Manual of practical anatomy : the upper limb / by J. Cossar-Ewart.

MANUAL

OF

PRACTICAL ANATOMY

BY

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WITH OUTLINE PLATES ENGRAVED BY W. J. BALLINGALL

THE UPPER LIMB

LONDON
SMITH, ELDER, & CO., 15 WATERLOO PLACE
1879

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MANUAL OF PRACTICAL ANATOMY.

For the practical study of human anatomy the following instruments are required:—

1. Six scalpels
2. Two pairs of dissecting forceps.
3. Two pairs of hooks.
4. One pair of straight-bladed, sharp-pointed scissors.
5. A blowpipe.

The *Scalpels* should have a good rounded cutting edge. Those of a dagger shape, either double or single, are practically useless. They should be all of a medium size, and not of several different sizes as generally supplied by the instrument maker.

The *Forceps* should be tested before purchase, so as to see that their serrated points fit accurately, and that their spring is neither too strong nor too feeble. When too strong, they fatigue the fingers; and when too weak, they adhere to the tissue grasped. One pair may have finer points than the other, but both should be at least 4½ inches in length.

Hooks.—There should be only two hooks on each chain, and it is advisable to have two pairs.

The *Scissors.*—Besides the pair of strong, pointed scissors provided in the cases, a pair of small curved (eye) scissors will be found of great use for fine dissections.

Sharpening stones, saws, &c., are supplied in all anatomical rooms.

For the sake of cleanliness and comfort, the student should have an old coat, apron, and glazed-linen sleeves; and he should also have a packing and several large sewing needles; and, for the preservation of his part, methylated spirit, with pure carbolic acid added in the proportion of 1–20; linen; coarse macintosh and bandages will also be requisite.

Provided with the above, and having obtained a part, say an arm, the student should before beginning the axilla—

I. Learn the anatomy of the bones of the arm and shoulder girdle, and the changes induced by movement of the arm; and examine the bony landmarks of the axilla on an articulated skeleton, so noting the relations of the clavicle, scapula, humerus, and upper ribs, that at any moment their exact position can be pictured in the imagination.

II. Attend to the position of the subject. See that the shoulders are supported by blocks, and the arm placed on a board, at right angles to the trunk, and abducted and rotated, so that the palm of the hand looks upwards.

III. Plan the incisions mentioned below. In making the incisions, first simply score the skin with the point of the knife. When satisfied they are correct, holding the knife at right angles to the surface, press the point at once right through the skin; and then, with the belly of the knife, cut down to the fat beneath, carrying the knife along the line already traced.

IV. In reflecting the skin seize the corner of the marked-out flap with the forceps, and apply the knife in the angle between the raised skin and the fat, keeping the edge of the knife rather towards the skin.

When a corner sufficiently large to grasp has been thus removed, the fingers will be found more useful than the forceps. If the skin is forcibly pulled upwards, and long sweeps are made with a sharp knife, a large flap can be speedily removed.

V. Remove the superficial fascia. If there is much fat, this may be done freely, as it is generally a waste of time to look for the cutaneous nerves; but when there is only a thin layer of superficial fascia, the nerves should be looked for first. In all cases keep the reflected skin attached, for it is extremely useful for the preservation of the part; but be as careful to remove the superficial fascia beneath it, for when the fat is retained, the part cannot be kept clean.

VI. Look for the Cutaneous Nerves. Before doing this, the direction in which they run should be ascertained; and, when seeking for them, incisions should only be made parallel to their supposed course. When exposed, a drawing indicating their distribution should be made while they are *in situ*.

VII. Expose and clean the large nerves and vessels by cutting parallel to them from above downwards; the small nerves, such as the nerve of Wrisberg, which lies at the posterior border of the large blue, flaccid, axillary vein, and the cutaneous branch from the musculo-spiral to the inner side of the arm, should always be first found. The small nerves

are generally best discovered by a careful use of the forceps. Their origins and anastomoses should when possible be made out.

The small veins and lymphatics having been noted, should be removed, as their presence only tends to obscure the other structures.

An extremely useful and instructive view is obtained when the vessels, nerves, and muscles have simply been exposed. In this anatomically dirty condition they most nearly approach what we find in surgical operations, and they lie in a more natural state than when all the investing and connecting fascia and fat have been removed.

VIII. Clean the muscles only in the direction of their fibres, and reflect the fascia in the same way as the skin, by steadily cutting in one direction. Care should be taken in cleaning such muscles as the deltoid and gluteus maximus not to separate the fibres too much from each other by removing the thin membranous septa between them.

IX. Make drawings of each stage of the dissection. In order to dissect with advantage, the dissector should plan out his work the night before, making rough outlines indicating the position of the principal structures to be met with. When the dissection has been made, these outlines should be filled in, and all points likely soon to be forgotten noted on the other side. On the evening of the same day the sketch should be completed, and the student should make sure that each muscle, nerve, and vessel figured is thoroughly understood. A dissecting manual, or Quain and Sharpey's 'Anatomy,' may be used for reference. Any point not mastered should be seen to the next morning.

This is the only satisfactory way of studying practically human anatomy, and, when adopted, the student feels as if he were engaging in an original investigation.

For the benefit of those who have not acquired the art of drawing, and for those who find the time at their disposal much too limited, I have prepared the accompanying outlines. They may, besides serving as a guide, enable the student to make graphic memoranda of his dissections. When completed from the dissection, and shaded and coloured at home, they may form a useful atlas.

The figures of the bones have been added that a general idea of the muscular attachments may be obtained before the dissection is begun and during its progress. They are only intended to serve as a guide to the surfaces of attachment more or less visible on every bone. The dotted lines may be coloured, as in the first plate, by an ordinary red and blue pencil.

Preservation of the part. This is a matter of the greatest importance.

As soon as a part is allotted, it should, as far as possible, be protected by a bandage which has been saturated with the above-mentioned spirit and carbolic acid, or a solution of carbolic and glycerine (1–10), and then enveloped in coarse macintosh. As little as possible of this covering and of the skin should be removed at a time; and at the end of each day's dissection, after sprinkling the part with carbolised spirit, and interposing a piece of linen soaked in the same between the skin and the structures beneath, the skin should be replaced and stitched, and the part again carefully covered with the macintosh.

THE UPPER LIMB.

SECTION I.

THE BACK OF THE SHOULDER.

A. **EXTERNAL ANATOMY.**—The subject in the prone position, the chest and pelvis raised by blocks;

Note 1. In the middle line the Occipital protuberance and the Ligamentum nuchæ extending from it to the seventh cervical vertebra; the spines of the twelve dorsal and five lumbar vertebræ, the back of the sacrum and coccyx.

2. The Posterior or Vertebral Border of the Scapula, the spine of the scapula ending in the Acromion process, and, under the arch formed by the acromion process and the clavicle, the Tuberosities of the humerus. Especially note the Rotation of the scapula as the arm is elevated above the level of the shoulder.

3. The space between the last rib and the crest of the ilium, and the Latissimus dorsi muscle passing upwards and outwards to form the posterior fold of the axilla.

B. **INCISIONS.**—The head being depressed and fixed by hooks, and the arms hanging over the edge of the table, insert the point of the scalpel through the skin over the occipital protuberance, and make (1) an incision along the middle line as far as the coccyx; (2) a transverse incision from the occipital protuberance to the back of the ear; (3) a transverse incision from the seventh cervical vertebra to the acromion process; and (4) a transverse incision along the crest of the ilium to join the first incision over the sacrum.

