerve* descends in the thorax, forming a continuous cord of ganglia, lying on the heads of the ribs behind the pleura, and connected to each other by a nervous cord. It enters the abdomen, to descend into the pelvis, and there terminates in a solitary ganglion, the *ganglion impar*.

CHAPTER IV.

THE ANO-PERINEAL REGION.

MALE.

This region is sometimes described as two regions—the *anterior*, or *perineal*, and the *posterior*, or *anal;* however useful this distinction may be in the practice of surgery, the anatomy of the two is so intimately connected, that it is impossible to consider either apart from the other.

The ano-perineal region extends from the os coccygis behind to the sub-pubic angle in front, from both of which points its boundaries diverge as far as the tuber ischii on either side; it follows that the whole space is of a diamond shape, or that of two triangles joined at their bases; the lateral boundaries are from the coccyx forwards to the tuber ischii, the great sacro-sciatic ligament, and edge of the gluteus maximus muscle; from the sub-pubic angle backwards to the same point, the rami of the pubes and ischium; a line drawn transversely from one tuber ischii to the other will separate this into two triangles, the anterior being the proper perineal region, the posterior being the anal region; this transverse line is indicated more deeply by the transversus perinæi muscle, vessel, and nerves.

The integuments covering this region are thin, of a brownish colour, and scattered over with hairs; the aperture of the anus is a little posterior to the centre, and is surrounded by irregular folds of skin,

caused by the contraction of the sphincter ani muscle, and frequently presents vascular tumours, termed hemorrhoids. The anterior region is convex in the centre, and is marked from behind forwards by a projecting line, the raphe, which, commencing in front of the anus, runs forwards along the mesial line of the perineum, to be continued on the under surface of the scrotum to the root of the penis, where it terminates ; this line indicates the course of the urethra, and serves as an important guide in all operations in this region.

On raising the integuments, the subcutaneous cellular tissue is exposed : in the perineal region this is thin, loose, and destitute of fat ; it is continuous on either side with that of the thighs, in front with that of the scrotum, and posteriorly contains, in the centre, the sphincter ani muscle; on each side it becomes loaded with fat, and sinks into and fills up a large fossa, the *ischio-rectal space*, between the side of the rectum, covered by the levator ani muscle and the lateral and inner surface of the pelvis. This cellular tissue contains a few superficial blood-vessels and nerves; the anterior are derived from the perineal vessels and nerves, with the exception of one, the superficial pudic nerve, which is derived from the gluteal or lesser sciatic nerve ; the posterior come from the inferior hemorrhoidal.

Beneath the subcutaneous cellular tissue of the perineal region is the *perineal fascia ;* this is a dense layer of fascia investing and binding down the muscles ; on either side it is firmly attached to the rami of the ischium and pubes and tuber ischii. Anteriorly, it is gradually lost on the cellular tissue of the scrotum; posteriorly, it dips deep in front of the rectum, and is continuous with the base of the triangular ligament; on either side of this it

sinks into the ischio-rectal fossa, and is continuous with the adipose tissue in this neighbourhood; on the mesial line, this fascia is attached to the centre of the acceleratores urinæ muscles.

This fascia being carefully raised, the perineal muscles are exposed; these are the acceleratores urinæ, erector penis, and transversus perinæi.

The *acceleratores urinæ* muscles are connected together, on the mesial line, so as to form one muscle, which surrounds the bulb and a portion of the urethra in front of this, in a species of muscular sling. This muscle has no distinctly fixed attachment which may be called its origin, its most fixed being the tendinous portion which lies above the urethra, between it and the body of the penis; its inferior and lateral portions are chiefly muscular, and enclose the urethra, meeting so as to form a raphe on the mesial line; posteriorly, the conjoined muscles are attached to a ligamentary structure, which extends from the front of the anus to the back part of the bulb, the *ano-urethral* ligament, or the *common central point* of the perineum; and anteriorly each is prolonged on the lateral surface of the corpus cavernosum penis; a few fibres are lost on the anterior surface of the triangular ligament.

A portion of this muscle has been described as a distinct muscle, under the name of the *compressor hemisphærii bulbi;* it may be easily divided artificially into a number of muscles.

The *erector penis* lies to the outer side, and embraces the crus penis: arising from the inner surface of the tuber ischii, it courses along the inner surface of the crus, then beneath, and finally gets to the outer surface of the corpus cavernosum, into which it is inserted.

The *transversus perinæi* crosses the perineum, in a

nearly transverse direction, from the inner surface of the tuber ischii to the ano-urethral ligament, or central point of the perineum.

Behind these muscles, and on a plane superficial to them, is the *sphincter ani* muscle; this surrounds the anus as the orbicularis palpebrarum and the orbicularis oris do the eye and mouth; it is attached posteriorly to the coccyx and the fibrous band which connects this to the rectum, and anteriorly is implanted into the ano-urethral ligament.

The perineal muscles will be found to circumscribe a triangular space: thus the base is posteriorly at the transversus perinæi muscle, the inner edge is formed by the side of the acceleratores urinæ muscles, the outer by the erector penis; the apex is in front, where these muscles converge. In the natural state, this space is small, but appears large in the dissected state; in it will be found the perineal and the transversus perinæi vessels and nerves. The former are derived from the pudic artery, the latter from the pudic nerve.

The *internal pudic artery* is one of the branches of the internal iliac, from which it arises near to its termination; the pudic artery soon passes out of the pelvis, through the great sciatic notch, below the pyriformis muscle, winds round the lesser sacro-sciatic ligament, and re-enters the pelvis by the lesser sciatic notch; it then courses along the inner surface of the tuber ischii, about an inch and a half from the edge of the bone, and bound down by a fibrous expansion, derived from the great sacro-sciatic ligament; it thence ascends between the layers of the triangular ligament, beneath the pubic arch and sub-pubic ligament, perforates the superficial layer of the triangular ligament, and terminates in the artery of the corpus cavernosum penis

and the dorsal artery of the penis. The branches of this artery are the inferior hemorrhoidal, transversus perinæi, perineal, the artery of the bulb, and its two terminating branches.

Three of these vessels are found in the perineum, namely, the perineal artery, the transverse artery, and the artery of the bulb.

The *perineal* or *superficialis perinæi* artery runs from the pudic inwards and downwards, perforates the base of the triangular ligament, and then, turning forwards, runs in the centre of the triangular space, already described, and terminates in the scrotum. This artery is accompanied by the perineal nerve, a branch of the pudic nerve.

The *transversus perinæi* artery courses along the anterior surface of the transversus perinæi muscle, and terminates on the mesial line.

The *artery of the bulb* lies more deeply seated than these; it arises near the base of the triangular ligament, runs inwards between the layers of the membrane, and entering the bulb, supplies the spongy structure of the corpus spongiosum urethræ.

The *triangular ligament* is a dense layer of fascia, which fills up the anterior triangle of the inferior opening of the pelvis, supporting the bladder, and fixing the urethra in situ; it is another of those provisions which Nature has adopted for preventing the displacement of the pelvic viscera. On each side it is firmly attached to the inner side of the rami of the ischium and pubes, within the crura penis, being here continuous with the outer layer of the pelvic fascia; its apex is turned forwards and upwards, fills up the sub-pubic angle, and divides into two layers, enclosing the sub-pubic ligament, and expanding on the anterior and posterior surfaces of the pubes; its base, directed backwards, is

lunated, to accommodate the anterior surface of the rectum, and here expands on this intestine and levator ani muscle, becoming continuous with the inner layer of the pelvic fascia and cellular tissue of the pelvis.

This ligament is perforated about its centre, but nearer the base by the urethra, the membranous portion of which passes through it from the pelvis to the perineum, and at the same time receives an expansion from the upper and lower surfaces of the ligament; the upper expansion is prolonged over the prostate gland. and forms the fibrous covering of this organ; the lower descends forwards, covers Cowper's glands as they lie in the angle between the bulb and membranous portion, and is lost on the fibrous covering of the corpus spongiosum urethræ.

The triangular ligament is also perforated a little beneath the symphisis pubis by the dorsal veins of the penis, and by the perineal vessels, as just described.

Two muscles are also described as lying between the layers of this triangular ligament, the *deep transverse*, or elevator urethræ of Santorini, and the constrictor isthmi urethralis.

Cowper's glands lie in the angle between the bulb and the membranous portion of the urethra; they are two in number, one on each side, about the size of a pea, and open by a small duct, one inch in length, on the mucous surface of the urethra, in front of the bulb.

The *urethra* may now be seen in nearly the whole of its course; this canal consists of three portions, the prostatic, membranous, and spongy; the first so named from its being surrounded by the prostate gland, the second from its peculiar structure, and the third from its being surrounded by the

corpus spongiosum, forming a portion of the penis.

The *prostatic portion* lies within the pelvis, and above the triangular ligament; it passes through the prostate gland, nearer its upper than its under surface; it is about one inch and a quarter in length, and passes downwards and forwards; its interior is wider in the centre than at its extremities; on the lower surface is the caput gallinaginis, or veru montanum, on which the common ejaculatory ducts open; and on each side of this the sinus pocularis, or vesicula prostatica, on which, as well as on the surface of the surrounding membrane, the prostate ducts open.

The *membranous portion* lies intermediately between the pelvis and perineum, being contained in the layers of the triangular ligament, which it ultimately perforates. This portion of the urethra lies immediately beneath the sub-pubic arch, from which it is separated by the sub-pubic ligament, the anterior portion of the triangular ligament, and the dorsal veins of the penis; it is slightly curved, the concavity turned upwards, and is about three quarters of an inch in length; its cavity is smooth, and lined by the mucous membrane, and is smaller than any other part of the urethra, excepting the external orifice.

The *spongy portion* of the urethra is the longest, and extends from the preceding to the external orifice; its direction varies much. It is surrounded by the erectile tissue of the corpus spongiosum, and is lined by mucous membrane; at its posterior extremity is an enlargement of the spongy tissue, forming the bulb; and anteriorly is a much larger expansion, the glans penis. The orifice of the urethra is the smallest part of the canal, immediately be-

hind which is its largest portion, the *fossa navicularis.*

As this completes the anatomy of the perineum, properly so called, the relation of all these parts, in connection with the numerous important operations performed therein, and in the diseases to which they are subject, should be carefully considered.

In the *lateral operation of lithotomy*, the incisions run nearly in the course of the perineal artery; the first divides the skin, subcutaneous cellular tissue, superficial vessels and nerves, perineal fascia, and slices off a few fibres of the superficial sphincter ani muscle; the second sinks into the triangular space between the erector penis and compressores urethræ muscle, divides the perineal artery and nerve, the transversus perinæi muscle, vessels, and nerves, the base of the triangular ligament, and some of the middle fibres of the levator ani muscle; in the last incision, when the point of the knife is sunk into the groove of the staff, and thence carried upwards and backwards, the parts divided are the anterior layer of the triangular ligament, the membranous part of the urethra, and with it the compressores isthmi urethralis muscle, the left lobe of the prostate gland and its investing fascia, and the neck of the bladder.

The parts endangered and to be avoided in this operation are, posteriorly, the rectum; anteriorly, the bulb and its artery; externally, the pudic artery; and superiorly, the peritoneum, vesiculæ seminales, and vasa deferentia.

In *extravasation of urine*, in consequence of rupture of the urethra, either from direct violence or from the existence of stricture, the yielding part is almost invariably the membranous portion, hence the urine flows between the triangular ligament

and the perineal fascia; the former prevents its ascent into the pelvis, the latter its descent, or its passage downwards on the thighs; the union of these posteriorly prevents the urine from being infiltrated about the rectum; the result is, that the fluid is pressed onwards towards the scrotum and penis, and fills their subcutaneous cellular tissue, and thence ascends on the front of the abdominal parieties.

Abscesses in perineo are much influenced by the fascia; when matter forms in Cowper's glands, it usually bursts into the urethra; when between the triangular ligament and perineal fascia, it is directed forwards, as in extravasation of urine; but when in the subcutaneous cellular tissue, it will point externally.

Stricture most frequently forms in the membranous portion of the urethra, directly behind the bulb, and hence, as well as from its anatomical relations, this part presents the greatest difficulty in passing the bougie or catheter; at this part the urethra begins to ascend to the bladder, so that it becomes necessary, so soon as the instrument has reached it, to raise its point; this is accomplished by depressing the handle, whilst the instrument is at the same time pushed gently onwards into the bladder; care must be taken whilst doing this that the urethra is kept straight and tense, as otherwise the point of the instrument will strike against and be impeded by the triangular ligament, the subpubic ligament, or by the urethra itself. If the point be too much elevated, the instrument may be forced through the upper surface of the canal, and thus pass between the bladder and pubis, and not enter the vesical cavity.

The prostatic portion of the urethra offers but

little difficulty to the passing of the catheter, although it may be obstructed by the veru montanum, or by one of the openings on this. In the old subject, where the prostate gland becomes enlarged either in its lateral or middle lobe, the passing of instruments is rendered difficult; but the consideration of this belongs to works on surgery, to which we must refer for further information.

CHAPTER V.

THE ABDOMINAL REGION.

This region presents for consideration the abdominal parieties, the cavity of the abdomen, and its contained viscera, and most of the various forms of hernia, viz., inguinal, femoral, umbilical, ventral, etc.

The *anterior surface* of the abdomen is the most extensive; it is bounded above by the ensiform cartilage in the centre, and on each side the costal cartilages and extremities of the last three ribs; inferiorly by the pubes, and on each side by Poupart's ligament; laterally it is continuous with the *lateral regions*, these are small in extent, and reach from the last rib to the crest of the pelvis. The *posterior* surface of the abdomen expands a little in consequence of the obliquity of the last rib, which bounds it above, and the crest of the ilium, which bounds it inferiorly; on the mesial line it is formed by the spinal column. The pelvis, inferiorly, and the spine, posteriorly, are the only osseous boundaries of the abdomen, all the rest are muscular: thus superiorly, the diaphragm; anteriorly, laterally, and posteriorly, the abdominal muscles, quadratus lumborum, and lumbar mass of muscles; and inferiorly, the levatores ani muscles.