C. Reflect the skin and superficial fascia mapped out, and with the dissector of the head and neck look for the following Cutaneous Nerves: —

1. **The Great Occipital** (posterior primary branch of second cervical), which pierces the trapezius an inch below its origin from the superior curved line of the occipital bone, and passes upwards, and somewhat outwards, to the scalp.
2. **The Small Occipital** (second cervical), running along the posterior border of the sterno-mastoid to the scalp between the ear and the great occipital nerve.
3. **The Third Occipital**, passing upwards near the middle line, to join the great occipital.
4. **Twelve Dorsal** nerves, six (inner offsets) which, accompanied by small arteries, pierce the trapezius near the spine, and six (outer offsets) which pierce the latissimus dorsi opposite the angles of the ribs.
5. **Three Lumbar** nerves (outer offsets) which pierce the latissimus dorsi, and cross the crest of the ilium to supply the skin over the buttock.

D. **MUSCLES.**—The muscles in this region passing to the shoulder girdle and humerus are the Trapezius, Latissimus dorsi, Levator anguli scapulæ, Rhomboidei and Serratus magnus.

1. **Trapezius** (Pl. II.)—Clean the muscle by cutting parallel to its fibres, and note its

Origin from the inner third of the superior curved line of the occiput and the occipital protuberance;
The Ligamentum nuchæ;
The spines and supraspinous ligaments of all the dorsal vertebræ, and its

Insertion into the outer third of the clavicle
The upper border of the acromion process
The upper edge of the spine of the scapula
} (Pl. I.).

Action.—The fibres of the trapezius radiate towards the upper margin of the arch formed by the clavicle, acromion process and the spine of the scapula. They on contracting pull the scapula upwards and inwards; and assist the serratus magnus to raise the arm above the head by rotating the scapula. The lower fibres acting alone depress the scapula.

Nerves.—Spinal accessory and branches from the cervical plexus.

Artery.—Superficial cervical (transversalis colli).

Fill in the nerves piercing the trapezius, and indicate the direction of its fibres, and the extent of its aponeurotic origin in Pl. II.

The trapezius, when cleaned, should be reflected by making an incision an inch from the middle line along its whole length, after its origin, insertion, action, and the direction of its fibres have been noted, and the space between it, the latissimus, and the posterior border of the scapula has been defined.

On reflecting the trapezius trace the spinal accessory (VIII. cranial nerve) towards its lower border, and the accompanying branches of the superficial cervical artery. The trapezius will now be seen to have rested on the splenius and complexus, levator scapulæ, rhomboidei, erector spinæ, latissimus dorsi, and supraspinatus (Pl. VI.), and the vessels and nerves supplying them.

2. **Latissimus dorsi** (Pl. II.).

Origin.—By tendinous fibres from spines and supra-spinous ligaments of the six lower dorsal vertebræ; through the medium of the lumbar fascia from the lumbar and the two upper sacral vertebræ, and from the outer edge of the posterior half of the iliac crest;

By muscular slips (1) from about an inch of the iliac crest in front of the fascia; (2) from three or four of the lower ribs, the slips interdigitating with those of the external oblique muscle;

And often by a thin muscular slip from the inferior angle of the scapula (Pl. I.).

Insertion into the inner side of the floor of the bicipital groove (Pl. VIII.) by a strong thin fibrous tendon, which is continuous with the tendon of the teres major below, but separated from it above by a bursa.

Note that the fibres of the latissimus rising from the ribs pass almost vertically upwards, those from the crest and lumbar fascia obliquely upwards, and those from the dorsal vertebræ almost horizontally outwards; and that the united fibres first partly envelope, and then pass in front of the teres major. It will be seen further on that the lowest fibres have the highest insertion.

Action.—The latissimus depresses the raised arm, and then rotates it inwards and draws it across the back.

With the arm as its fixed point, it may elevate the ribs, as in attacks of asthma, or assist in raising the trunk when the arms are fixed above the head, as in climbing.

Nerves.—Long subscapular (posterior cord of brachial plexus) and

branches from the outer offsets of the dorsal nerves, which pierce it to reach the skin of the buttock. Add nerves to Pl. VI.

Artery.—Subscapular (axillary) (Pl. IV.).

Fill in the cutaneous nerves piercing the latissimus, and indicate the direction and extent of its muscular fibres in Plate II.

Reflect the latissimus, by cutting from the upper margin, two inches from the middle line, downwards and outwards, to a point two inches below the free end of the last rib; and note its origin from the lumbar fascia and iliac crest and the above-mentioned interdigitations with the external oblique, and that the muscle rested on a small part of the rhomboideus major and infraspinatus, the teres major, serratus posticus inferior, the lumbar fascia, the lower ribs, and their intercostal muscles, and the posterior portions of the external and internal oblique abdominal muscles. The intimate relation of the latissimus to the teres major at its insertion into the humerus will be seen when the axilla is examined; in the meantime note that they together form the posterior fold of the axilla, and that this fold is on a lower level than the anterior fold formed by the great pectoral muscle.

3. **Levator anguli scapulæ** (Pl. II.).

Origin.—By tendinous slips from the posterior tubercles of the transverse processes of the upper four (3, 4, or 5) cervical vertebræ.

Insertion into the base of the scapula between the spine and the superior angle (Pl. I.).

Note its form, the direction of its fibres, its relations to the spinal accessory nerve, and the superficial cervical artery, to the splenius, sterno-mastoid, and scaleni muscles above; the trapezius, and rhomboideus minor below.

Action.—Depresses the acromion by raising the superior angle of the scapula, and, acting along with the superior fibres of the trapezius, shrugs the shoulders.

With the scapula as its fixed point, it bends the head to the same side.

Nerves.—From brachial plexus (V.) and from the deep cervical plexus.

Artery.—Superficial cervical (transversalis colli).

4. **Rhomboideus minor** (Pl. II.).

Origin.—Seventh cervical and first dorsal vertebræ, and ligamentum nuchæ.

Insertion.—The base of the scapula opposite the triangular surface at the origin of the spine (Pl. I.).

5. **Rhomboideus major** (Pl. II.).

Origin.—The spines and interspinous ligaments of the upper four or five dorsal vertebræ.

Insertion into a tendinous arch, which passes from the spine to the lower angle, and in part directly into the base, of the scapula (Pl. II.).

Action.—The fibres of the two muscles closely connected with each other pass obliquely downwards and outwards, and, on contracting, draw the base of the scapula upwards and inwards: when acting along with the levator scapulæ they depress the acromion process; when with the trapezius, they pull directly inwards, and fix, the scapula. Through the fibrous band nearly all the fibres are able to act directly on the lower angle of the scapula.

Nerve.—Special branch from the brachial plexus (V.).

Artery.—Posterior scapular (transversalis colli).

The rhomboids are almost completely covered by the trapezius; a small portion of the major, between the trapezius and the latissimus, varying in size with the position of the arm, is subcutaneous. They rest on the serratus posticus superior.

E. **DISSECTION.**—Detach the trapezius from the spine of the scapula and trace upwards the spinal accessory nerve, noting its relation to the Levator scapulæ and its connection with the cervical plexus.

Display the attachment of the omo-hyoid to the upper border of the scapula (Pl. I.) and to the suprascapular ligament; and note the suprascapular artery and nerve, the artery passing over and the nerve under the ligament; and at a higher level the transverse cervical artery, which sends a branch (superficial cervical) to the trapezius and levator scapulæ, and is continued onwards as the posterior scapular along the base of the scapula under the levator and rhomboids. Fill in the vessels and nerves exposed, and shade the rhomboids and levator scapulæ muscles in Pl. II.

Reflect the rhomboids by dividing them near their origin, look for the small nerve supplying them, and trace the artery towards the inferior angle of the scapula. The nerve will be seen when the base of the scapula is separated from the ribs to run downwards under cover of the levator scapulæ and cross the upper border of the serratus magnus.

F. If the part is being dissected for the second time, an instructive view of the axilla and the root of the neck from behind will be obtained by dividing the serratus magnus near its insertion into the base of the scapula, and drawing the scapula as far as possible from the ribs.

Note the omo-hyoid passing obliquely upwards above the clavicle to cross the upper cord of the brachial plexus.

The suprascapular artery running towards the upper border of the scapula behind the clavicle and under cover of the omo-hyoid and trapezius, and its small acromial branch passing to the shoulder to anastomose with a branch of the acromial thoracic over the deltoid.

The suprascapular nerve (V.) passing downwards behind the omo-hyoid to pass under the suprascapular ligament.

The three cords of the brachial plexus (5, 6, 7, and 8 cervical, and 1st dorsal), issuing from between the scaleni muscles to enter the axilla, giving off subscapular branches to the subscapular, teres major, and latissimus muscles.

The posterior thoracic (V. and VI.), along the surface of the serratus magnus.

The subclavian artery appearing below and in front of the cords of the brachial plexus, to enter the axilla as the axillary artery, and be continued into the arm as the brachial.

The scalenus anticus, in front of the artery, passing to the tubercle on the first rib; and the posticus, behind the artery, passing to the second rib.

The axillary vein, passing upwards to become the subclavian, which crosses the first rib in front of the scalenus anticus.

The subclavius muscle overlying the vessels and nerves passing to the axilla; also the pectoral muscles, and the nerves passing to them, forming the anterior boundary of the axilla.

Make a drawing of the parts displayed, and then carefully replace and fix, by means of ligatures, the divided serratus magnus, so that a

dissection of the axilla may be made in the usual way when the subject is turned.

G. In this section the dissector has met with the following structures, the relations of which he should now, as far as possible, before the subject is turned, carefully observe; and by means of notes and sketches endeavour to fix in his memory:—

1. **The Great and Small Occipital** nerves (II.), and the **Third Occipital** passing to the scalp.
2. **Twelve Dorsal Cutaneous** nerves, six inner and six outer offsets.
3. **Three Lumbar** nerves, outer offsets.
4. **The Trapezius** muscle, supplied by the spinal accessory nerve and branches of the cervical plexus, and the superficial cervical artery.
5. **The Latissimus dorsi**, supplied by the long subscapular and branches from the dorsal nerves and by the subscapular artery.
6. **The Levator anguli scapulæ**, supplied by a branch from the V. and by branches from the cervical plexus, and by the superficial cervical artery.
7. **The Rhomboideus minor** and **major**, supplied by a special branch from the brachial plexus and by the posterior scapular artery.
8. **The Posterior Belly** of the omo-hyoid supplied by the descendens noni.
9. **The Serratus magnus**, supplied by the posterior thoracic nerve and the long thoracic artery.
10. **The Suprascapular artery** from the subclavian and the **suprascapular nerve** from the brachial plexus (V.), passing to the muscles on the dorsum of the scapula; and
11. **The Transversalis colli** artery dividing into the **superficial cervical** which runs upwards under cover of the Trapezius, and the **posterior scapular** which runs along the vertebral border of the scapula under the rhomboids.

SECTION II.

THE PECTORAL REGION AND AXILLA.

A. **EXTERNAL ANATOMY.**—The subject on its back, and the thorax raised by a block, carry the finger along the collarbone or clavicle from the inner or sternal end—the point where the arm is hinged to the trunk—to its union with the acromion process, noting the double curve, the almost horizontal direction (in the erect position the clavicle inclines slightly downwards), and if there are any projections present—the result of fracture, or of the partial ossification of tendons or ligaments attached to it.

Also note the changes in position of the clavicle when the arm is raised and depressed.

Note the clavicular portion of the sterno-cleido-mastoid muscle attached to the inner end of the clavicle, and a deep fossa above the manubrium sterni between the origins of the two muscles.

The space between the sterno-mastoid and the trapezius is covered over by the platysma, under which, near the clavicle, the external jugular vein ends. In this space near the sterno-mastoid feel for the edge of the scalenus anticus, and the subclavian artery issuing from behind it to cross the first rib on its way to the axilla.

External to the artery the firm cords of the brachial plexus may be made out, and, crossing them nearly parallel to the clavicle, the posterior belly of the omo-hyoid muscle.

Passing from the arch formed by the clavicle, acromion process, and spine of the scapula, is the deltoid muscle; through its fibres feel the tuberosities of the humerus, the lesser in front and the greater externally, and between them the bicipital groove; with the one hand rotate the arm, and with the other feel the upper end of the humerus moving under the acromion process, and next note that there is no prominence in the healthy axilla or below the coracoid process.

In the groove between the pectoral and deltoid muscles an inch below the

clavicle, feel for the coracoid process, and from it, passing upwards, the coraco-acromial ligament.

Define the groove between the deltoid and pectoral muscles, through which the cephalic vein passes from the arm, and note that the lower margin of the great pectoral muscle runs outwards, in a line with the fifth rib, to form the anterior fold of the axilla (Pl. IV. and V.).

The axilla, which has its posterior fold formed by the latissimus and teres major, is pyramidal in shape,—its size varying with the position of the arm. When the arm lies parallel to the trunk there is a deep hollow, but when abducted and raised, the axilla is nearly flat.

Note that no glands can be felt in the healthy axilla; that when the arm is removed from the chest all the large vessels and nerves are carried with it, and may be felt at the inner side of the fold formed by the coraco-brachialis (Pl. VI.).

Over the pectoral muscle is the mammary gland, small in the male, but extending in the female, from the third to the sixth or seventh rib, and from near the sternum to the border of the axilla being most prominent at its inner and lower aspect.

Note that the nipple, situated nearer the inner than the outer side, projects outwards and is surrounded by a coloured ring, the areola; that small tubercles mark the orifices of the galactophorous ducts, from fifteen to twenty in number; and that the papillæ on the nipple and areola are large and prominent. For a detailed description see Quain's 'Anatomy.'

B. **INCISIONS.**—The arm resting on a board at right angles to the trunk and rotated outwards, make an incision along the middle of the sternum. From the upper end of this incision carry the knife to the outer end of the clavicle, and thence down the arm to the anterior fold of the axilla; make a third incision from the ensiform process to the posterior fold of the axilla (if a female subject, make a circular incision round the nipple, external to the areola), and reflect the large flap thus mapped out, the dissector of the right arm beginning at the ensiform process. If the breast has been left, first dissect up the circle of skin as far as the root of the nipple, and note the straight ducts and their dilatations, passing vertically to the apex; and then remove the whole breast, so as to leave nothing but the deep fascia over the pectoral muscle.

The deep fascia across the axilla is very strong. Note that it is con-

tinuous with the fascia over the pectoral muscles, with the fascia at the inner side of the arm, and with the fascia investing the lower margin of the latissimus dorsi. The skin over this fascia is of a dark colour, thickly covered with hairs, and provided with large sweat glands.

C. **CUTANEOUS NERVES.**

1. **Branches from the Cervical plexus** which cross the clavicle to reach the skin over the chest and shoulder.

Look for (*a*) a sternal branch which crosses the clavicle about two inches from its inner end to supply the skin over the sternum.

(*b*) Two clavicular branches which cross the middle of the clavicle and pass to the lower border of the pectoral muscle, communicating on their way with the anterior branches of the intercostal nerves.

(*c*) Acromial branches which cross the outer end of the clavicle to supply the skin over the shoulder (Pl. IV.).

2. **Branches from the Intercostal** nerves.