The abdominal cavity is divided, for the purpose of description, into three regions, the epigastric, umbilical, and hypogastric, and these are further subdivided; but these divisions, and the parts which they contain, are sufficiently pointed out in works on descriptive anatomy, to which we must refer.

The most important, in a surgical point of view, are the *inguinal regions*, as being immediately connected with hernia.

Section I.

INGUINAL HERNIA.

There are two forms of Inguinal Hernia, namely, the *oblique* and *direct*; the anatomy of which may be considered together.

On raising the integuments from either inguinal region, the subcutaneous cellular tissue, or *superficial fascia*, is exposed; this is distinguished from similar fasciæ elsewhere, by being more extensive and dense, in some places approaching to an aponeurotic structure. It may be divided into several layers, but two are sufficient for all purposes—these are the *superficial* and *deep* layer.

The *superficial layer* is continuous above and laterally with the general subcutaneous cellular tissue of the abdominal parieties, inferiorly it passes on the outer side, over Poupart's ligament, and becomes continuous with the superficial fascia of the femoral region; internally it descends over the spermatic chord to the penis and scrotum, where it loses its fatty character, and becomes continuous with the fine cellular tissue of these organs; it contains a quantity of adipose tissue, but varying much in different individuals, and also some lymphatic glands, blood-vessels, and nerves.

The *lymphatic glands* are three or four in number; they lie on, or a little above, Poupart's ligament, having their long axes parallel to it, and are enclosed in capsules formed by the superficial layer of this fascia; they receive the lymphatics from

the superficial structures of the penis and scrotum, and empty themselves into the lymphatics leading to the lumbar glands.

The *superficial arteries* met with in the fascia are branches from the external pudic and external epigastric branches of the femoral artery, which wind over Poupart's ligament, and are distributed to the skin and fascia of this region.

The principal *nerves* are two in number; one, the hypogastric branch of the ilio-hypogastric nerve, perforates the tendon of the external oblique, a little above the external ring, and is lost in the integuments about the pubes; the other, the *ilio-inguinal* nerve, or *spermaticus superficialis*, passes out through the external ring, and descends to the integuments of the scrotum and upper and inner part of the thigh.

The *deep* layer of this superficial fascia, or Scarpa's fascia, lies in immediate contact with the tendon of the external oblique muscle; it is more dense and aponeurotic than the superficial layer; superiorly and externally it is gradually lost in the superficial fascia; internally it is continuous with the cellular tissue of the chord, scrotum, and penis, but, inferiorly, terminates abruptly by being attached, a little below Poupart's ligament, to the front of the fascia lata. These two layers of the superficial fascia form the first covering of an inguinal hernia, beneath the skin. In femoral hernia, when the tumour turns up, over Poupart's ligament, it rests on the deep layer of the superficial fascia, which separates it from the external oblique tendon.

On raising the superficial fascia the tendon of the external oblique muscle is exposed, covering the lower part of the abdomen, and forming, with its

fellow of the opposite side, a strong sheet of tendon, which supports the viscera and prevents their escape; superiorly, the muscle is composed of fleshy fibres, from which the tendinous fibres proceed downwards and inwards towards the pubes, near to which they spread out, and, at a short distance above it, separate into two distinct bands or chords, which, leaving an interval between them (the external abdominal ring), pass to be inserted into the pubes. These bands are obscured from view by the spermatic chord in the male, and the ligamentum teres in the female, each of which passes out through the external abdominal ring, and also by the *intercolumnar* or *spermatic fascia*.

By drawing the spermatic chord gently downwards this last fascia is well seen; it proceeds from the edges or margins of the ring just described, and also from the intercolumnar *bands* or *transverse fibres* of the external oblique tendon, descends from these over the spermatic chord, so as to form a sheath or covering for it, and is lost in the general cellular tissue of the chord. This forms one of the coverings of an inguinal hernia.

On removing the intercolumnar fascia, the spermatic chord will be seen passing out of the external abdominal ring, to descend into the scrotum; as it does so it nearly closes up the opening, but lies more towards its inferior wall, and there rests upon the external pillar of the ring, which forms a groove for its reception by the reflection of some of its fibres, which pass to be inserted into the inner extremity of the ilio-pectineal line, and form the third insertion of Poupart's ligament.

The disposition of the two bands, or chords into which the external oblique tendon splits, as it approaches the pubes, is now apparent. The *internal*,

which is also the anterior and superior, is a broad flattened band, and proceeds inwards towards the linea alba and symphisis pubis : the lower fibres are implanted into the upper part and front of the symphisis, where they decussate with the fibres of the opposite side; the upper fibres pass in front of the rectus muscle, and are inserted into the linea alba ; a few of these cross behind the others, and unite with their fellows of the opposite side, so as to form the *triangular ligament* of inguinal hernia. Between the lower edge of this band and the chord a small interval generally exists, favouring the protrusion of a hernial tumour.

The *external chord*, or *pillar of the ring*, is a round fibrous chord, continuous with, and forming part of, *Poupart's ligament ;* it passes inwards, behind the spermatic chord, and is inserted into the spine or tubercle of the pubes.

Besides these descending fibres of the external oblique tendon, some of its fibres take a transverse course with regard to these—these are the *intercolumnar bands;* they pass from Poupart's ligament upwards and inwards, decussating with the descending fibres, and gradually terminate; they are best marked near to the external ring, and at the upper extremity of this two or three unite, and form a distinct binding for this part of the opening; from these intercolumnar bands proceeds the *intercolumnar* or *spermatic fascia.* These transverse bands are of use in strengthening the aponeurosis of the external oblique muscle, and prevent the splitting of its descending fibres.

The interval between these two chords is the *external abdominal ring;* it is triangular in shape; its apex is turned upwards and outwards, and is rounded off by the transverse fibres, as just

described; its base is inferiorly, and is formed by the crest of the pubes; its superior and internal boundary is formed by the internal pillar; its inferior and external by the external pillar; its longitudinal extent is from one inch to an inch and a quarter; its transverse is from half an inch to three quarters; it is protected posteriorly by the triangular ligament, the conjoined tendons, and the edge of the rectus muscle.

Through the external abdominal ring an inguinal hernia passes out to descend into the scrotum.

The lower margin of the external oblique muscle is continuous with, and assists in forming, *Poupart's ligament;* this strong fibrous chord stretches from the anterior superior spinous process of the ilium externally, downwards and inwards towards the pubes, into which it is inserted by a double process: one forming the external pillar of the external abdominal ring; the other, formed by a reflection backwards of its posterior fibres, is inserted into the inner extremity of the ilio-pectineal line, and is called Gimbernaut's ligament, or the third insertion of Poupart's ligament (see Femoral Hernia). Poupart's ligament affords attachment superiorly to the external oblique fibres, part of the internal oblique and transversalis abdominis and the cremaster muscles; inferiorly, it is firmly attached to the *fascia lata;* in this direction it is slightly curved, the concavity turned downwards.

On slitting up the external oblique tendon, a little above and parallel to Poupart's ligament, the spermatic canal and chord will be seen nearly in their whole length.

The *spermatic canal* is the oblique passage between the abdominal muscles, which transmits the spermatic chord in the male, the ligamentum teres

in the female, and in both sexes allows of the protrusion of the intestines, so as to form an inguinal hernia by oblique descent. It reaches from the internal to the external abdominal ring, and in this course passes downwards, forwards, and inwards, or towards the mesial line; it is from an inch and a half to three inches in extent, according to the subject, and the parts between which the measurement is taken.

It is bounded *above* by the lower margin of the internal oblique and transversalis muscles; *below* by Poupart's ligament; *in front* by the external oblique tendon, and a portion of the internal oblique; *behind* by the transversalis fascia, the triangular ligament, and the conjoined tendons, and occasionally by a few fibres of the internal oblique.

The internal oblique muscle, arising by fleshy fibres, inferiorly takes origin from the outer extremity of Poupart's ligament, in some cases from the outer half, in others not more than one-third, from which its fibres pass upwards and inwards, its very inferior fibres only descending inwards over the chord to the conjoined tendons. In most cases, the chord passes beneath the lower margin of this muscle, having about half an inch in front, so as to form one of its anterior boundaries; but in other cases, when the muscle is well developed, the chord will pass through or between its fibres, and thus some of these will be behind, so as to form one of its posterior relations: in such cases, when an oblique inguinal hernia exists, the danger of strangulation is greater than usual.

The *cremaster muscle* arises in common with the internal oblique from the upper part of Poupart's ligament, and from the lower border of the trans-

versalis muscle, thence the fibres descend chiefly on the front and outer side of the chord, forming a series of loops, the concavities looking upwards and inwards, which expand inferiorly in the tunica communis and tunica vaginalis testis. This muscle forms one of the coverings of an oblique inguinal hernia. Some authors describe it inferiorly as forming a fascia—the fascia cremasterica. Although indistinct in the normal state, this muscle becomes strong and well marked in old cases of inguinal hernia.

On raising the lower fibres of the internal oblique muscle the full extent of the spermatic or inguinal canal is exposed.

The *internal ring*, or inner opening of the spermatic canal, is an oblique aperture in the transversalis fascia; it lies about half an inch above Poupart's ligament, and nearly midway between the anterior superior spine of the ilium and the symphisis pubis, but somewhat nearer the latter; it is bounded *above* by the lower margin of the transversalis muscle; *below* by Poupart's ligament; *internally* by the epigastric artery; *externally* its upper and lower walls approach and bound it in this direction; it is an ill-defined aperture, and is rather a prolonged funnel in the transversalis fascia. Through this aperture the hernial tumour makes its first exit from the abdominal cavity; the internal ring is obscured by a process from the transversalis fascia, which descends to invest the chord, and forms the *fascia propria* of oblique inguinal hernia.

The transversalis muscle, like the internal oblique, varies much as to the extent of its origin from Poupart's ligament, this seldom exceeding the external third, and never so as to pass behind the chord; the lower margin of this muscle crosses

above the inner ring, and forms the superior boundary of the spermatic canal.

The *transversalis fascia* forms the posterior boundary of the spermatic canal, throughout its greatest extent; this is a layer of fascia which lies beneath the transversalis muscle, hence its name, and invests the peritoneum; *superiorly*, where the abdominal muscles are strong, this fascia is weak, and is gradually lost in the cellular tissue investing the abdominal muscles on their anterior, posterior, and external surfaces; but inferiorly, where these muscles are weak or do not exist, the transversalis fascia becomes dense and aponeurotic, so as to protect the abdominal cavity; it here descends on the anterior surface of the peritoneum, towards Poupart's ligament, where it passes backwards above this ligament, and, at a short distance behind it, the transversalis fascia unites with the fascia iliaca and fascia lata, and forms a strong tendinous boundary in this direction (see Femoral Hernia). On the inner side of the internal abdominal ring also the transversalis fascia is well marked, and frequently presents a well-defined concave margin; it here encloses the epigastric artery between its layers; still more internally the fascia transversalis is intimately connected with the conjoined tendons and triangular ligament, and is here inserted into the crest of the pubes. Immediately over the iliac vessels, as they pass out of the pelvis, the transversalis fascia passes in front of them into the thigh, the iliac fascia passing posteriorly, so as to form a sheath.

The *conjoined tendons* lie almost immediately behind the external ring; they are the united tendons of the internal oblique and transversalis muscles, which here pass in front of the rectus muscle,

and form a protection, behind the external abdominal ring, against the formation of hernia; in some cases, this is much more perfect than in others.

The *epigastric artery* forms the inner boundary of the internal abdominal ring; this vessel arises from the external iliac, about a quarter of an inch above Poupart's ligament; it first descends inwards, it then turns upwards, so as to embrace the cul de sac of the peritoneum, ascends in front of this, and, contained in the transversalis fascia, crosses to the inner side of the internal abdominal ring, and then enters the sheath of the rectus muscle, where it terminates by anastomosing with the internal mammary artery between the muscle and the posterior layer of the sheath. The epigastric artery gives off several small branches to the surrounding parts—the only important one is

The *spermatic* or *cremasteric* branch, which passes off from it, near the internal ring, and descends to supply the coverings of the chord.

The epigastric artery is accompanied by two veins, the venæ comites, between which it lies. Sometimes but one vein accompanies the artery, it lies then to the inner side of the artery.

From the close relation which this vessel bears to the internal ring, it is much endangered in the performance of the operation for the relief of strangulated oblique inguinal hernia If our incisions be carried deep, the vessel is seriously endangered, and is only to be avoided by dividing the stricture in a direction upwards and outwards. Although its relation to the external ring is not so intimate in the normal state, its position is much altered in cases of old oblique hernia, the weight of which has the effect of drawing down the internal ring until it lies immediately behind the external. In the

normal state, then, the epigastric artery lies between the two rings, but nearer the internal; in old cases of oblique hernia it may lie behind or on the inner side of the external ring.

The *course* of an oblique inguinal hernia is as follows. It is first projected from the abdomen against the internal ring; it passes through this in front of the spermatic chord, and receives its *first* abnormal covering from the transversalis fascia, named the *fascia propria:* the tumour now crosses the epigastric artery, passes beneath the lower margin of the internal oblique muscle, or between its fibres, and here receives a *second* covering from the cremaster muscle; descending inwards, it arrives at the external abdominal ring, passes forwards through this, and receives its *third* covering from the intercolumnar fascia; its *fourth*, from the superficial fascia, consisting of two layers; and, *lastly*, the integuments. It soon descends into the scrotum, conducted by the chord, and confined by its coverings, until it arrives at the upper part of the testis, upon which it rests.

The coverings of an oblique inguinal hernia are, from without inwards, *skin*, *superficial fascia* (two layers), *intercolumnar fascia*, *cremaster*, *fascia propria*, and *peritoneal sac.*

DIRECT INGUINAL HERNIA

Is that form which, instead of traversing the spermatic or inguinal canal, bursts directly forwards from the abdomen through the external ring. This form of the disease is comparatively rare, as the external ring is well secured posteriorly, in most cases, by—first, the triangular ligament; second, the conjoined tendons; third, transversalis fascia; and, fourth, the edge of the rectus muscle. These parts

have all just been described. It follows that the direct inguinal hernia can have no relation to the fascia propria or to the cremaster. As it bursts forwards, it makes its way through the transversalis fascia by the side of the conjoined tendons, and receives its *first* abnormal covering at the external ring, from the intercolumnar fascia; its *second* from the superficial fascia; and, lastly, from the skin.

Its coverings from without inwards are *skin*, *superficial fascia* (two layers), *intercolumnar fascia*, and *peritoneal sac*.

In this form of hernia, when strangulated, the division of the stricture must be directed upwards and *inwards*. As, however, from the alterations effected in the relative positions of the two rings in old cases of hernia, it is sometimes impossible, *a priori*, to ascertain the exact nature of the disease, it becomes necessary in such cases to "steer a middle course," and carry our incision of the stricture directly upwards.

The operations for strangulated hernia are much modified of late years, in consequence of the introduction into practice of the operation of dividing the stricture *external to the sac, and then compressing this, as in the taxis, so as to return the hernial tumour*. The object to be sought therefore is the *seat of the stricture*. This having been ascertained, is to be cut down upon and divided, when the hernial tumour may, in the majority of cases, be returned. Should the stricture be in the neck, or the interior of the sac, this must be opened, and the stricture relieved. The author of this claims to be the first who proposed this operation, in the pages of the *Lancet*, 1836, and again, in his "Treatise on Hernia," 1837; and yet, strange to say, his prior claims have

not been noticed by one writer on the subject. Mr. Luke, of the London Hospital, must be considered the first to have put it into practice and to have established it, by the exercise of his excellent skill and accomplished judgment.

In dividing the stricture in inguinal hernia, the epigastric artery is avoided by cutting, in the oblique species, upwards and outwards; in the direct, *upwards and inwards;* or, in cases of doubt, *directly upwards.* The old and barbarous operation of cutting through the whole of the tumour, from the neck of the sac down to the very bottom of the scrotum, is at length happily exploded.

On examining the internal surface of the abdominal parieties corresponding to the inguinal region, two depressions will be noticed on each side, which seem to favour the formation of inguinal hernia; the external of these is separated from the internal by the projection of the obliterated umbilical artery; the internal lies to the inner side of this, and is separated from its fellow of the opposite side by the projection of the urachus on the mesial line. The outer depression or external inguinal fossa leads to the formation of a hernia by oblique descent; the internal, to that by direct descent.

Inguinal hernia is rare in the female, and is still more rarely strangulated. Its anatomy and the necessary operations are sufficiently indicated in the preceding description.

Section II.

FEMORAL HERNIA,

On examining the anterior surface of the thigh immediately below Poupart's ligament, a consider-

able fossa will be felt nearly in the centre, but somewhat nearer the pubes, between the origin of the adductor muscles on the inner, and the femoral vessels on the outer side. Into this fossa a femoral hernia descends from the abdominal cavity.

Beneath the integuments covering this region lies the subcutaneous cellular tissue, or *superficial fascia*. This varies in different subjects; in some, being loaded with fat—in others, being quite free from this. The superficial fascia is loose and continuous on every side with the surrounding cellular tissue; in the centre, however, it is fixed, being here attached to the front of the fascia lata—*the cribriform fascia*. It is divided into two layers, the superficial and deep, between which lie some subcutaneous vessels and lymphatic glands. The superficial layer passes upwards over Poupart's ligament, and is here quite free.

The *lymphatic glands* contained in the superficial fascia, and especially connected with the subcutaneous layer, are three or four in number, and are placed vertically; these receive the lymphatics from the lower extremity, and communicate with the deeper set, two or three in number, which accompany the femoral vessels, one lying usually in the femoral ring. These have little or no connection with the superior set of inguinal glands, which lie along Poupart's ligament, and receive the lymphatics from the genital organs.

The *arteries* met with in this superficial fascia are branches from the external pudic, superficial epigastric, and external circumflexa ilii. These are all branches of the femoral, arising from this vessel immediately below Poupart's ligament, and perforating the fascia lata at various points, become at length subcutaneous. The branches met with in

the superficial fascia of this region perforate the cribriform fascia, and then become superficial. Some descend, but most pass upwards over Poupart's ligament, and supply the integuments and fascia of the lower part of the abdominal parieties; many also pass inwards to the penis and scrotum of the male, the labium and pudenda of the female. These superficial arteries are derived chiefly from the external pudic and superficial epigastric. One or more veins accompany each of these arteries, and pour their blood into the internal saphena vein, as it curves round to penetrate the cribriform fascia and join the femoral vein.

The *cutaneous nerves* found in the superficial fascia are chiefly derived from the anterior crural. Some of the abdominal nerves also send down small branches which terminate in it, and a few filaments from the genito-crural branch of the lumbar plexus may also be met with in it.

The *deep layer* is more membranous, especially near to Poupart's ligament, and in connection with the saphena vein, which perforates it to join the femoral vein; its deep surface is closely connected with the cribriform fascia, and around this, with the pubic and iliac portions of the fascia lata.

The *great* or *internal* saphena vein here perforates the cribriform fascia and joins the femoral. This vessel ascends from the foot and leg along the inner surface of the thigh, superiorly it comes forwards, forms a curve, the convexity turned upwards, and about an inch and a half below Poupart's ligament penetrates the cribriform fascia. The curve formed by this vein assists in preventing the descent of a femoral hernia below the saphenic opening.

Beneath the preceding lies the *fascia lata;* this is a dense aponeurotic structure, which invests the

muscles of the thigh, and sends in septa to divide them. *Inferiorly*, it is attached to the ligaments and tendons around the knee-joint; it thence passes upwards, surrounding the thigh, to the pelvis. At its pelvic extremity on the anterior surface of the limb, it divides into three portions, an *outer* or *iliac*, an *inner* or *pubic*, and a *central* or *cribriform* portion.

The *external* or *iliac* portion is the strongest; it is attached, externally and posteriorly, to the crest of the ilium, and anteriorly to Poupart's ligament; a short distance below this it passes in front of the femoral vessels, and becomes attached by a distinct process to the front of the pubic portion; it here reflects backwards some fibres which are continuous with the base of Gimbernaut's ligament; its lower edge is well defined, and presents a curve which surrounds the cribriform fascia in this direction. That portion of the iliac process of the fascia lata which is directed downwards and inwards has been particularly described by Mr. Hey, and is named *Hey's ligament;* its pubic attachment is frequently named *Colles's ligament. Inferiorly*, the iliac and pubic portions are continuous in front of the femoral vessels and form a curve, the concavity directed upwards; this is *Burns's ligament.*

The *inner* or *pubic* portion of the fascia lata covers the front of the pectineus and adductor muscles; internally, it is attached to the symphisis pubis; as it passes outwards, in front of the pectineus muscle, it sinks behind the femoral vessels, at the outer edge of which it divides into two layers, which enclose the psoas magnus and iliacus internus muscles, and pass to be inserted—the anterior layer into the posterior surface of the iliac portion;

the other, or the posterior layer, into the capsular ligament of the hip-joint. Traced upwards, the pubic fascia reaches the origin of the pectineus muscle, is here implanted into the ilio-pectineal line, and is continuous with the fascia iliaca and Gimbernaut's ligament. *Inferiorly*, the pubic portion of the fascia lata is continuous with the iliac portion, in front of the femoral vessels, forming, as already described, Burns's ligament.

Between these two portions of the fascia lata, at a short distance below Poupart's ligament, these fasciæ are wanting, and here leave an oval space in front of the femoral vessels, which is filled up by the cribriform fascia, or central portion of the fascia lata; this is a thin layer of fascia, perforated by numerous foramina, for the transmission of blood-vessels, nerves, and lymphatics, and is so intimately connected with the superficial fascia in front and the fascia lata, as to belong equally to both of these structures; posteriorly, it is attached to the sheath of the femoral vessels.

The most important opening in the cribriform fascia is the *saphenic;* this transmits the saphena vein; it is oval in shape, and is bounded inferiorly by Burns's ligament.

The little resistance offered by the cribriform fascia, and especially at the saphenic opening, favours the course of a hernial tumour forwards. Hence it will be found that, as soon as a femoral hernia deseends to a point opposite the saphenic opening, it turns forwards, and thence ascends in front of the fascia lata, but under the superficial fascia, until it crosses Poupart's ligament, where it rests on the external oblique, with the intervention of the deep layer of the superficial fascia of inguinal hernia, or Scarpa's fascia. Femoral hernia

is prevented descending on the thigh, so as to pass beneath Burns's ligament by a reflection of this structure backwards, which passes to be attached to the front of the sheath of the femoral vessels, and by the convexity of the arch of the saphena vein; once directed forwards through the saphenic opening, the hernia is pressed upwards by the flexure of the hip-joint and the motions of the limb.

The point from which a femoral hernia descends from the cavity of the abdomen is the *femoral ring;* this is an oval aperture, situated behind Poupart's ligament, and to the inner side of the femoral vein.

Behind Poupart's ligament the brim of the pelvis is deficient, in order to allow of the passage of the soft parts to and from the lower extremity. Across this space stretches Poupart's ligament; *externally*, this is attached to the anterior superior spine of the ilium; *internally*, it is implanted by its second insertion, the external pillar of the external abdominal ring, into the spine or tubercle of the pubes, and by the third insertion, Gimbernaut's ligament, into the ilio-pectineal line. The space between Poupart's ligament and the brim of the pelvis is the crural arch, and transmits the following parts. Between the spines of the ilium, the inguino-cutaneous nerve; next the psoas magnus and iliacus internus muscles; and between them, the anterior crural nerve; still more internally, the femoral artery and vein pass. To the inner side of these is an oval-shaped opening, the *femoral ring*, through which a femoral hernia descends into the thigh; on the inner side of this is Gimbernaut's ligament.

The crural arch is rendered still more secure by the attachment of the iliac fascia and transversalis

fascia behind Poupart's ligament. This junction of the two fasciæ, as described in inguinal hernia, is indicated by a tendinous white line, immediately behind the ligament, which reaches from the spine of the ilium to the outer side of the femoral vessels; at this point the fasciæ are not united, but descend, the transversalis fascia in front of, the fascia iliaca behind, the femoral vessels, so as to form the *femoral* or *crural sheath*, which encloses the vessels and descends with them into the thigh, where it is gradually lost. The anterior and posterior layers of this sheath are united by a parittion which passes from one to the other, and thus separates the femoral artery and vein,a nd prevents a hernial tumour passing into the femoral sheath or between the vessels. This sheath is funnel-shaped, its base being turned upwards.

Crossing in front of the femoral or crural sheath is a fibrous band, sometimes named the *deep crural arch*. This begins about the centre of the ligament, and is thence prolonged inwards, widens, and is inserted into the pectineal line at the upper surface of the conjoined tendons. This appears to be a condensation of the fascia transversalis at this point, and is supposed to form the stricture, in some cases, of femoral hernia.

To the inner side of the femoral vein is the *femoral* or *crural* ring ; this is an oval aperture, much larger in the female than the male, its long axis being transverse, and about one-half to three quarters of an inch in extent. It is bounded, *in front*, by Poupart's ligament; *behind*, by the pectineal or pubic portion of the fascia lata, covering the pectineus muscle; externally, by the inner layer of the crural or femoral sheath, which separates it from the femoral vein ; and internally, by the base

of Gimbernaut's ligament. The femoral ring is partially closed by a lymphatic gland, and by some loose cellular tissue, derived from the transversalis fascia, and named the *fascia propria* of femoral hernia.

The femoral ring is the upper opening of the crural or femoral canal, by means of which a femoral hernia descends into the thigh. It is from one inch to one inch and a quarter in length; and is formed in front by the falciform process of the fascia lata, and cribriform fascia, as far as the lower part of the saphenic opening; behind, by the pectineal or pubic portion of the fascia lata; externally, by the femoral vein and femoral sheath. It is analogous to the spermatic or inguinal canal of inguinal hernia.

Some anatomists describe the crural canal as the inner or third portion of the femoral or crural sheath; others, on the contrary, include the femoral sheath as a portion of the crural canal. So long as the anatomical facts are remembered, the nomenclature is unimportant.

Gimbernaut's ligament bounds the femoral ring *internally*. It is triangular in shape; the base is lunated, free, and directed outwards; the apex is turned inwards, and reaches to the spine of the pubes; one edge or margin is turned forwards and somewhat downwards, and is continuous with Poupart's ligament; the other, in the contrary direction, is implanted into the inner extremity of the ilio-pectineal line.

So completely is the abdominal cavity protected behind Poupart's ligament, that there is but one point where a hernial tumour usually descends —this is the femoral ring; as the hernia enters this, it receives its *first* covering from the fascia propria,

which it may burst through; it then descends into the crural canal; when it arrives at the saphenic opening, its further descent is arrested; it now turns forwards, and then ascends until it crosses Poupart's ligament, and rests on Scarpa's fascia, on the outer surface of the abdomen.

Its coverings are *skin*, *superficial fascia* (two layers), and *fascia propria*; lastly, the peritoneal sac, enclosing intestine, etc.

Closely connected with the anatomy of the femoral ring is that of the obturator artery. In the common origin of this vessel from the internal iliac, its connection with the femoral ring is of little importance; but as it frequently arises from the epigastric, whence it descends in close relation to the femoral ring, it must be carefully borne in mind. In most of these cases, the obturator artery will pass to the outer side of the ring, and then behind it—in these it is not endangered in the operations on the femoral ring; but in some rare cases, it passes in front of the ring, and then to its inner side—in these, it is avoided with difficulty.

The seat of stricture in femoral hernia has been referred to almost all the ligaments and processes of fascia connected with it. The division of the falciform process and Gimbernaut's ligament is that most usually resorted to now-a-days, and most successfully. In dividing the stricture, the knife should be directed *inwards*, as by cutting *outwards* the femoral vein is endangered, and *forwards*, the spermatic chord or ligamentum teres.

CHAPTER VI.

THE AORTIC REGION.

THIS region is that occupied by the aorta throughout its whole course, from its origin at the heart, to its termination in the right and left common iliac arteries. In most, if not all, anatomical works a separate description is given of this vessel, according as it may be found in the thoracic or abdominal regions, and hence the student too frequently forms a confused and perhaps an incorrect idea of the anatomy of this important vessel. We shall describe it throughout, and have little doubt that this arrangement will facilitate the study of even the most advanced anatomical student.