(*a*) Lateral branches found between the ribs along the side of the chest, which divide into anterior and posterior sets, to supply the skin over the pectoral and latissimus dorsi muscles.

(*b*) Anterior branches, which penetrate the pectoral muscle three inches from the middle line and turn outwards to supply the skin and the mamma, and communicate with the anterior branches of the lateral cutaneous.

The lateral branch of the first intercostal is generally absent, and even the anterior branch may be wanting; the lateral branch of the second intercostal (**intercosto-humeral**) enters the axilla and supplies the skin on the inner side of the arm (Pl. VI.).

D. **VESSELS.**—Small branches from the intercostal arteries may be seen accompanying the nerves, and thoracic, internal mammary, and intercostal branches passing to the glandular substance and connective tissue of the mamma.

Lying in the groove between the pectoralis and deltoid look for the cephalic vein, and trace it upwards till it disappears below the clavicle to join the axillary vein (Pl. V.); sometimes it passes over the clavicle.

The lymphatics of the mamma either pierce the intercostal spaces to enter the glands lying in the anterior mediastinum behind the sternum, or pass to the lower and inner set of glands in the axilla.

E. **THE AXILLA.**—Clean the pectoral muscle by cutting parallel to its fibres, and remove the strong fascia stretched across the axilla. Note that all the vessels and nerves lie at the inner side of the arm, and are carried with it when it is raised and abducted, so that a large space is left next the chest in which only fat and glands lie. Clear away the fat from the inner side until the lower set of glands are reached, and note that they are supplied by small arteries and connected to each other by delicate lymphatic vessels. Besides the lower set of glands—those first affected in patients suffering from cancer of the mamma—there are glands higher up lying parallel but also internal to the vessels and nerves. These upper glands receive the lymphatics from the arm, and become swollen and painful when septic matter reaches them from a wound in the fore-arm or hand.

Clean out the fat from the axilla, beginning on the outer side next the vessels, making more use of the forceps than the scalpel. Be careful to preserve the small nerve of Wrisberg lying at the posterior edge of the vein, the cutaneous branch of the musculo-spiral nerve lying near the artery, and on the inner side the posterior thoracic nerve lying on the serratus magnus (Pl. VI.).

The fat removed, and the arm at right angles to the trunk, the axilla is seen to be a pyramidal space between the arm and the chest, with its apex between the clavicle, the upper margin of the scapula, and the first rib; bounded **anteriorly** by the pectoral muscles, **posteriorly** by the subscapularis, teres major, and latissimus, **internally** by the first four ribs and their intercostal muscles and the upper part of the serratus magnus, and **externally** by the humerus, and the coraco-brachialis and biceps muscles.

Through the space the vessels and nerves pass to and from the arm, and in it lie lymphatic glands and the vessels and nerves which supply the structures forming its boundaries.

The inner part of this space is especially interesting to the surgeon, for in it abscesses may form and the pus be prevented escaping by the dense fascia already examined; the glands may require excision along with a cancerous mamma, or the artery may require ligature for aneurism, or the humerus may escape into the space from the shallow glenoid cavity.

Especially note that the large axillary vein lies internal to and almost conceals the artery and nerves.

F. The **Pectoralis major** and **minor** and the **Subclavius muscles** are now to be considered.

1. **Pectoralis major** (Pl. IV.).

Origin.—(1) The sternal portion from the front of the sternum, the cartilages of all the true ribs except the seventh, and the aponeurosis of the external oblique abdominal muscle.

(2) The clavicular portion from the inner part of the anterior border of the clavicle (Pl. I. and III.).

Insertion into the outer edge of the bicipital groove of the humerus (Pl. VIII.), the clavicular fibres passing obliquely downwards, those from the ribs obliquely upwards; a double tendon is thus formed, the deeper and higher part of which belongs to the lowest or costal portion of the muscle.

Action.—Rotates the hanging arm inwards and carries it forwards, so that the hand lies over the opposite thigh.

Depresses and adducts the raised arm; or when the arm is raised and fixed, as in climbing, it raises the trunk to the same side; both acting, the trunk is raised vertically.

Its lower edge forms the anterior fold of the axilla; its upper is in contact with the deltoid below but slightly removed from it near the clavicle, where the cephalic vein disappears to join the axillary.

Nerves.—External (outer cord) and internal (inner cord) anterior thoracic (Pl. VI.).

Artery.—Acromial thoracic (axillary).

Indicate the direction of the fibres, and fill in the cutaneous nerves in Pl. IV.

Dissection.—Divide the clavicular portion of the muscle at its origin, and look for the nerves and vessels passing to it; and note the upper border of the pectoralis minor and the strong membrane (**costo-coracoid**) passing from it to be attached to the coracoid process, the lower border of the clavicle, and the first rib. This membrane encloses the subclavius muscle, blends with the sheath of the axillary vessels, and extends to the origin of the coraco-brachialis. It is penetrated by the acromio-thoracic vessels, cephalic vein, and external thoracic nerve.

Divide the rest of the muscle four inches from its origin, and reflect the one part inwards, the other outwards; and note the double

insertion of the tendon, from which an expansion passes over the bicipital groove to the capsule of the joint, another into the groove, and a third to the fascia of the arm.

The pectoralis major will now be seen to have covered the subclavius and pectoralis minor muscles, the sheath of the axillary vessels, and the branches perforating it between the pectoralis minor and the clavicle.

Below the lesser pectoral muscle it rested on the side of the chest and concealed the axillary vessels and nerves and the upper part of the biceps and coraco-brachialis.

2. **Pectoralis Minor** (Pl. IV.).

Origin.—From the third, fourth, and fifth ribs, external to their cartilages and the fascia over the intercostal muscles.

Insertion into the anterior half of the inner border, and upper surface, of the coracoid (Pl. III.) process.

Nerve.—Internal anterior thoracic (inner cord).

Artery.—Acromial thoracic.

Action.—With its fixed point at the ribs it pulls the coracoid process downwards and forwards, and thus throws the inferior angle of the scapula backwards; with its fixed point at the scapula it expands the chest.

Covered by the pectoralis major, except at the lower part when the arm is raised, it partly conceals the axillary vessels and nerves and the internal anterior thoracic nerve.

3. **Subclavius.**—In order to expose this muscle make a transverse incision through the costo-coracoid membrane, but before removing the membrane note its extension to the true sheath of the vessels and that it is derived from the portion of the deep cervical fascia over the scaleni muscles.

Origin.—From the first rib, at the junction of the osseous and cartilaginous parts.

Insertion into a groove on the under surface of the clavicle (Pl. III.).

Nerve.—Special branch from the brachial plexus (V. and VI.).

Artery.—Clavicular branches of acromio-thoracic.

Action.—The clavicle fixed, it raises the first rib; but it especially

aids the costo-clavicular ligament in preventing over-elevation of the clavicle.

Examine the **sterno-clavicular articulation**, noting the inter-clavicular and costo-clavicular (rhomboid) ligaments, and the anterior and posterior sterno-clavicular ligaments. Cut into the joint and examine the inter-articular fibro-cartilage which is attached to the clavicle above and the sternum below. Note that there is a synovial cavity on each side of the cartilage.

G. **THE AXILLARY ARTERY** (Pl. IV.), when exposed by the removal of its sheath, is seen to be the continuation of the subclavian, and to extend from the lower border of the first rib to the lower edge of the teres major.

Deeply situated above, it is only covered by the skin and fascia beyond the lower margin of the pectoralis major; note that its direction varies with the position of the arm.

To simplify the description, the artery may be divided into three parts:—

I. The part above the pectoralis minor, which was **concealed** by the pectoralis major, the costo-coracoid membrane, and crossed by the cephalic vein, the acromio-thoracic artery and vein and the external anterior thoracic nerve—the structures which pierce the costo-coracoid membrane.