The *aorta* arises opposite the junction of the left costal cartilage and sternum, from the upper and right extremity of the base of the left ventricle, by three convex extremities, which are implanted into a strong fibrous band, which thus intervenes between them and the fleshy fibres of the ventricle; from this the aorta passes upwards forwards, and to the right side, until it arrives at a point opposite to and behind the cartilage of the second rib, when it curves transversely backwards and to the left side, until it reaches the left side of the body of the second dorsal vertebra, where it turns downwards and descends to the inferior edge of the third dorsal vertebra; it thence descends, enters the posterior mediastinum, and traverses this cavity first to the left of the spinal column, but at the lower

part nearly on its anterior surface, and passing through the diaphragm, terminates on the front of the last dorsal vertebra by entering the abdominal cavity, and assuming the name of *abdominal* aorta. The vessel here descends nearly in front of, but a little to the left of, the four superior lumbar vertebræ, and terminates at the inferior margin of the fourth, by dividing into the right and left common iliac arteries.

In this course, the aorta is divided into three stages; the *first*, or *arch of the aorta* the *second*, or *thoracic aorta;* the *third*, or *abdominal aorta.*

Section I.

THE ARCH OF THE AORTA.

This extends from the origin of the vessel to the left side of the third dorsal vertebra, and is divided into three stages.

The *first* or *ascending* portion passes upwards forwards, and to the right side; and reaches as high as on a level with the upper border of the cartilage of the right second rib. It is about two inches in length, and is contained within the pericardium; at first it lies behind the origin of the pulmonary artery, but as this vessel passes upwards backwards, and to the left side, the aorta soon gets anterior to it, and to its right side; to its right is the superior vena cava, and to its left the left auricle and pulmonary artery. The left auricular appendix lies in front of both these vessels at their origins. Behind this portion of the arch is the right pulmonary artery.

The only vessels which arise from this stage are

the right and left *coronary arteries.* These vessels arise behind the semilunar valves, and are distributed to the tissues of the heart.

The *second* or *transverse* portion of the arch of the aorta is improperly so called, as it forms a curve, the convexity directed upwards and to the right side, and passes almost directly backwards to the left side of the second dorsal vertebra. This stage rests on the trachea, immediately above its bifurcation; and still more posteriorly to it are the œsophagus and thoracic duct. It is crossed in front, along its upper half, by the left vena innominata, and has also anterior to it the remains of the thymus gland; the left pneumogastric nerve crosses it near its termination, and the recurrent branch hooks round it at this point; the right pneumogastric inclines posteriorly to it; the phrenic and cardiac filaments of the sympathetic are on a plane anterior to it. This portion of the arch of the aorta gives off the three great trunks to supply the head, neck, and upper extremities, viz., the *arteria innominata, left carotid,* and *left subclavian arteries.*

The *third* or *descending* portion of the arch of the aorta lies to the left side of the spinal column, and extends from the second to the lower border of the third dorsal vertebra. It is covered by the left pleura, and gives off no branch of importance.

The *ductus arteriosus* joins the concavity of the arch of the aorta at the junction of its transverse and descending portions, and in the angle thus formed the left recurrent nerve hooks round the arch.

The curve formed by the arch of the aorta contains within its circumference the left auricle of the heart, the right pulmonary artery, the root of the left lung, the left recurrent nerve, and the œso-

phagus. The thoracic duct does not pass through the arch.

The continuation of the aorta from the third to the last dorsal vertebra is termed the thoracic aorta.

Section II.

THE THORACIC AORTA.

This portion of the vessel lies in the posterior mediastinum, covered on the left side by the pleura. The œsophagus lies anterior and to its right side, but inferiorly almost directly in front of it. The thoracic duct lies to its right side; and still more to its right is the right vena azygos. The left or demi-azygos vein crosses behind it to join the right. In front of the thoracic aorta are the root of the left lung, the heart, and pericardium.

The thoracic aorta is accompanied by numerous nervous filaments from the dorsal ganglia of the sympathetic, which form a plexus around it; towards its termination the *great splanchnic nerves* lie, one on each side of it, and only separated by a few fibres of the crus of the diaphragm.

The branches of the thoracic aorta are numerous, but small; they are the *bronchial*, *pericardial*, *œsophageal*, and *intercostal*.

The thoracic aorta passes through the aortic opening of the diaphragm, along with the thoracic duct and vena azygos, which lie to its right side, enters the abdomen, and receives the name of abdominal aorta.

Section III.

THE ABDOMINAL AORTA.

This vessel descends in front of the spine, but inclines inferiorly a little to the left side, and on the fourth lumbar vertebra divides into the right and left common iliac arteries.

The abdominal aorta has in front of it the solar plexus, pancreas, splenic vein, root of the mesentery, stomach, and the left lobe of the liver; below these, it is crossed by the left renal vein, duodenum, transverse arch of the colon, and transverse mesocolon, and, beneath these, the descending peritoneum; and some of the small intestines lie in front of it.

The vena cava inferior, or ascendens, lies to its right side, but at the upper part of the abdomen diverges from it to pass through the diaphragm. On the left side of the abdominal aorta are the trunk of the sympathetic nerve of the left side and the lumbar ganglia.

The abdominal, like the thoracic aorta, is surrounded by a plexus of nerves, formed principally from the solar plexus and lumbar ganglia.

The branches of this vessel are—

1. The *phrenic*, one on each side to the diaphragm.

2. The *cœliac axis*, which subdivides into—1, the *coronary artery*, to the stomach; 2, the *splenic*, to the spleen and stomach; 3, the *hepatic* artery, to supply the liver.

3. The *superior mesenteric* artery, to supply the small intestines, and one-half the large.

The *inferior mesenteric*, to supply the remaining half of the large intestines.

The above vessels arise from the front of the aorta, and supply the digestive viscera. The remaining branches of this vessel are, the *supra-renal*, the *renal*, the *spermatic*, and *lumbar* arteries.

From the angle of bifurcation of the aorta a small branch arises, the *middle sacral* artery; it runs downwards in front of the sacrum to terminate at the coccyx.

The only operation performed upon any part of the aorta is that of tying the abdominal portion of this vessel, as first practised by Sir A. Cooper. The operation may be performed, for the cure of aneurism of either of the common iliac arteries or of the abdominal aorta, a short distance above its bifurcation. There is only one point where this important vessel may be tied with any prospect of success, namely, between the origins of the superior and inferior mesenteric arteries. Above this point, the disturbance of the important viscera in the epigastric region would be sufficient to deter from the operation; and below the origin of the inferior mesenteric there is not sufficient room to apply a ligature, and to hope for the necessary contraction and obliteration of the vessel. Sir A. Cooper tied the abdominal aorta by making an incision, three inches in length, along the course of the linea alba; having divided the abdominal parieties and peritoneum, he passed his hand into the cavity of the abdomen, and scratched through the posterior layer of the peritoneum. He was guided to the artery by its pulsations, and placed a ligature around it.

This vessel may also be tied by making an incision through the abdominal parieties on the left side, extending from a little to the inside of the anterior superior spinous process of the ilium to the lower border of the costal cartilages; the muscles

having been divided, the transversalis fascia is next to be carefully cut through, when the peritoneal sac may be turned over to the opposite side ; the hand is to be passed in to the front of the lumbar vertebræ, and the artery secured. This mode of operating has the advantage of not wounding the peritoneum.

There can be no question as to the re-establishment of the circulation in this case, as the anastomosis between the superior and inferior mesenteric arteries is peculiarly free, and would at once convey the blood into the lower extremities; in addition, there is the anastomosis of the lumbar arteries, posteriorly, with the intercostal and diaphragmatic arteries, and in front the anastomosis between the internal mammary and the epigastric arteries.

THE ARTERIA INNOMINATA

Is the first large branch of the aorta ; it arises from the commencement of the transverse portion of the arch, from which it proceeds upwards forwards, and to the right side for about an inch and a half, until it arrives opposite the sterno-clavicular articulation of the right side, where it divides into the right carotid and the right subclavian arteries. This vessel lies behind the sternum and origins of the sterno-hyoid and thyroid muscles. Near its origin it is crossed by the left vena innominata; the right lies to its right side, and on a plane anterior to it, as also the right phrenic nerve.

The arteria innominata may be tied in cases of aneurism of the first stages of the right subclavian or right carotid artery. This operation is performed in the same manner as that of tying the first stage

of the subclavian; when this vessel is exposed, the finger will be conducted by it to the arteria innominata.

The left carotid and left subclavian arteries have been sufficiently described when treating of the cervical region.

From the depth at which these vessels lie in their first stage, the operation of securing either, and especially the left subclavian, must prove extremely difficult. The late Sir A. Cooper attempted to tie the left carotid in its first stage, but failed in doing so; and there is as yet no case on record of either of them having been tied, much less successfully. It would be vain to attempt to tie the left subclavian in the first stage, unless near to the scalenus anticus muscle, as its relation to the pleura adds to the embarrassment of the operator, and to the serious nature of the operation.

It is well to bear in mind, in examining tumours at the root of the neck, that aneurisms of the arch of the aorta will counterfeit those of its principal branches.

CHAPTER VII.

THE PELVIC REGION.

This region contains numerous important parts—namely, the pelvic viscera; the common, external, and internal iliac arteries; with their several branches and corresponding veins; the sacral plexus and its branches; the lumbo-sacral nerve; and the termination of the sympathetic nerve in the ganglion impar; and the hypogastric plexus.

ARTERIÆ ILIACÆ COMMUNES

Arise, one on each side, from the bifurcation of the aorta, in front of, and a little on the left side of, the fourth lumbar vertebra; from this, the *right common iliac* passes downwards, and to the right side, across the last lumbar vertebra, the origin of the vena cava and its own vein, and opposite the sacro-iliac symphisis terminates by dividing into the external and internal iliac arteries; the *left common iliac artery* takes a similar course to the left side, and terminates in the same manner. The right common iliac artery is a little longer than the left, and the relations of these vessels are somewhat different; thus the right common iliac vein lies first to the inner side of the artery, it then passes behind it to form the vena cava; the left vein lies internal to the artery throughout, and at some distance from it; to the outer side of both lies the psoas magnus muscle; the termination of the small intestine and right ureter cross the right, near its bifurcation; the colon and left ureter cross, in like

manner, the left; the latter is also crossed by the inferior mesenteric artery and vein.

The common iliac artery gives off no branch of importance but those in which it terminates; from the angle of bifurcation of the aorta proceeds usually the *middle sacral artery*.

The common iliac artery may be tied for aneurism of the external or internal iliac artery; the operation is performed by making an incision from three to four inches in length, extending from about one inch on the inner side of the anterior superior spinous process of the ilium upwards, with a slight degree of obliquity inwards; the skin, fascia, and abdominal muscles having been divided, the transversalis fascia is next to be cut through, the peritoneum is then to be drawn upwards, and towards the mesial line, the artery will thus be exposed, and the ligature is to be passed round it; on the left side this should be passed from within outwards, but on the right side the opposite direction should be preferred in tying the artery near to its origin.

THE EXTERNAL ILIAC ARTERY

Proceeds from the bifurcation of the common iliac at the sacro-iliac symphisis, downwards and outwards, along the inner edge of the psoas muscle, until it passes behind Poupart's ligament, where it terminates in forming the femoral artery. In this course the external iliac artery is bound down to the psoas by the *fascia propria*, or outer layer of the iliac fascia, which itself passes behind the artery to sink into the pelvis; to its inner side lies the external iliac vein; to its outer side, and at some distance from it, imbedded between the psoas magnus and iliacus internus muscles, is the anterior crural

nerve; the genito-crural nerve lies on its anterior and outer side, and generally in close contact with it. Near to its origin the external iliac artery is crossed by the ureter, and about the same point the vas deferens descends to its inner side; the spermatic vessels and nerves descend in front of and cross it obliquely. The peritoneum covers it throughout. The right external iliac artery is crossed near its origin by the ilium, terminating in the cæcum, and, in like manner, the left is crossed by the sigmoid flexure of the colon, descending into the pelvis to form the rectum.

The external iliac artery gives off but two branches of any importance, viz., the *epigastric* and *circumflexa ilii*; these arise immediately above Poupart's ligament from opposite sides of the artery, the epigastric from the inner, the circumflexa ilii from its outer side.

The *epigastric* artery first descends a little, then turns upwards and inwards, ascends towards the linea alba, between the layers of the transversalis fascia, crosses to the inner side of the internal abdominal ring, and then enters the sheath of the rectus muscle, where it terminates by anastomosing with the internal mammary artery.

The *circumflexa ilii* artery winds upwards and outwards, parallel to and behind Poupart's ligament, then along the inner side of the crest of the ilium, between the transversalis and internal oblique muscles, and terminates in supplying the abdominal parietes, anastomosing outwardly with the gluteal artery, internally with the epigastric, and superiorly with the lumbar arteries.

The external iliac artery has been frequently tied, and with the greatest success, for the treatment of aneurism of the femoral artery, high up, or

after this vessel has been unsuccessfully tied for the cure of popliteal aneurism.

As the aorta bifurcates nearly opposite to the umbilicus, but a little to its left side, a line drawn from this point, on either side, to about midway between the symphisis pubes and the anterior superior spine of the ilium, will indicate sufficiently for all practical purposes the course of the common and external iliac artery, and will serve as a guide in cutting down on either of these vessels.

The operation of tying the external iliac artery is best performed according to the method first recommended by Sir Astley Cooper, as follows :—"A semilunar incision is to be made through the integuments in the direction of the fibres of the external oblique, extending from near to the anterior superior spinous process of the ilium to a little below the inner side of the inguinal ring. The tendon of the external oblique is divided in this incision, and, on raising the flap, the spermatic chord may be seen passing beneath the edge of the internal oblique and transversalis muscles, and the superior opening of the inguinal canal and the epigastric artery, proceeding along the inner edge of this opening, beneath which the iliac artery is situated. Lastly, by passing the finger beneath the spermatic chord, the iliac vessel may be felt." The cul de sac of the peritoneum being drawn upwards, the external iliac artery may be seen without difficulty: the aneurism needle is now to be passed from within outwards, and the vessel secured, without including any of the nerves. The fascia propria is, in most cases, so dense as to require to be divided, or torn through before the needle can be passed beneath the artery. The ligature should be applied at some distance above the origins of the epigastric

and circumflexa ilii arteries. Mr. Abernethy recommended the incisions to be made over the course of the artery; but as this cuts across the fibres of the abdominal muscles, his mode of operating is objectionable, especially as it renders the patient ever afterwards liable to a hernial tumour.