The axillary vein lies at its **inner** side, the cords of the brachial plexus at some distance on the **outer**, the posterior thoracic nerve, the first digitation of the serratus magnus, and the first intercostal space lie **behind.**

The branches (Pl. IV.) from this part are:—

1. **The Superior Thoracic**, passing to the first intercostal space to supply the pectoral muscles and anastomose with intercostals and internal mammary.
2. **The Acromial Thoracic**, which gives off—

(*a*) Thoracic branches to the serratus magnus and pectoral muscles, which anastomose with the intercostals and internal mammary.

(*b*) Acromial branches to the deltoid and to the upper surface of the acromion to anastomose with a branch from the supra-scapular.

(*c*) A humeral branch, which passes in the same groove as the cephalic vein between the pectoral and deltoid muscles.

(*d*) Clavicular branches to the subclavius.

II. The second part, under **cover** of the pectoralis minor, was also covered by the major.

At its **inner** side is the inner cord of the brachial plexus; **externally**, the outer cord; and, **behind**, the posterior cord and the subscapularis muscle.

The branches are:—

1. **Alar Thoracic** (an inconstant branch which may arise from the subscapular or long thoracic), to supply the glands and the areolar tissue of the axilla.
2. **Long Thoracic**, which passes along the border of the pectoralis minor, and sends branches to the pectoral muscles, the serratus magnus, and subscapularis, the axillary and mammary glands. It anastomoses with the internal mammary and intercostals.

Divide the pectoralis minor near its insertion and throw it inwards and examine—

III. The part beyond the pectoralis minor, which was in great part **covered** by the pectoralis major. It is embraced by two large cords, which unite to form the median nerve. This large nerve runs along the front of the artery, and then passes to its outer side.

Internal to the artery, besides the inner head of the median, look for the ulnar nerve, the two internal cutaneous nerves, and, internal to these, the vein.

Externally, at the upper part, the outer head of the median and, lower down, the whole nerve, the external cutaneous nerve, and the coraco-brachialis muscle, penetrated by the external cutaneous nerve.

Behind the artery, the circumflex and musculo-spiral nerves, the lower portion of the subscapularis muscle, and the tendons of the latissimus dorsi and teres major.

The branches (Pl. IV.) are:—

1. **The Subscapular**, which runs along the lower border of the subscapularis muscle towards the inferior angle of the scapula supplying the serratus magnus, teres major, and latissimus, and sending a large branch (**dorsalis scapulæ**) to the dorsum of the scapula, from which a branch (**infrascapular**) enters and supplies the subscapularis. It anastomoses with intercostals, internal mammary, long thoracic, posterior, scapular and suprascapular arteries.

2. **Anterior Circumflex**, which passes under and partly supplies the biceps and coraco-brachialis, and sends an articular branch along the bicipital groove, a branch to the deltoid, and anastomoses with the posterior circumflex and acromio-thoracic.
3. **Posterior Circumflex**, which passes under the neck of the humerus to supply the deltoid and anastomose with anterior circumflex, suprascapular, and acromio-thoracic.

The Axillary Vein is the continuation of the basilic vein of the arm (Pl. V.); it lies to the inner side of the artery, and receives the subscapular and thoracic veins, the venæ comites of the brachial artery opposite the subscapular muscle, and the cephalic vein as it passes under the clavicle.

H. **THE BRACHIAL PLEXUS** consists of three large cords. The first, derived from the anterior division of the fifth and sixth cervical nerves and a small connecting branch from the fourth; the second from the seventh cervical; the third from the eighth cervical and first dorsal.

The three cords extend from between the scaleni muscles, downwards, to pass between the clavicle and the first rib, and enter the axilla at the outer side of the artery. On entering the axilla there is a rearrangement of the fibres, but the number of cords remains the same. The rearrangement generally consists in (1) a branch passing from the outer and inner divisions to join the middle one, which, passing behind the artery, is known henceforth as the posterior cord; (2) a branch passing from the middle to the outer division, which remains external to the artery as the outer cord. The inner division, without receiving any additional branches, passes along the inner side of the artery as the inner cord of the brachial plexus.

The branches to be looked for above the clavicle are:—

1. **The Nerve to the Subclavius** (V. and VI.), which arises at a higher level than the suprascapular, and passes downwards in front of the plexus.
2. **The Suprascapular** (V. and VI.)—the largest branch above the clavicle. It passes behind the omo-hyoid, through the supra-scapular notch, under the transverse ligament, to the supra- and infra-spinatus muscles.

3. **Nerve to the Rhomboids** and **Levator scapulæ** (V.), which reaches the muscles by piercing the scalenus posticus.
4. **Posterior Thoracic** (V. and VI.), which lies behind the plexus, and passes at once to the serratus magnus.

The branches below the clavicle (Pl. VI.) from

I. The outer cord are :—

1. **The External Anterior Thoracic,** crossing the artery and piercing the costo-coracoid membrane to reach the under surface of the pectoralis major.
2. **The External Cutaneous,** passing along the outer side of the artery to enter and supply the coraco-brachialis, biceps, and brachialis anticus.
3. **The outer head** of the median, which meets the inner head on the anterior surface of the artery.

II. The inner cord are :—

1. **The inner head** of the median.
2. **The Ulnar,** which runs along the inner side of the arm to pass behind the internal condyle of the humerus.
3. **The Internal Cutaneous,** which supplies the skin on the inner side of the arm.
4. **The Lesser Internal Cutaneous,** which unites with a branch from the intercosto-humeral, and also passes to the skin along the inner side of the arm.
5. **The Internal Anterior Thoracic,** which passes between the artery and vein to supply and pierce the pectoralis minor, and end in the major.

III. The posterior cord are :—

1. **The Musculo-spiral,** which passes behind the artery and along the musculo-spiral groove towards the external condyle.
2. **The Circumflex,** which passes behind the artery to wind round the neck of the humerus, along with the posterior circumflex artery, to supply the deltoid and **teres minor.**
3. **The Long Subscapular** nerve, which, passing with the artery over the subscapular muscle, supplies the latissimus and sometimes sends a branch to the teres major.
4. **The two Short Subscapular** nerves, to be dissected when the arm has been removed, which supply the subscapular and teres major muscles.

I. Divide the clavicle three inches from its acromial end, and pull the outer segment sufficiently far outwards to admit of a careful examination of the whole course of the nerves forming the brachial plexus, and make a sketch of the plexus, filling in all the branches, both above and below the clavicle, and dot in the course of the axillary artery.

Divide the vessels and nerves at the level of the upper border of the clavicle and fasten them to the cut-end of that bone by means of a cord. Next drag the acromion process as far as possible from the chest and clean the serratus magnus.

Serratus magnus (Pl. VI.).

Origin.—By nine muscular slips from the eight upper ribs, two inches external to their cartilages, (two slips rising from the second rib) and from the fascia covering the intercostal muscles.

Insertion.—(1) The portion from the first two ribs and the fascia between them is inserted into the upper angle of the scapula.

(2) The middle thin portion from the third and fourth ribs is inserted into the base of the scapula.

(3) The lower strong portion, from the fifth, sixth, seventh, and eighth ribs, which interdigitates with the external oblique, is inserted into a quadrilateral surface on the ventral aspect of the scapula (Pl. III.).

Action.—Carries scapula forwards; the lower fibres, by pulling the inferior angle forwards, assist the trapezius in rotating the scapula so as to raise the arm above the head.

The scapula fixed, it may act as an inspiratory muscle by raising the ribs.

Nerve.—Posterior thoracic (V. and VI.).

Artery.—Long thoracic.

Note that the muscle covers the ribs and intercostal spaces, that it is partly covered by the trapezius and the axillary vessels and nerves, that the subscapularis is in direct contact with it posteriorly, and that the levator scapulæ lies parallel to its upper margin.

J. In this section the following structures have been considered, and before separating the arm from the trunk what remains of them should be again examined.

1. **Cutaneous Nerves.**—(1) Descending branches from the superficial cervical plexus, viz. sternal, clavicular, and acromial. (2) Lateral and anterior branches from the intercostals.

2. Branches from **Thoracic, Intercostal,** and **Internal Mammary Arteries,** passing to the skin and the mamma.

3. **The Cephalic Vein,** passing along the groove between the pectoral and deltoid.

4. **Lymphatic Vessels and Glands** in the inner portion of the axilla.

5. **The Boundaries of the Axilla** and the vessels and nerves passing through it along the inner side of the arm.

6. **The Pectoralis major** and **minor,** forming the anterior boundary, and supplied by the anterior thoracic nerves and the acromio-thoracic artery.

7. **The Costo-coracoid Membrane** and the **Subclavius** muscle enveloped by it, the muscle supplied by a special branch from the brachial plexus (V. and VI.), and a branch (clavicular) from the acromio-thoracic artery.

8. **The Sterno-clavicular** and **Costo-clavicular Ligaments.**

9. **The Axillary Artery and its branches,** viz.

Superior thoracic, Acromial thoracic } above pectoralis minor.

Long thoracic, Alar thoracic } under pectoralis minor.

Subscapular, Anterior circumflex, Posterior circumflex } beyond pectoralis minor.

10. **The Axillary Vein,** lying internal to the nerves and artery, but external to the lymphatic glands.

11. **The Brachial Plexus,** made up of three cords, formed by the coalescence of the fifth, sixth, seventh, and eighth cervical, and first dorsal, which lie behind and at the sides of the axillary artery, and give off—

I. Above the clavicle :—

(1) The nerve to the rhomboids and levator scapulæ (V.).
(2) The nerve to the subclavius
(3) The suprascapular nerve } (V. and VI.).
(4) The posterior thoracic nerve.

II. Below the clavicle:—

(1) External anterior thoracic nerve
(2) External cutaneous nerve
(3) Outer head of median
} outer cord.

(4) Internal anterior thoracic nerve
(5) Inner head of median
(6) Ulnar nerve
(7) Internal cutaneous nerve
(8) Lesser internal cutaneous nerve
} inner cord.

(9) Musculo-spiral nerve
(10) Circumflex nerve
(11) Three subscapular nerves
} posterior cord.

12. **The Serratus magnus**, its posterior thoracic nerve (V. and VI.), and long thoracic artery.

The senior student should, before proceeding further, note—

1. The sterno-clavicular articulation, observing that its strength depends on its ligaments, and that, owing to these being weakest in front and behind, dislocations are likely to be either backwards or forwards.
2. That just as the sterno-clavicular articulation mainly depends for its strength on an accessory (costo-clavicular) ligament, so the acromio-clavicular articulation depends chiefly on the coraco-clavicular ligament.
3. The displacements which would result from a fracture external to, and a fracture between the two parts of, the coraco-clavicular ligament, also from a fracture of the acromion or coracoid process.
4. That in a fracture of the clavicle at its middle the shoulder would fall downwards, and be dragged forwards and inwards by the pectorals, serratus magnus and subclavius muscles, and especially that the inner fragment would be retained in its normal position by the great pectoral muscle and costo-clavicular ligament counteracting the influence of the sterno-mastoid.
5. The effects of a dislocation of the head of the humerus (1) into the axilla; (2) in front of the coracoid process; (3) under the spine of the scapula, that a downward, but especially a downward and forward, dislocation would cause œdema of the arm by compressing the axillary vein, and pain in the axilla and arm by pressing on the cords or branches of the brachial plexus.

6. That the axillary artery lies on, or comes into close contact with, and may be compressed against, the first rib between the deltoid and pectoralis major, or against the neck of the humerus, by introducing the fingers into the axilla.
7. That in order to escape the vessels and nerves at the inner side of the arm and the posterior thoracic artery running along the border of the pectoralis minor, incisions into the axilla should be made near the chest, midway between the anterior and posterior folds.
8. That in order to reach the third part of the axillary artery, which is surrounded by the branches of the brachial plexus, an incision should be made parallel to the vessel through the skin and strong fascia, forming the floor of the axilla, and the vein which obscures the artery drawn inwards.

SECTION III.

THE SCAPULAR REGION AND SHOULDER.

A. The limb having been removed by the division of the serratus magnus, the levator scapulæ, and omo-hyoid, make out, with the aid of Pl. I.–III., the exact attachment of the following muscles, viz.

The omo-hyoid, to the upper border of the scapula, the levator, rhomboids, and serratus magnus to its base.

The slip for the latissimus to its inferior angle.

The pectoralis minor to the coracoid process, and the

Subclavius to the under surface of the clavicle.

The pectoralis major to the outer ridge of the bicipital groove of the humerus, and the latissimus, folding itself round the lower edge of the teres major, is inserted in front of it into the floor of the bicipital groove. To admit of the one muscle acting independently of the other, a bursa exists between the two tendons near their insertion, which comes into view when the tendons are separated.

The muscles attached to the scapula should now be cut short, the axillary vessels and nerves cleaned of the remaining fat and connective tissue, and their branches again examined and followed for some distance towards their several destinations; the short subscapular, which was before concealed, should be looked for and traced to the subscapularis muscle.

B. The muscles to be studied in this section are the Subscapularis, Deltoideus, Supra- and Infra-spinatus, Teres minor and major.

Clean the subscapularis, and pull outward the vessels and nerves lying over it.

1. **The Subscapularis.**

Origin.—From ventral surface of scapula, and from tendinous septa attached to the osseous ridges radiating from the base to the superior angle (Pl. III.).

Insertion.—By tendon into the lesser tuberosity of the humerus, and by muscular fibres into half-an-inch or an inch of the shaft below the tuberosity (Pl. VIII.).

Action.—Depresses and rotates inwards the raised humerus.

Nerve.—Short subscapular.

Artery.—Infrascapular, from dorsal branch of subscapular.

Note that the subscapularis covers the ventral surface of the scapula, and that its tendon is in close contact with the capsule of the shoulder joint: that the lower border projects beyond the scapula covering the long head of the triceps and coming in contact with the teres major and latissimus: that as the subscapular artery runs along its lower border it gives off a branch (dorsalis scapulæ), which passes through a **triangular space**, bounded in front by the subscapularis, teres major, and long head of the triceps.

From this dorsal branch the infrascapular artery arises and enters the substance of the muscle.

A great part of the subscapularis was in contact with the serratus magnus, and over the outer portion the axillary vessels and nerves still lie, and round its lower border the circumflex nerve and posterior circumflex artery pass on their way through a **quadrilateral space** to the under surface of the deltoid. This space is bounded in front by the subscapularis above, the teres major below, the long head of the triceps internally, and the shaft of the humerus externally.

To expose the deltoid remove the skin and fascia from the shoulder, being careful to leave the acromial branches of the superficial cervical plexus passing downwards, and the cutaneous branches from the circumflex nerve which (1) pierce the deltoid over the shoulder, and (2) turn round its posterior border (Pl. V.).

Clean now the deep fascia from the surface of the deltoid, cutting parallel to, but not separating too much its coarse fibres.

2. **The Deltoideus** (Pl. IV.).

Origin.—From the lower edge of the spine of the scapula, the anterior edge of the acromion, and the outer half of the clavicle (Pl. I.).