THE INTERNAL ILIAC ARTERY

Proceeds from the bifurcation of the common iliac downwards, inwards, and somewhat backwards, sinking into the cavity of the pelvis, behind the peritoneum and rectum, and, after a short course of little more than an inch and a half, terminates at the upper border of the great sciatic notch in two large branches, a *posterior* and an *anterior*. This vessel has behind it the lumbo-sacral nerve, the origins of the pyriformis muscle, and some of the anterior sacral nerves; its vein lies rather posterior to it, and most frequently a plexus of veins, proceeding to form the internal iliac trunk, surrounds it.

In the adult the internal is generally smaller than the external iliac; but in the fœtus the internal is much the larger, forms the continuation of the common iliac, and returns the blood of the fœtus to the mother; it is then called *umbilical*.

The *posterior* branch of the internal iliac artery gives off three branches, the *ilio-lumbar*, *lateral-sacral*, and *gluteal* arteries. The *ilio-lumbar* and *lateral-sacral* are small branches, and are distributed chiefly to the parietes of the pelvis, as indicated by their names.

The *gluteal artery* is the largest branch of the internal iliac, and, immediately after its origin, passes backwards, out of the pelvis, through the great sciatic notch, above the pyriformis muscle, and accompanied by the superior gluteal nerve to

supply the gluteal muscles, as described in the *Gluteal Region*.

The *anterior* division of the internal iliac gives off numerous branches to the pelvic viscera—viz., the *vesical*, *middle hemorrhoidal;* and in the female the *uterine* and *vaginal*—and three considerable branches to the external surface of the pelvis, the *obturator*, *sciatic*, and *pudic* arteries; these only need be considered here.

The *obturator* artery runs forwards across the pelvis, a little below its brim, and escapes through the obturator foramen, into the upper and inner part of the thigh, where it terminates; this artery is accompanied by its nerve and vein; the former in front, the latter behind. The obturator artery frequently arises from the epigastric artery, and thence descends, inwards to the obturator foramen, crossing the femoral ring, and becoming closely related to femoral hernia (see p. 121).

The *sciatic* artery is next in size to the gluteal; it escapes from the pelvis below the pyriformis muscle, along with the sciatic nerves, and is lost in the surrounding muscles, and by anastomosing with the circumflex and perforating arteries.

The *pudic* artery passes out of the pelvis with the preceding, winds round the spine of the ischium, re-enters the pelvis through the lesser sciatic notch, and is lost in the perineum and genital organs.

The RECTUM is supplied with blood from three sets of *hemorrhoidal* arteries—the *superior* from the inferior mesenteric, the *middle* from the internal iliac, and the *inferior* from the pudic; it is supplied with nerves from the sympathetic and sacral nerves; the former are distributed chiefly to its upper, the latter to its lower part.

The internal iliac artery may require to be tied in cases of aneurism of any one of its principal branches. The operation may be performed as recommended for securing the common iliac artery, or by cutting down along the course of this vessel; the former is the preferable mode, especially on the left side; the external or common iliac having been exposed, the finger is to be passed along the vessel, and the internal iliac will be found without difficulty; the passing of the aneurism needle is not so easy of accomplishment, as the vessel lies within the pelvic cavity, and is closely related to its veins, the sacral nerves, and rectum; it is best to isolate the artery first with the finger, and then to pass the ligature around it.

CHAPTER VIII.

THE INFERIOR OR LOWER EXTREMITIES

Consist each of the thigh, leg, and foot; and in these present many regions of considerable importance. The first of these will be best described under the heads of—1st, the *anterior femoral region;* 2nd, the *gluteal region;* 3rd, the *posterior femoral region;* 4th, the *popliteal region* or *space.*

Section I.

THE ANTERIOR FEMORAL REGION

Occupies the anterior surface of the thigh, and extends from Poupart's ligament to the knee-joint. It contains numerous muscles, the femoral artery and vein and their branches, the anterior crural nerve, its branches, and several descending filaments of nerves from the lumbar plexus. It comprises two important regions, namely, Scarpa's triangle and Hunter's canal, the description of which will include that of the most important parts in the anterior femoral region.

SCARPA'S TRIANGLE.

This space has been named after the celebrated anatomist and surgeon Scarpa, who first recommended that the femoral artery should be tied here,

for the cure of popliteal aneurism; and thus, by the extension of the correct principle first promulgated by the eminent John Hunter, introduced the greatest triumph of modern surgery.

Scarpa's triangle occupies the anterior surface of the upper third of the thigh. It is bounded *externally* by the sartorius muscle, *internally* by the adductor longus. Its apex is beneath, formed by the decussation of these muscles; its base is above, and is formed by Poupart's ligament; the centre of this space is hollow, unless in the very fat subject. Along the mesial line, the femoral artery may be traced in the living subject with the fingers; close to this, and to its inner side, descends the femoral vein, and to its outer side the anterior crural nerve.

Beneath the integuments lies the superficial fascia, or subcutaneous cellular tissue, containing numerous blood-vessels, nerves, and lymphatic glands, as described with femoral hernia. The most important of these may be enumerated as follows:—*Arteries*, external pudic and superficial epigastric, and branches; *Veins*, the internal saphena vein and its numerous branches; *Nerves*, on the outer side, filaments from the inguino-cutaneous branch of the lumbar plexus; in front and internally, branches from the anterior crural, ilio-scrotal, and genito-crural nerves. The lymphatic glands are those met with in the dissection of femoral hernia, and need not be again described. Beneath these lies the fascia lata, presenting the arrangements described in femoral hernia. Beneath this fascia lie the femoral vessels contained in the femoral or crural sheath, and surrounded by a quantity of loose cellular tissue.

THE FEMORAL ARTERY

Is the continuation of the external iliac; it commences as the artery passes beneath Poupart's ligament, whence it descends into the thigh until it reaches the tendinous opening in the adductor magnus muscle, where it enters the popliteal space, and assumes the name of popliteal artery. The femoral artery occupies only two-thirds of the thigh on its anterior and then on its internal surface; its course will be indicated by a line drawn from the centre of Poupart's ligament to the inner edge of the patella. In the first part of its course it lies in Scarpa's triangle, and then enters a tendinous canal, *Hunter's canal*, formed by the vastus internus and adductor muscles.

In *Scarpa's triangle*, the femoral artery lies superficial, being only covered by the integuments, superficial fascia, fascia lata, and sheath. It rests posteriorly on, first, the psoas magnus, then, with the intervention of some fatty cellular tissue, the profunda vessels and nerves, on the pectineus, and then on the adductor brevis; it crosses in front of the hip-joint, being separated from the capsular ligament by the psoas magnus and a large bursa. The femoral vein at first lies on the same level as the artery to its inner side, but immediately beneath Poupart's ligament the vein inclines towards its posterior surface, and at the lower part of the triangle lies nearly behind the artery.

The *anterior crural nerve* lies to the *outer* side of the femoral artery, at a distance of from half to three-quarters of an inch, and imbedded between the psoas magnus and iliacus internus muscles; it soon gives off a considerable branch, which accom-

panies the artery throughout the greater part of its course, and becomes the internal saphenus nerve; in addition, the anterior crural nerve gives off several large branches, many of which pass behind the artery, to accompany its branches and supply the muscles.

The femoral artery in Scarpa's triangle gives off, immediately beneath Poupart's ligament, the superficial epigastric, external pudic, and the circumflexa ilii arteries. The *superficial epigastric* soon perforates the fascia lata, and ascends in the superficial fascia over Poupart's ligament, to supply the abdominal integuments; the *external pudic*, sometimes two branches, run inwards to supply the integuments of the penis and scrotum. The *external circumflexa ilii* winds beneath the fascia lata, round the outer side of the pelvis, and becoming superficial terminates in supplying the integuments of this region, and anastomoses with the lumbar branches of the aorta, of the deep circumflexa ilii and the gluteal arteries.

The *profunda artery* is a large branch, and arises from the femoral, from an inch and a quarter to an inch and a half below Poupart's ligament, rarely beyond, but frequently above, this point, and not unfrequently behind Poupart's ligament. This vessel arises from the outer side of the femoral, but soon turns inwards, passes behind the artery, from which it is separated by its own vein and branches of the anterior crural nerve, and on the inner side of the vastus internus terminates by giving off the perforating arteries. The profunda is the principal artery for supplying the thigh with blood; its branches are the *external* and *internal circumflex* and the *perforating* arteries.

The *external circumflex artery* passes from its origin, directly outwards, or a little upwards, between the branches of the anterior crural nerve, beneath the sartorius and rectus femoris, and then sinks between the vastus externus and cruræus muscles, and there terminates in numerous branches, to supply these and the surrounding muscles.

The *internal circumflex artery* arises from the inner part of the profunda, runs upwards, and then sinks through a triangular space formed between the pectineus, psoas, and obturator externus, above the trochanter minor, and gets to the back of the thigh, where, at the lower edge of the quadratus muscle, it anastomoses with the sciatic and perforating arteries. This artery supplies the surrounding muscles; a small branch, the *articular* artery, proceeds from it, through the notch in the acetabulum, to the hip-joint, to supply the round ligament and head of the bone.

The *perforating arteries* are three in number, and are so called from perforating the tendons of the adductor muscles close to the linea aspera, to reach the back part of the thigh. The terminating branch of the profunda, sometimes described as a fourth perforating artery, pierces the tendon of the adductor magnus and so gets to the back of the thigh. All these branches meet on the posterior surface of the limb, and here form a complete chain of anastomosis with each other, the sciatic and gluteal arteries above, and the articular branches of the popliteal inferiorly, which extends from the hip to the knee-joints, and preserves a perfect supply of blood to these and the other parts of the limb, in cases where the femoral or profunda artery or both these vessels should be tied, wounded,

or destroyed. All the branches of the profunda are accompanied by filaments from the anterior crural nerve.

Below the origin of the profunda, the femoral artery in Scarpa's triangle seldom gives off any branch of importance. It is here usually joined by the *internal* saphenus nerve, which lies first to its outer side, and then gets in front of it; this nerve has a double origin, one branch from the anterior crural, the other from the obturator nerve; it will be found in Hunter's canal, with the femoral artery, and below this point, first, with the anastamotica magna artery and then with the internal saphena vein.

The *anterior crural* nerve is one of the large terminating branches of the lumbar plexus; it enters the thigh between the psoas magnus and iliacus internus muscles, and immediately divides into a lash of filaments to accompany the branches of the femoral artery and terminate with them. One or two branches become cutaneous, and descend on the front and outer part of the thigh; one frequently runs superficial to the course of the femoral artery. The principal, but by no means largest, branch of the *anterior crural nerve* is the internal saphenus nerve; this arises by two heads as just stated, runs inwards to join the femoral artery, and accompany it in the lower part of its course, and in Hunter's canal, and thence to descend to the leg with the internal saphena vein.

The operation of tying the femoral artery, as recommended and practised by Scarpa, has led the way to the greatest modern improvement in surgery, namely, the treatment of aneurism by tying the vessel at a considerable distance from the diseased part.

The point to be selected for tying the femoral artery, when we can choose, is about a hand's breadth, or from three to four inches, below Poupart's ligament; this will be from an inch and a half to two inches below the origin of the profunda, and thus the supply of this vessel will still be preserved to the limb.

An incision being made over the course of the artery, its coverings are by degrees divided, the sheath opened, and the artery exposed; the needle is passed from within outwards, and the vessel secured.

But the femoral artery may also be tied above this point, say a little beneath Poupart's ligament; here, although the supply from the profunda is cut off, the anastomosis of this vessel on the back part of the limb soon receives the blood from the sciatic and gluteal arteries, and conducts it to the thigh and lower parts. A few cases are on record where, from an unusual distribution of the vessels—as, for example, the division of the femoral artery high up into two branches, and the subsequent union of these at a point below the ligature—this operation has failed; but these are anomalies rarely met with, and cannot influence our rules of practice, which must be applicable to the majority of cases.

Immediately below Scarpa's triangle the femoral artery sinks behind the sartorius muscle, and here an interval sometimes exists, before it enters the tendinous canal in which John Hunter first recommended this vessel to be tied, and hence termed, *Hunter's canal.* This eminent surgeon and physiologist thus led the way to Scarpa's improvement, and to him is to be ascribed the great merit of the more modern operation.

Formerly, the aneurismal part of the vessel was

tied, but as this was diseased the results were most calamitous, and most surgeons preferred the amputation of the limb; now-a-days, this is not only saved, but is restored to its original integrity.

HUNTER'S CANAL.

This is a tendinous canal, occupying about the middle third of the thigh on its inner side, and containing the femoral artery and vein and the internal saphenus nerve; it lies immediately beneath the sartorius muscle, and is bounded externally by the vastus internus, internally by the adductor longus and magnus, and is covered in front by a strong tendinous aponeurosis, derived from and uniting these muscles: it is triangular in shape, the apex posteriorly towards the linea aspera. The tendinous aponeurosis covering the canal forms its base, and varies much: in some subjects it is continued upwards near to Scarpa's triangle, and terminates gradually; in others it is much shorter, and ends abruptly; inferiorly, the adductor tendon forms a small opening, through which the femoral artery and vein pass backwards into the popliteal space; beneath its lower margin, the anastomotica magna artery and internal saphenus nerve pass to the knee. On opening the canal, the femoral vessels and saphenus nerve are exposed; the nerve lies in front, next is the artery, and immediately behind, and closely connected with it, is the femoral vein.

The only branch given off by the femoral artery, in this part of its course, is the *anastomotica magna*, which arises close to its termination, and descends, accompanied by the internal saphenus nerve, along the posterior margin of the sartorius muscle to the inner side of the knee-joint; this artery sends branches to the sartorius and vastus muscles and

ends by anastomosing with the articular branches of the popliteal artery.

The operation of tying the femoral artery in Hunter's canal, for the cure of popliteal aneurism is now never performed, as it has been found to terminate unfavourably in the few cases operated upon by John Hunter and others. The operation may be easily performed by making an incision along the anterior border of the sartorius muscle, drawing this to the inner side, and then opening the tendinous canal; care must be taken not to mistake the vastus muscle for the sartorius. This operation is not likely to succeed; the tendinous structures granulate badly, and the close contact of the femoral artery and vein renders it difficult to separate them without injury to one or the other.

In amputations of the thigh about this part, some difficulty is experienced in securing the femoral artery, as it retracts into the canal; this must be slit open and the artery drawn out and secured, without injuring the vein or nerve.

This is a good situation for applying the tourniquet to the femoral artery, when requisite, as, although contained in a tendinous canal, it may be compressed firmly against the femur. In Scarpa's triangle it is more difficult to command the circulation, as the artery rests only upon soft parts; many hence prefer compressing the external iliac behind or a little above Poupart's ligament.

The muscles found within this region are the sartorius, rectus, vastus internus, vastus externus, cruræus, gracilis, pectineus, adductor brevis, longus, and magnus, and the terminations of the psoas magnus and iliacus internus, and, more deeply seated, the obturator externus.

Section II.

THE GLUTEAL REGION.

Beneath the integuments of this region lies a large quantity of fat, in which several branches of nerves and arteries are found; the former are derived from the posterior lumbar nerves, the lumbar plexus, and the sacral plexus; the vessels are principally derived from the gluteal and circumflexa ilii. The fascia lata covering the gluteus maximus muscle is thin, and sends processes between the fibres of the muscle ; in front of this, however, it is remarkably dense, where it invests the gluteus medius and tensor vaginæ femoris; superiorly, it is attached to the brim of the pelvis, and behind to the posterior surfaces of the sacrum and coccyx; inferiorly, it is continuous with the fascia lata of the back of the thigh, and is here firmly connected with the tendons of the tensor vaginæ femoris and gluteus maximus.

The *gluteus maximus* is one of the strongest muscles of the body; quadrilateral in shape, it crosses nearly horizontally from the sacrum, coccyx, and great sacro-sciatic ligament over the tuber ischii, trochanter major, and several soft parts, to be implanted into the fascia lata, and into the lower part of the line leading from the trochanter major to the linea aspera; the upper and lower margins of this muscle are well defined—the lower forms the fold of the nates or buttock. The gluteus maximus muscle covers, in addtion to the parts mentioned, the following, in order from above downwards: the posterior portion of the gluteus medius, the gluteal artery, and superior gluteal nerve escaping from the sciatic notch, the pyriformis

muscle, the sciatic artery, and greater and lesser sciatic nerves, the internal pudic artery and nerve as they wind round the spine of the ischium to re-enter the pelvis, gemellus superior, obturator internus tendon, gemellus inferior, quadratus femoris, and between this and the upper part of the adductor magnus muscle, the anastomosis between the internal circumflex and sciatic arteries. As it crosses the tuber ischii, the gluteus maximus covers the origins of the hamstring muscles and the tendon of the obturator externus.

The principal arteries met with here are the gluteal, sciatic, and pudic; these are branches of the internal iliac, and pass out of the pelvis through the great sciatic notch.

The *gluteal artery* is one of the first and largest branches of the internal iliac; it passes out of the great sciatic notch, above the pyriformis muscle, along with the superior gluteal nerve, and immediately divides into a lash of branches, to supply the gluteal muscles, bone, and integuments; some of these ascend towards the crest of the ilium to anastomose, in front, with the circumflexa ilii artery, others pass backwards towards the sacrum to anastomose with the lumbar and sacral arteries, whilst others descend to anastomose with the sciatic, pudic, and circumflex femoris arteries.

The superior gluteal nerve, which accompanies this artery is derived from the lumbo-sacral nerve; like the artery it divides, as it passes out of the pelvis, into numerous filaments, to supply the gluteal and other muscles.

The *sciatic artery*, soon after its origin, passes out of the pelvis below the pyriformis muscle, along with the great and lesser sciatic nerves, descends in the space between the tuber ichii and great trochanter

to anastomose with the internal circumflex femoris artery between the inferior edge of the quadratus femoris and the upper margin of the adductor magnus muscle; it sends branches to all the surrounding parts: one, the *comes nervi ischiadici*, of large size, descends with the sciatic nerve to supply its tissue; a few small branches enter and supply the hip-joint.

The *internal pudic artery* passes out of the great sciatic notch, at a short distance from the preceding, and, accompanied by the pudic nerve, winds round the lesser sciatic ligament, where it is attached to the spine of the ischium, re-enters the pelvis through the lesser sciatic notch, and thence is met with in the anatomy of the perineum, as already described; some branches, the *inferior hemorrhoidal*, pass backwards to supply the lower extremity of the rectum, and anastomose with the other hemorrhoidal arteries.

The principal veins which return the blood from the branches of the internal pudic artery do not accompany these, but pass directly backwards to the internal iliac vein, and form in their course a large venous plexus, which surrounds the neck of the bladder and prostate gland, and pours out a large quantity of blood when wounded, as in the operation of lithotomy, etc.

The *sciatic nerves*, two in number, are branches of the sacral plexus, and pass out of the great sciatic notch, below the pyriformis muscle, although sometimes one of them will pass between its fibres.

The *lesser sciatic* or *inferior gluteal* nerve, as it escapes, supplies the gluteus maximus muscle, and integuments, and sends off two remarkable branches, the *inferior pudendal*, or *perineal*, and the *posterior*

cutaneous nerves. The inferior pudendal winds round the tuber ischii, perforates the fascia lata, and is lost in the integuments of the perineum and scrotum. The posterior cutaneous nerve descends along the back of the thigh, perforates the fascia lata about its centre, and descends in the integuments over the popliteal region, and even below this.

The *great sciatic* nerve, the largest nerve in the body, descends between the tuber ischii and great trochanter, then along the back part of the thigh to the popliteal space, where, or above which, it divides into its terminating branches, the internal and external popliteal nerves.

The arrangement of the nerves of the lower extremity is somewhat curious and interesting. Thus the anterior crural nerve supplies the muscles on the anterior and lateral surfaces of the thigh ; the obturator nerve or nerves, the obturator externus and the adductor muscles; the superior gluteal nerve supplies the gluteus medius and minimus; the inferior gluteal, the gluteus maximus. The large muscles on the back of the thigh are supplied by the great sciatic, which thence descends to supply exclusively the muscles of the leg and foot; the small muscles at the back of the hip are supplied chiefly by separate branches from the sacral plexus. These facts are useful in explaining the partial paralysis of certain muscles, either from injury or disease.

The gluteal artery is occasionally injured by bayonet and other wounds, and has been tied with success; a line drawn from the posterior inferior spine of the ilium to the upper edge of the trochanter major will cross this vessel at its exit from the pelvis; an incision being made in the direction

of the fibres of the gluteus maximus muscle, the artery may be felt by passing the finger on to the upper border of the great sciatic notch, and there secured by a tenaculum, or needle. The writer heard the late Mr. Carmichael describe his operation of tying the gluteal artery. He stated "that he had little or no difficulty; that, so soon as he had cut through the gluteus maximus, he found a quantity of coagulated blood, which being turned out, he felt the artery against the brim of the sciatic notch, and succeeded in securing it at the first dip of the needle." In cases of wounds, the artery may be secured in a similar manner, by enlarging the wound, if necessary; where the hemorrhage cannot otherwise be restrained, the abdominal aorta must be compressed against the lumbar vertebræ. This artery, or some of its principal branches may be the subject of aneurism; here a ligature of the internal or common iliac may be necessary, when other means fail.

The sciatic or pudic artery may also be wounded, and require to be tied. The sciatic nerve will always point out the former; the latter, from its circuitous course, is found with greater difficulty; the spine of the ischium will indicate it outside the pelvis, and in the perineum it is found about an inch and a quarter from the edge of the tuber ischii; it may be wounded here in the operation of lithotomy, and should be secured. In fat, robust subjects these operations will prove much more difficult than in persons of a lean, emaciated figure. In difficult cases it is better to secure the artery at the risk of enclosing some of the soft parts in the ligature, than to allow the patient to die of hemorrhage.

Section III.

THE POSTERIOR FEMORAL REGION.

The posterior surface of the thigh presents little of practical importance, until we arrive at the popliteal region or space; in it we see the hamstring muscles, namely, on the outer side, the biceps, and on the inner the semitendinosus and semimembranosus, and between them the great sciatic nerve descending; here also may be noticed the great chain of anastomosis formed between the gluteal, sciatic, and internal circumflex arteries above, the perforating arteries in the centre, and the articular branches of the popliteal inferiorly, and which is so useful in re-establishing the circulation when the arteries on the anterior surface of the limb are destroyed or tied.

Section IV.

THE POPLITEAL REGION.

This region, or space, is situated at the back of the knee-joint, extending upwards into the lower third of the thigh, and downwards into the upper fourth of the leg.

Beneath the integuments covering this region is the subcutaneous cellular tissue, or *superficial fascia;* it is loose, contains little fat, and is frequently infiltrated with serum; in it are the terminating branches of the posterior cutaneous nerve, a branch of the lesser sciatic, and some smaller filaments.

Beneath these, lies the *popliteal fascia.* This is a dense aponeurotic structure, continuous with the fascia lata above, and the fascia of the leg inferiorly;

on each side it invests the tendons, which it secures *in situ*, and passes beneath them to be attached to the ligaments surrounding the knee-joint. The fibres of the fascia interlace with each other; some, taking nearly a transverse course, are usually very distinct, and serve to strengthen this fascia and connect the tendons of the opposite sides, which thus act as tensors of the fascia. This aponeurosis is generally perforated by small vessels and nerves; the last are cutaneous filaments from the popliteal nerves. The principal vessel is the posterior or external saphena vein, which usually perforates this fascia, either about the centre, or a little below this point, to penetrate the space, and join the popliteal vein.

The popliteal fascia exerts considerable influence on the diseases of this region. In inflammation affecting the fatty cellular tissue of the cavity, the tension produced by the fascia adds much to the sufferings of the patient, and calls for an early incision; in more chronic cases, matter, when formed, is prevented by the fascia from pointing posteriorly; it ascends into the thigh, and usually towards its inner surface, where the resistance is least, and may burst here.

Similar effects are produced on aneurismal and other tumours forming beneath this fascia; when they fill the popliteal space they ascend into the lower and inner part of the thigh, and may be mistaken here for diseases affecting the femoral artery, or other structures in this region. In examining these tumours, the importance of flexing the joint, so as to relax the fascia, is apparent.

On dividing this fascia the popliteal space or cavity is exposed; this is found to be of a lozenge or diamond shape, or that of two triangles joined at

their bases across the centre of the knee-joint. Of these the superior triangle is the larger, and occupies the inferior third of the thigh; it is bounded externally by the biceps tendon, and internally by the tendons of the semitendinosus and semimembranosus. The inferior triangle, the smaller, occupies the superior fourth of the leg, and is bounded on either side by the heads of the gastrocnemii muscles. In the natural state these spaces are of much smaller extent.

The popliteal space is filled with a quantity of fat, in which the popliteal vessels and nerves are lodged. The latter are the first met with; they are two in number, the *internal* and *external popliteal*, and are the terminating branches of the great sciatic nerve, which divides at the upper part of this space, or sometimes above this. Of these the *internal popliteal* is the larger; it descends almost vertically in the original course of the nerve, through the popliteal space, and nearly in the mesial line, and over the course of the artery, and escapes with it from the popliteal space, when it descends into the leg, and forms the posterior tibial nerve.

The branches given off by the internal popliteal nerve are, a few articular filaments to the knee-joint, several muscular branches to the heads of the gastrocnemius, soleus, plantaris, and popliteus, and the *external saphenus* nerve; this, the largest branch, receives a filament also from the external popliteal nerve, the two heads uniting at a variable point, sometimes in the centre of the calf of the leg. The nerve descends beneath the fascia, and, on the posterior surface of the gastrocnemius externus, accompanies the posterior saphena vein, and, perforating the fascia a little below the middle of the leg, becomes cutaneous.

The *external popliteal* nerve runs from its origin downwards and outwards, along the outer part of the popliteal space, close to the biceps tendon and on its inner side, passes below this, and winds round the neck of the fibula, amongst the fibres of the peroneus longus, and here divides into its two terminating branches, the anterior tibial and musculo-cutaneous nerves.

The branches of the external popliteal nerve consist of a few articular and cutaneous filaments, and the *communicans fibularis* branch, which passes to form, with the corresponding branch from the internal popliteal nerve, the posterior saphenus nerve, just described.

Most deeply seated in the popliteal space, and separated from the nerves by a quantity of fat, lie the popliteal vessels, in close contact with each other, the vein being superficial or posterior to the artery. This vein, the commencement of the femoral, is formed by the junction of the anterior and posterior tibial veins, at the lower part of the space, receiving also the external or posterior saphena vein; at first it lies on the inner side of the artery, then immediately behind it, and at the upper part of the space a little to its outer side.

Beneath and anterior to the vein lies

THE POPLITEAL ARTERY.

This vessel, the continuation of the femoral, enters the popliteal space through the tendinous opening in the adductor magnus, passes downwards and outwards through nearly the central line of the popliteal space, and, entering the leg, terminates by passing beneath the tendinous arch of the soleus

muscle, at the lower margin of the popliteus, by dividing into the anterior and posterior tibial arteries. In this course, the popliteal artery lies first on the inner and posterior surface of the femur and a few fibres of the adductor magnus, then on the ligamentum posticum of the knee-joint, with the intervention of one or two lymphatic glands and the azygos artery, beneath this, on the popliteus muscle and the aponeurotic expansion covering this muscle from the semimembranosus tendon; it has superficial to it the popliteal vein and nerves as just described, the popliteal fascia, and integuments; at the upper part of the space, the semimembranosus muscle overlaps the artery a little on the inner side, and inferiorly, it is in like manner covered by the converging heads of the gastrocnemius externus; here the posterior saphena vein and nerve lie over it; at the upper part of the space the internal popliteal nerve lies to the outer side of the artery, but at the lower part inclines to its inner side. The relations of the plantaris muscle to this artery are the same as the outer head of the gastrocnemius muscle, with which it arises; inferiorly the plantaris tendon crosses the artery.