Insertion into the outer surface of the shaft of the humerus near its middle (Pl. VIII.), the fibres being continuous above, with the pectoralis major and embraced below by the origin of the brachialis anticus.

Action.—The whole muscle acting, the humerus is raised to an angle of 90°. The anterior fibres pull the arm forwards, the posterior backwards.

Nerve.—Circumflex (posterior cord).

Arteries.—Circumflex.

The deltoid forms the prominence of the shoulder; its margins are easily defined, the anterior running parallel to the pectoralis major, the posterior obliquely from the spine of the scapula to the middle of the arm.

Reflect the deltoid by dividing its fibres near their origin, and note that it lies over the upper end of the humerus, the infraspinatus and teres minor muscles, the teres major, the long head of the triceps, the long tendon of the biceps lying in the bicipital groove, the coraco-brachialis and short tendon of the biceps passing downwards from the coracoid process, and the circumflex nerve and vessels passing through the quadrilateral space (which is bounded above posteriorly by the teres minor) to reach its under-surface.

The circumflex nerve (posterior cord of the brachial plexus) should be traced into the substance of the muscle, its branch to the teres minor looked for, and its remaining cutaneous branches followed downwards. If the posterior circumflex artery, as sometimes happens, is a branch from the superior profunda artery, it is found at the lower instead of the upper margin of the teres major.

3. **The Supraspinatus** (Pl. II.).

Origin.—From the greater part of the supraspinous fossa (Pl. I.), the upper surface of the spine, and the fascia over it.

Insertion into the upper facet of the great tuberosity (Pl. VIII.).

Action.—It aids in raising the arm, but especially helps in fixing it when raised above the head.

Nerve and Artery.—Suprascapular.

It is covered by the trapezius and acromion process, and conceals the suprascapular vessels and nerve, part of the capsule of the joint, and at its attachment is in contact with the infraspinatus.

4. **Infraspinatus** (Pl. II.).

Origin.—From infraspinal fossa (Pl. I.), the lower surface of the

spine, the fascia covering it, and from the septa between it and the teres muscles.

Insertion into middle facet of the great tuberosity of the humerus, connected with the supraspinatus above and the teres minor below (Pl. X.).

Action.—Rotates outwards the hanging arm, and aids the posterior fibres of the deltoid in pulling back the raised arm.

Nerve.—Suprascapular.

Arteries.—Suprascapular and dorsalis scapulæ.

This muscle is partly subcutaneous, partly covered by the deltoid above and by the latissimus below; its lower edge is often inseparably connected with the teres minor. Springing from the scapula, it will afterwards be seen to cross the suprascapular vessels and nerves and lie on the capsule of the joint.

5. **Teres minor** (Pl. XI.).

Origin.—From upper two-thirds of inferior costa of the scapula (Pl. I.) and from the fascia over it and the septa between it and the adjacent muscles.

Insertion into the lowest facet of the great tuberosity of the humerus, and into nearly an inch of the shaft of the humerus below (Pl. X.).

Action.—Depresses the raised humerus and then rotates it outwards. Along with the supraspinatus, infraspinatus, and subscapularis, it aids in preventing dislocation of the head of the humerus when the arm is raised above the head.

Nerve.—Branch from the **circumflex**, on which a swelling may exist.

Artery.—Dorsal branch of subscapular.

Covered by the deltoid, it crosses the long head of the triceps, the dorsalis scapulæ artery, and lies on the capsule of the joint; near its lower margin the circumflex nerve and posterior circumflex artery wind round the humerus to enter the deltoid. A considerable swelling may be seen on the nerve supplying it just before it penetrates the fibres of the muscle.

6. **Teres major** (Pl. XI.).

Origin.—From rough surface at inferior angle (Pl. I.), and from a varying extent of the inferior border of the scapula, and from the fascia over the teres minor.

Insertion into the bicipital groove of the humerus (Pl. VIII.), being

connected with the tendon of the latissimus below, but separated from it in the rest of its extent by a bursa.

Action.—It depresses and adducts raised humerus, and, by further contracting, rotates it inwards and carries it behind the back.

Nerve.—Middle subscapular.

Artery.—Branches from the subscapular.

The relations of this muscle are important and should be carefully studied. Already it has been seen to form along with the latissimus the posterior fold of the axilla, and to be crossed by the axillary vessels and nerves near its insertion.

Note now—

(1) That the upper edge lies parallel to the subscapularis.

(2) That the latissimus covers the muscle at its origin and is folded round its lower border.

(3) That it forms the lower boundary of the triangular interval (Pl. XI.), through which the dorsalis scapulæ passes, and the lower boundary of the quadrilateral space, through which the circumflex nerve and posterior circumflex artery pass.

Note that the subscapularis forms the upper boundary of these spaces in front, and that the teres minor forms the upper boundary behind.

C. Clean and examine the following ligaments:—

1. Between the **Scapula** and **Clavicle** (Pl. III.)

The coraco-clavicular, which consists of (*a*) a posterior (conoid) part, and (*b*) an anterior (trapezoid) part, united posteriorly, but separated from each other in front.

2. Between the **Clavicle** and **Acromion.** The acromio-clavicular. Between the ends of the bones an interarticular fibro-cartilage, with a synovial sac at each side, may sometimes be found on opening into the joint.

3. Over the **Scapular Notch.** The transverse ligament.

4. Between the **Acromion** and **Coracoid** processes a large triangular ligament.

Saw through and throw backwards the acromion process and the part of the clavicle still attached to it, noting that a bursa exists between the acromion process and the tendon of the supraspinatus.

In order to see the suprascapular nerve and vessels, detach the supra- and

infraspinatus muscles from the humerus, and throw them back. The artery, having passed over, and the nerve under, the transverse ligament, they send branches to the supraspinatus muscle, the scapula, and the joint. The nerve then, running under the acromion process, ends in the infraspinatus. The artery, after supplying the infraspinatus, anastomoses with the dorsalis scapulæ in the substance of the teres minor, and, at the inferior angle, with the posterior scapular (Pl. XI.).

Note that some of the fibres of the supra- and infraspinatus muscles, as well as fibres from the teres minor, are inserted into the capsule of the joint, and that a bursa exists between the capsule and the teres minor.

Remove now the subscapularis, noting the tendinous septa attached to the ridges (Pl. III.), the infrascapular artery passing under its lower edge from the dorsalis scapulæ to supply it and to anastomose with the supra- and posterior scapular branches, its connection with the capsule of the joint, and the large bursa lying between the tendon and the capsule, which sometimes communicates with the joint.

Learn the anastomoses of the scapular arteries, viz. the dorsalis scapulæ (subscapular) and its infrascapular branch with the suprascapular and posterior scapular (thyroid axis of subclavian), the acromial branch of suprascapular with the acromial branch from the acromio-thoracic (axillary).

Remember also that a branch which passes between the rhomboids from the posterior scapular anastomoses with the superficial cervical, and that the subscapular and thoracic arteries, anastomose with the intercostal arteries (aorta) and with the superior intercostal (subclavian).

The **shoulder joint** may now be examined, but if the part is in a good state of preservation it may be left until the dissection of the forearm has been completed.

In studying the shoulder joint bear in mind that everything has been modified to admit of free movement of the forearm and hand (conditions which favour extensive movement generally admit of easy dislocation). On examining the skeleton the large rounded head of the humerus will be found looking backwards—to admit of free internal rotation,—lying in an exceedingly shallow

glenoid cavity: the acromion and coracoid processes and the ligament between them—structures which practically form a segment of an articular cavity—are a considerable distance from the tuberosities and head of the humerus. On examining the capsular ligament, it will be found so loose that when the muscles are removed and air admitted into the joint, the head of the humerus at once falls an inch or more from the glenoid cavity.