Besides several muscular and cutaneous branches, the popliteal artery gives off five *articular arteries* to the knee-joint; two of these are *superior*, two *inferior*, and one *central* or *azygos*.

Of the *superior articular* arteries, the *external* winds round the outer head of the gastrocnemius, above the outer condyle, and beneath the biceps tendon, reaches the outer and then the anterior surface of the knee-joint, and here anastomoses with the other articular arteries and the anastomotica magna artery; the *internal* winds round the inner head of the gastrocnemius, beneath the ad-

ductor magnus and hamstring tendons, and terminates, in like manner, in front of the joint.

Of the *inferior articular* arteries, the *external* passes upwards and outwards, runs between the external semilunar cartilage and external lateral ligament, and terminates like the preceding. The *internal* descends inwards, passes between the internal lateral ligament and tibia, and anastomoses in front, with descending branches from the other articular arteries, and with the recurrent branch of the anterior tibial artery.

The *azygos* branch passes forwards, perforates the ligamentum posticum of Winslow, and enters the knee-joint to supply the ligaments and synovial membrane in its interior.

One or two lymphatic glands are frequently met with between the popliteal artery and the posterior ligament of the joint ; an enlargement of one of these may push back the artery, and thus be mistaken for aneurism.

The popliteal artery is more frequently the subject of aneurism than any other of the external arteries of the body; this has been assigned to the vessel entering and leaving the popliteal space through a tendinous opening or ring, and thus becoming fixed at these points, is easily ruptured on any violent extension of the limb. But this is an error, as the effect of muscular contraction on these openings is to increase, not diminish, their extent.

As the disease occurs generally in persons who have been much engaged in horse exercise, as in jockeys, cavalry soldiers, etc., it is more likely that the long-continued flexure of the joint tends to produce a contraction of the artery, which, being stretched in this state, by any unusual extension of

the limb, ruptures, and thus forms an aneurism. All sedentary trades will have a similar tendency, and doubtless produce the same results.

In these cases the artery, being diseased, is never tied here; when pressure has failed, the femoral artery is tied in Scarpa's triangle, which is to be preferred to securing this vessel in Hunter's canal.

The popliteal artery may require to be tied here in cases of wounds, or in hemorrhage from one or more of the vessels of the leg near the popliteal space.

For this purpose an incision must be made, from four to five inches in length, over the course of the artery, or nearly on the mesial line of the popliteal space: the parts to be divided are the skin, cellular tissue and popliteal fascia, and the adipose tissue; these being cut through, the artery will be found, the deepest of all the parts, resting upon the posterior ligament. The parts to be avoided are the posterior cutaneous nerve, the posterior saphena vein and nerve (if it exists here), the internal and external popliteal nerves, and the popliteal vein. This operation is not to be recommended, as the close contact of the vein and artery, the contiguity of the knee-joint, the depth at which the vessel lies, and the quantity of fatty tissue in this space, are serious objections to it.

In removing the ends of the bones, for disease of the knee-joint, etc., the popliteal artery must be avoided, by keeping the knife close to the bone, the artery being at the same time drawn out of the way, if necessary.

Section V.

ANTERIOR SURFACE OF THE LEG, OR ANTERIOR TIBIO-FIBULAR REGION.

This region occupies the anterior surface of the leg, from the knee above to the ankle-joint beneath, bounded by the anterior edge of the tibia internally, and the fibula on the outer side.

On raising the integuments from this region, the *superficial fascia* is exposed, and in it the superficial arteries and nerves. The former are unimportant. About the ankle, and especially over the malleoli, several venous branches are seen, these form the commencement of the internal and external saphenæ veins, which afterwards ascend behind this region. The nerves are numerous, and are derived chiefly from the external popliteal or peroneal nerve, which divides into numerous branches as it winds round the neck of the fibula, some of which become subcutaneous; one large branch of this nerve, the *musculo-cutaneous*, perforates the fascia of the leg about the junction of its middle and inferior thirds, and descends in front of the ankle-joint to the dorsum of the foot; a few filaments from the external saphenus nerve on the outer, and from the internal saphenus nerve on the inner side, will be met with in the integuments.

Beneath these is the *fascia* or *aponeurosis* of the leg. This is a dense strong fascia, especially at the upper part, where it gives origin, by its deep surface, to muscular fibres; it is attached here to the margin of the tibia and head of the fibula, and thence descends, firmly attached to these bones, until it reaches the ankle, where it terminates in the anterior annular ligament, and more gradually on the

dorsum of the foot. This fascia, as in the fore-arm, sends in processes, or septa, between the muscles to separate them, and afford them origin; its fibres interlace; near the ankle its transverse fibres are well marked.

This fascia is raised with difficulty from the bellies of the muscles, as these take origin from it; but it is separated from the tendinous portions by loose cellular tissue.

The muscles in this region are the tibialis anticus, extensor communis digitorum, extensor pollicis, and peroneus tertius; the first two fill the space superiorly between the tibia and fibula.

The *tibialis anticus* is the most internal, and is attached to the tibia, fascia, and intermuscular septa; its tendon is strong, descends in front of the ankle-joint, and goes to be implanted into the inner and under surface of the internal cuneiform bone, and metatarsal bone of the great toe.

The *extensor communis*, or *longus digitorum*, arises from a small portion of the tibia, from the fibula, intermuscular septa and interosseous membrane. As its tendon passes beneath the annular ligament, in front of the ankle-joint, it separates into four tendons, which are implanted into the dorsal surfaces of the last two phalanges of the four outer toes. The inferior portion of this muscle is closely connected with the peroneus tertius, and sometimes cannot be separated from it.

The *extensor proprius pollicis*, at its origin, lies between the two preceding muscles; it is attached to the fibula and interosseous membrane, and is inserted by its tendon into the last phalanx of the great toe.

The *peroneus tertius* arises below the extensor communis, but leaves this below the ankle, and

goes to be implanted into the base of the metatarsal bone of the little toe.

THE ANTERIOR TIBIAL ARTERY

Is the principal artery of the front of the leg; it lies deep upon the interosseous membrane, and is one of the terminating branches of the popliteal artery. This vessel terminates, as described, at the lower margin of the popliteus muscle, by dividing into the anterior and posterior tibial arteries; the latter, the larger of the two, descends along the back part of the leg, to supply this and the sole of the foot; the *anterior tibial* artery passes immediately forwards from its origin, between the tibia and fibula, and above the interosseous membrane, and then descends along the anterior surface of the membrane, until, at a short distance above the ankle, it inclines inwards to the front of the tibia, then passes beneath the annular ligament of the ankle-joint, forming the dorsal artery of the foot, and becomes subcutaneous. In the upper third of the leg, this artery lies between the tibialis anticus and the extensor longus digitorum muscles; in the middle third, between the tibialis anticus and the extensor pollicis, and, finally, between the tendons of the extensor pollicis and extensor digitorum longus; thus being related to each of these muscles twice during its course, viz., in the first and second thirds to the tibialis anticus in the first and inferior thirds to the extensor longus, and in the second and inferior thirds to the extensor pollicis. The anterior tibial artery, like all arteries of its class, is accompanied by two venæ comites. The *anterior tibial* nerve joins it at the junction of the upper and middle thirds of the leg; this, one of the terminating

branches of the external popliteal, is given off, as this nerve winds round the neck of the fibula; the branch then runs inwards and joins the artery, which it accompanies to its termination, lying first to its outer side, then crossing in front of it to get to its inner side. Some small filaments from the internal popliteal nerve generally accompany the anterior tibial artery as it passes forwards above the interosseous membrane.

The branches of the anterior tibial artery are the *recurrent*, two *malleolar*, and a few articular and muscular branches.

The *recurrent* branch arises immediately as the trunk appears on the front of the leg, and frequently in the interosseous space; it turns upwards and inwards, runs through the substance of the tibialis anticus muscle, and supplies the external surface of the knee-joint. The other branches are distributed as implied by their names.

The anterior tibial artery may be tied in any part of its course, but the operation is much more easily performed in the lower than in the upper part of the leg, as here it lies deep between the muscles on the interosseous membrane; the cases requiring this artery to be tied are wounds, aneurisms, or nævi materni, and in some rare cases hemorrhage from the sole of the foot.

A line drawn obliquely inwards from the head of the fibula to the cleft between the two inner metatarsal bones, will indicate the course of this vessel, and serve as a guide in cutting down upon it. The external incision should be about three inches in length in the lower operations, but in the higher at least four inches, and the deeper incisions should be carried between the muscles just described as forming its lateral relations.

It occasionally happens that the anterior tibial artery will supply the sole of the foot, the posterior tibial terminating behind the internal malleolus; in such cases, when hemorrhage proceeds from the sole of the foot, the anterior tibial artery, it is evident, is the vessel to be secured: in all cases its influence on hemorrhage from the sole of the foot should be ascertained, before proceeding to operate, by compressing its trunk where it crosses the dorsum of the foot.

In amputating the leg high up, there may be some difficulty in securing the anterior tibial artery, as it is liable to retract itself behind the interosseous membrane; in such cases, this membrane is to be divided, and the artery secured.

Section VI.

GASTROCNEMIC REGION, OR CALF OF THE LEG.

The calf of the leg is composed of two very powerful muscles, the gastrocnemius externus and the gastrocnemius internus or soleus, and a small muscle, the plantaris. Beneath these, lie the deep vessels and nerves of the back of the leg; and still more deeply, the deep muscles, the tibialis posticus, the flexor communis digitorum pedis, the flexor longus pollicis, and the popliteus.

On raising the integuments from the gastrocnemic region, there will be found on the inner side, and immediately behind the inner edge of the tibia, the *internal saphena vein*, and its accompanying nerve; this vein is formed by the junction of the veins proceeding from the dorsum and inner part of the foot,

crosses the internal malleolus, and gets to the back and inner part of the leg, where it ascends in the subcutaneous cellular tissue immediately behind the inner edge of the tibia. It here receives several superficial veins, and becoming much enlarged, crosses on the inner side of the knee, and thence ascends in the thigh, and terminates in the femoral vein, a little below Poupart's ligament. The internal saphena vein is accompanied, in the leg and foot, by the internal saphenus nerve, which joins it at the inner side of the knee, and thence descends with it to terminate in sending numerous cutaneous filaments to supply the inner side of the foot and anastomose with the cutaneous filaments from the musculo-cutaneous and anterior tibial nerves

The *external saphena vein* arises in a similar manner from the outer surface of the foot, crosses the outer ankle, and gets to the posterior surface of the leg. It here ascends beneath the fascia, passes between the heads of the gastrocnemius externus muscle, and sinks into the popliteal space to join the popliteal vein. This vein is accompanied by the *external* or *posterior saphenus nerve*, which, arising by two roots, one from the internal, the other from the external popliteal nerve, descends in the leg, accompanying the vein, and finally terminates in supplying the integuments on the outer side of the foot.

The superficial muscles on the back of the leg are covered by a layer of fascia, similar to that investing the muscles of the fore-arm, but much less dense; it is continuous superiorly with the popliteal fascia, and receives additional fibres from the tendons about the knee-joint. It thence descends, investing the gastrocnemius externus, and is attached on either side to the margins

of the tibia and fibula, and inferiorly is lost by becoming continuous with the annular ligaments of the ankle-joint.

Immediately beneath this fascia lie the superficial muscles forming the calf of the leg, namely, the gastrocnemius externus, gastrocnemius internus or soleus, and the plantaris; the gastrocnemius externus arises by two heads from the posterior surface of the femur above the condyles, and passes downwards to terminate in the tendo Achillis; the soleus or gastrocnemius internus has a double origin also—the inner, extremely small, proceeds from the posterior surface of the tibia, immediately below the popliteus; the outer head, by much the larger, proceeds from the posterior surface of the fibula, and thence descends to terminate in the tendo Achillis; this tendon thus forms the united insertion of these two muscles. It is first flattened, then becomes rounded, and is inserted into the lower and back part of the os calcis—a large bursa mucosa existing between it and the upper part of the bone.

The double origins of the soleus muscle are united by a tendinous structure forming an arch, the concavity looking upwards, beneath which the popliteal vessels and nerve descend into the leg; the constriction of the popliteal artery by this arch is said to lead to the formation of aneurism, but this is evidently incorrect.

The plantaris muscle arises with the external head of the gastrocnemius externus, from the line above the outer condyle of the femur, and forms a remarkably long tendon, which, running downwards between the gastrocnemius externus and soleus, is inserted into the os calcis on the inner side of the tendo Achillis.

The principal action of the gastrocnemius muscles is to extend the foot on the leg, but their most important use is the elevation of the body in progression, so as to throw it forward by raising the os calcis, the anterior part of the foot resting on the ground as the point of resistance; the gastrocnemius externus will also influence the knee-joint; the soleus has no effect on this articulation. The attachments of these muscles are important in the treatment of fractures and dislocations of the thigh and leg.

When the femur is fractured in its lower third, the origins of the gastrocnemius externus will tend to displace the lower end of the bone, and draw it backwards behind the upper; this is best counteracted by the flexed position of the limb, on which the muscle is relaxed. Similar effects will result in fractures of the bones of the leg, unless the muscles be relaxed, or other means be taken to prevent the displacement of the bones by the action of the gastrocnemius. The modern advocacy, by some, of the straight position in most, if not all, fractures of the lower extremity, is not judicious.

The tendo Achillis is frequently ruptured, and requires, in its treatment, the complete relaxation of the gastrocnemic muscles, by flexing the knee and extending the ankle-joint as much as possible. Rupture of the plantaris tendon is spoken of by some authors, but is unworthy of serious consideration.

Beneath the gastrocnemic muscles lie the deep vessels, nerves, and muscles of the leg. These are invested and bound down by a deep layer of fascia, of considerable strength. Superiorly, this fascia is continuous with the fascia covering the popliteus muscle, and is especially derived from the inferior

insertion of the semi-membranous muscle; as it descends, it becomes attached on each side to the tibia and fibula, and immediately above the ankle becomes well marked, having distinct transverse fibres, which serve the purpose of an annular ligament, and bind down the tendons in this situation; it is here lost by becoming continuous with the internal annular ligament.

Immediately beneath the deep fascia, and resting on the deep muscles of the leg, are the deep vessels and nerves, consisting of the posterior tibial and fibular arteries, and the posterior tibial nerve.

THE POSTERIOR TIBIAL ARTERY

Is the continuation, both in size and direction, of the popliteal artery. This vessel bifurcates at the lower margin of the popliteus muscle, into the *anterior* tibial and *posterior* tibial arteries. The anterior has just been described; the *posterior tibial* artery descends inwards along the posterior surface of the leg, first lying nearly midway between the tibia and fibula, but gradually getting behind the former until it arrives at the ankle-joint, where it passes behind the internal malleolus, and, entering the sole of the foot between the two heads of the abductor pollicis, terminates by dividing into the plantar arteries.

In the upper two-thirds of the leg the posterior tibial artery lies deep, being covered by the gastrocnemic muscles and fascia; but beneath this it becomes superficial, being covered only by the integuments and deep fascia; behind the external malleolus, it is covered by the internal annular ligament; the posterior tibial artery lies first on the tibialis posticus muscle, then on the flexor longus digitorum, and finally on the posterior surface of the tibia and

internal lateral ligament; it is accompanied by two venæ comites, one on each side, and by the *posterior tibial* nerve, which first lies to its inner side, then to its outer side, and behind the internal malleolus, posterior to it.

The only important branch given off by the posterior tibial artery in the leg is the peroneal artery; the other branches are *muscular* to the surrounding muscles, and a *nutritious* artery to supply the tibia.

THE PERONEAL ARTERY

Is a branch of considerable size, and arises from the posterior tibial, from one to two inches below the edge of the popliteus muscle; it runs from its origin downwards and outwards towards the fibula, sinks deep amongst the fibres of the flexor longus pollicis, reaches the interosseous membrane at a short distance above the ankle-joint, and here terminates by sending a branch forwards through the interosseous membrane to anastomose with the anterior tibial artery, and several branches on the outer and back part of the ankle-joint to anastomose with similar branches from the posterior tibial artery. The peroneal artery gives off no branch of practical importance; it is accompanied by two venæ comites, but not by a nerve, being the largest artery in the body unaccompanied by a nerve.

The posterior tibial artery may require to be tied in cases of wounds in the calf of the leg, behind the external malleolus, or in cases of hemorrhage from wounds or disease of the sole of the foot.

In case of wounded arteries, the rule of practice is *to enlarge the wound if necessary, and tie both ends of the bleeding vessel.* But there are a few exceptions to this rule; thus, in cases of hemorrhage from

wounds in the sole of the foot and palm of the hand, it is thought better to tie the principal artery leading to the wounded vessel than to dissect amongst the delicate structures of these regions, and so secure the bleeding artery. In case of wounded arteries from fractured bone, it is most objectionable to cut down on the bleeding vessel, as we convert a perhaps simple into a compound fracture; it is preferable, when the hemorrhage cannot be otherwise restrained, to tie the artery leading to the wounded vessel; in such cases, there is another objection to tie the wounded vessel, as it is probably in a lacerated state, and if tied in this condition secondary hemorrhage is most likely to ensue.

To tie the posterior tibial artery in the upper part of its course is a difficult operation, especially in muscular subjects; it is done as follows:—Make an incision from four to six inches in length parallel, and a little posterior, to the inner margin of the tibia, taking care to avoid the internal saphena vein and nerve; the integuments and fascia having been divided, the gastrocnemius externus is exposed; this is to be drawn aside, when a little dissection will expose the inner head of the soleus, where it is attached to the tibia; this is fleshy on its external surface, tendinous internally; the fleshy fibres having been divided, the tendinous are also to be cut through, and the muscle being slightly raised, the posterior tibial artery will be found at from one inch to one and a quarter inch from the inner edge of the tibia, bound down by the deep fascia; this being cut through, the artery is to be secured. If care be not taken, the tendinous portion of the soleus will be mistaken for the deep fascia, and the artery may not be found.

The late Mr. Guthrie recommended, in tying this artery, to make an incision along the posterior surface of the limb over the course of the vessel, and, having cut through the gastrocnemic muscles, to secure the artery at the bottom of the wound.

The posterior tibial artery may be tied, with comparative facility, in the lower third of the leg, as it is here only covered by the integuments and fascia; an incision having been made through these, from three to four inches in length, nearly in the centre, between the tendo Achillis and tibia, the artery will be exposed without difficulty.

This vessel may also be secured as it passes behind the internal malleolus; it is here covered only by the integuments, fascia, and an expansion from the internal annular ligament, and lies between the tendons of the flexor longus digitorum and the flexor longus pollicis, accompanied by its venæ comitis, and having the nerve lying posterior to it. In this operation, a semilunar incision, the concavity turned towards the the internal malleolus, will be found the best. Ship carpenters are peculiarly liable to wounds of the artery in this situation in using the adze.

In consequence of the deep position of the peroneal artery, and its being protected by the fibula, this vessel is rarely wounded, except in fractures of the bones. In order to tie this vessel, "M. Lisfranc recommends an incision through the integuments, obliquely from within outwards and from below upwards, from the external edge of the tendo Achillis to the posterior and external surface of the fibula, taking care to avoid the vena saphena externa. Next, the fascia must be divided, the superficial being separated from the deep-seated layer of muscles, and then the aponeurosis cover-

ing the deep layer. Lastly, the internal edge of the flexor longus pollicis, behind which is found the artery, must be directed outwards."

Mr. Hey relates a case in which he removed a portion of the fibula, to tie this artery; such practice cannot be too strongly condemned.

In gun-shot, and other severe wounds of the leg, where one or both of the principal arteries have been injured, and the limb becomes injected with blood, the propriety of amputating, rather than tying the arteries themselves, or the vessel leading to these, must always be considered; if these injuries be complicated with compound fracture of one or both bones, amputation is almost always to be preferred.

The *posterior tibial nerve*, which accompanies the artery, is the continuation of the internal popliteal, and accompanies the artery throughout, lying first to its inner and then to its outer side, and posterior to it, behind the internal malleolus; it here divides into the internal and external plantar nerves, to supply the sole of the foot and toes; its branches in the leg are muscular, and are distributed to the deep muscles, except the popliteus.

The deep muscles of the leg are the popliteus, tibialis posticus, flexor longus digitorum pedis, and flexor longus pollicis pedis, the last three enter the sole of the foot, and terminate here.

Behind the internal malleolus, the following parts are found from within outwards, that is, from the malleolus to the os calcis: tendon of tibialis posticus, flexor longus digitorum tendon, posterior tibial artery and venæ comites, posterior tibial nerve, tendon of flexor longus pollicis, plantaris tendon, and tendo Achillis.

Behind the external malleolus will be found the

tendons of the peroneus longus and brevis, and superficially the external saphenus nerve.

On the outer side of the leg, and arising principally from the fibula, lie the peroneus longus and brevis muscles; their tendons pass behind the external malleolus to their insertions, the brevis into the base of the metatarsal bone of the fifth toe, the longus into the base of the metatarsal bone of the great toe.

The influence of these numerous tendons in fractures of the leg, injuries and amputations of the foot, and in dislocations of the regions, is highly important, and requires an accurate information on the part of the surgeon in their treatment.

In fractures, dislocations, and injuries of the foot, their being relaxed will generally tend best to the object in view. In amputations, their insertions should be preserved, if possible. In the various forms of club-foot, also, the action of these tendons exert a powerful influence in producing the deformity and in preventing its cure.

Section VII.

PLANTAR REGION, OR SOLE OF THE FOOT

The integuments of the sole of the foot are remarkably dense and hard, especially in those situations which are most exposed to pressure, namely, over the os calcis, the ball of the great toe, and along the outer margin of the foot. As in the hand, they are connected to the subjacent parts by a quantity of hard, granulated fat, most abundant posteriorly, which serves as an elastic cushion in progression, and also protects the deeper-seated parts from compression or injury. In it will be found a

few superficial vessels and nerves. Near to the heel is the *cutaneous nerve of the sole of the foot*; it is derived from the posterior tibial nerve, and is lost in the posterior part of the sole of the foot; on each side and in front a few cutaneous filaments of the plantar nerves are also seen.

Beneath the preceding lies the plantar *aponeurosis* or *fascia*; this, the strongest fibrous structure in the body, is of a glistening whitish colour; triangular in shape, it arises by its smaller extremity posteriorly from the tubercles on the under surface of the os calcis, passes forwards, expands, and, opposite the heads of the metatarsal bones, divides into five processes, each of which subdivides into two to permit of the transmission of the digital tendons, vessels, and nerves, and are finally implanted into the tendinous sheaths, and into the lateral ligaments of the metatarso-phalangeal articulations. Anteriorly, the plantar fascia is composed of three portions—the central, external, and internal; the central portion, much the strongest, covers the principal muscles, tendons, vessels, and nerves of the sole of the foot; the external, next in strength, covers the muscles of the fifth toe; and the internal, the weakest, invests the muscles of the great toe. Between these sets of muscles the fascia sends in septa which divide them and afford origin to their fibres; somewhat similar septa, but much weaker, pass into the adipose tissue immediately beneath the skin. The fibres of the plantar fascia are chiefly longitudinal; some well-marked transverse fibres cross it anteriorly, so as to prevent the too great separation of its longitudinal fibres. The deep surface of the plantar fascia is rough, and affords origin to muscular fibres. The plantar fascia is an important structure in the sole of the foot; it

not only protects the soft parts from undue pressure, but it also preserves the concavity of the sole of the foot, in which they are lodged, and maintains the arched shape, on which the integrity of the foot and its beauty mainly depend.

In practice, the plantar fascia resists the swelling of the subjacent parts during inflammation, and thus adds much to the patient's suffering; it also restrains the course of matter to the surface, and causes it to burrow amongst the tendons and muscles, and finally to appear at a distant point, forming long, tortuous, and troublesome sinuses, and not unfrequently leading to incurable disease of the foot. The necessity of early and free incisions in such cases is obvious. In hemorrhage from the vessels of the foot, it prevents the due application of pressure on the bleeding vessel, and renders its being secured a difficult operation; hence the propriety, under such circumstances, of tying the posterior and, if necessary, the anterior tibial artery.

The muscles of the sole of the foot are usually divided into four layers, according to their depth from the surface; they may also be divided, as in the palm of the hand, into three masses—internal, middle, and external; the former division is preferred.

The first layer consists of three muscles, abductor pollicis, flexor brevis digitorum, and abductor minimi digiti.

The second layer consists of the tendons of the flexor longus digitorum, flexor longus pollicis, the musculus accessorius, or massa carnea Jacobi Sylvii, and the lumbricales.

The third layer consists of the flexor brevis pollicis, adductor pollicis, transversus pedis, and flexor brevis minimi digiti.

The fourth layer consists of the interossei muscles, and the deep tendons of the peroneus longus and tibialis posticus.

The mode in which the muscles and tendons of the sole of the foot are made to cross each other in almost every direction, tends to the stability of the foot, adds to its elasticity, and, by maintaining the plantar arch both in the longitudinal and transverse directions, preserves the soft parts and the vessels and nerves from undue pressure during progression.

The principal plantar arteries and nerves are found between the first and second layers of muscles.

THE PLANTAR ARTERIES

Are two in number—the *internal* and *external*, and are the terminating branches of the posterior tibial artery.

The *internal plantar* artery is the smaller ; it runs forward beneath the abductor pollicis to the root of the great toe, and ends in supplying the inner side of the foot, and in sending digital branches to supply the opposed surfaces of the great and second toes, and anastomoses with the branches of the external plantar artery.

The *external plantar* artery forms the *plantar arch;* it first runs outwards, towards the metatarsal bone of the little toe, it then winds inwards, towards the great toe, sinks deep amongst the muscles of this toe, and terminates in the first metatarsal space by anastomosing with the digital branches of the internal plantar artery, and with the terminating branch of the anterior tibial artery. The concavity of the plantar arch is turned inwards, the convexity outwards and forwards. From the concavity of the arch proceed numerous branches to supply the mus-

cles; from the convexity are derived the *digital arteries.* These, four in number, supply the opposed surfaces of the four outer toes; the first is distributed to the outer surface of the foot and little toe, the remainder bifurcate opposite the clefts between the toes, and are distributed to their opposite surfaces as in the fingers.

Small branches from the plantar arch, *the perforating arteries,* pass upwards through the foot, and anastomose freely with the branches of the anterior tibial artery, in the substance of the interossei muscles.

The *plantar nerves* are also two in number, and are the terminating branches of the posterior tibial nerve. Of these, the *internal* is the larger; it runs forwards between the flexor brevis and abductor pollicis, and divides into four digital nerves; the first or inner supplies the internal surface of the great toe, each of the others divides opposite the cleft between the toes, and supplies their opposed surfaces, inclusive of the inner surface of the fourth toe.

The *external* plantar nerve, besides sending small filaments to the adjoining muscles, divides into two branches—the superficial and deep—at the outer margin of the flexor brevis digitorum; the *superficial* gives off two digital nerves, one of which supplies the outer surface of the little toe, the other the opposed surfaces of this and the fourth toe, as in the hand; the *deep* branch accompanies the plantar arch, and is lost in the interossei, the adductor pollicis and lumbricales muscles.

The treatment to be adopted in wounds of the plantar arteries, or hemorrhage from them, from other causes, has been considered with the posterior tibial artery.

In amputations of the foot, no portion should be removed that can possibly be saved, as the sacrifice of a single bone, or even a part thereof, may destroy the insertion of an important muscle, and so interfere with the future usefulness of the entire limb. However neat or dexterous it may appear to amputate at the articulations, the future well-being and comfort of the patient must never be sacrificed to the operating character, or, it may be, the self-esteem of the surgeon. The great end of surgery, indeed of the healing art, is the alleviation of human suffering, and the restoration of the sufferer to the most perfect health within the reach of human aid, and this must always be kept in view, under all circumstances.

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