Note, though, as already indicated, the joint is osseously and ligamentously weak, that several muscles are closely connected with it, viz. the subscapularis in front, the supraspinatus above, and the infraspinatus and teres minor above and behind; and that the humerus is bound down by the long tendon of the biceps, and kept from slipping into the axilla by the long head of the triceps.

Note, by again referring to the skeleton, that the arch formed by the acromion and coracoid processes and acromo-coracoid ligament, not only prevents the arm being raised higher than a right angle, but further absolutely prevents dislocation upwards; also that, when the arm is at a right angle with the trunk, there is nothing to prevent dislocation downwards into the axilla, but the long head of the triceps.

Remove now the muscles and tendons around the joint and examine the bursa between the capsule and the arch above, and the bursa between the capsule and the tendon of the subscapularis, noting especially if it communicates with the joint.

Examine the capsule and define the strong coraco-humeral band from which a slip (gleno-humeral) sometimes passes to the bicipital groove. The capsule will be found stretching from the margin of the glenoid cavity to the anatomical neck of the humerus, and issuing through it in front is the long tendon of the biceps.

Open the capsule and follow the tendon to the upper border of the glenoid cavity where it blends with the fibro-cartilaginous glenoid ligament which fixed round the margin helps to deepen the cavity.

The capsule is lined by a synovial membrane which envelopes the tendon of the biceps, and is reflected over it for some distance along the bicipital groove.

D. In this section the under-mentioned muscles, nerves, and vessels have been examined, and the dissector should make sure that he knows them before passing to the region of the arm, viz:—

1. **The Attachments** of the omo-hyoid, the rhomboidei, serratus magnus, latissimus, and pectoralis minor, to the scapula; the subclavius to the clavicle; the pectoralis major to the outer edge, and the latissimus and teres major to the inner edge of the bicipital groove of the humerus.
2. **The Subscapularis,** supplied by the short subscapular nerve and the infrascapular artery.
3. **The Deltoid,** supplied by the circumflex nerve and posterior circumflex artery.
4. **The Circumflex Nerve,** which, besides supplying the deltoid, sent cutaneous branches through it to the shoulder and round its lower margin to the upper third of the arm, and a special branch to the teres minor.
5. **The Posterior Circumflex Artery,** which winds round the humerus with the nerve and anastomoses with the anterior circumflex, suprascapular, and acromio-thoracic arteries.
6. **The Supraspinatus and Infraspinatus,** supplied by the suprascapular nerve and artery.
7. **The Teres minor,** supplied by the circumflex nerve and the dorsalis scapulæ artery.
8. **The Teres major,** supplied by the middle subscapular nerve and branches from the subscapular artery.
9. The **Ligaments** of the **scapula** and **clavicle.**
10. **The Shoulder joint,** its ligaments and the muscles surrounding it.

SECTION IV.

REGION OF THE ARM.

A. **EXTERNAL ANATOMY.**—Hold the forearm in the one hand, and with the other feel the prominent internal and the rounded external condyle of the humerus, and between them behind, but nearer the inner, the moveable olecranon process of the ulna and the cord-like ulnar nerve (funny bone) in the deep groove at its inner side. Note that the highest point of the olecranon is in a line with the condyles when the arm is fully extended, but that it is in front of them in extreme flexion.

A dimple below the external condyle indicates the position of the head of the radius, which can be easily felt when the arm is repeatedly turned from the prone to the supine position.

In front of the radius lie the supinator longus muscle, and at the inner side the pronators and flexors, deep in the triangular space between them is the coronoid process, and, passing through the space, the firm tendon of the biceps, with the brachial artery and median nerve at its inner side (Pl. V.).

Carry the fingers from the external condyle upwards along the condyloid ridge and outer side of the shaft to the insertion of the deltoid; and note that the deltoid separates the extensor muscles clothing the humerus behind, from the flexors covering it in front.

Feel for the brachial artery passing from the lower border of the teres major along the edge of the coraco-brachialis and prominent biceps muscle (Pl. VII.).

B. **DISSECTION.**—The arm lying with the front uppermost, make an incision along the middle line to a point two inches below the elbow, and at right angles to this incision make another half round the arm above and below.

Reflect the skin, and look for the following cutaneous veins and nerves lying in the superficial fascia.

C. **VEINS.**—Look for the **median** below the bend of the elbow, which divides into an inner and outer branch. Follow the inner branch (**median basilic**) across the aponeurotic expansion from the biceps to the point where it unites with the ulnar veins to form the **basilic.** Trace the basilic vein along the inner edge of the biceps till it pierces the fascia about the middle of the arm to run along the inner side of the brachial artery and become continuous with the axillary vein (Pl. V.).

Follow the outer division of the median (**median cephalic**) upwards in the groove between the biceps and supinator longus muscles till it unites with the radial vein to form the **Cephalic**, which, after running along the outer edge of the biceps, passes along the groove between the deltoid and pectoralis major to disappear beneath the clavicle (Pl. V.).

A small lymphatic gland may with care be found over the internal condyle. It receives the lymphatics from the forearm and hand, and the vessels issuing from it chiefly accompany the basilic vein to end in the upper set of glands in the axilla.

D. **NERVES.**—Look on the **outer side** for:—

1. The termination of the branches already seen passing from the **Circumflex** over the lower edge of the deltoid (Pl. V.).
2. The branches from the **musculo-spiral.**
   (*a*) A branch running along the side of the cephalic vein (Pl. V.).
   (*b*) A lower branch piercing the fascia below the insertion of the deltoid, to pass to the outer side and back of the forearm.
3. Branches from the **musculo-cutaneous**, piercing the fascia at the outer side of the tendon of the biceps to pass over the median cephalic, but partly under the radial vein, to the front of the forearm (Pl. V.).

On the **inner side** look for:—

1. **The large Internal Cutaneous Nerve** at the inner side of the artery, and trace it to the inner side of the forearm (Pl. V.), noting—
   (*a*) A small offset which pierces the fascia a short distance below the anterior fold of the axilla to pass to the front of the arm.

(*b*) A large outer branch which pierces the fascia in the middle of the arm, external to the basilic vein, to pass partly over and partly under the median basilic vein to the front of the forearm.

(*c*) A large inner branch which passes over or under the basilic vein to cross the internal condyle and be distributed on the back of the forearm.

2. **The small Internal Cutaneous Nerve** of Wrisberg, which pierces the fascia about the middle of the arm behind the internal cutaneous to pass to the inner side of the arm and the space between the olecranon and internal condyle.

3. A branch from the **musculo-spiral**, which pierces the fascia at the inner side of the arm below the teres major and passes towards the olecranon.

4. The termination of the **Intercosto-humeral**, which is distributed along with the two previous nerves.

The strong **fascia** enveloping the muscles, vessels, and nerves, should now be cleaned; its connection with the fascia above, which formed the floor of the axilla and covered the pectoral and deltoid muscles, noted; also the fibres passing to it from the pectoralis major, latissimus, and teres major above, and from the biceps (semilunar fascia) below. Note that it sends strong septa between the flexor and extensor muscles to be attached to the condyles, the condyloid ridges, and the olecranon process. The ulnar nerve and inferior profunda artery will be afterwards found piercing the inner septum on their way to the groove between the olecranon and internal condyle; the musculo-spiral nerve and superior profunda artery piercing the outer septum from behind to pass under the supinator longus.

Having noted the exact position of the brachial artery at the inner side of the biceps, the groove between the biceps and the supinator longus (Pl. VII.), the upper edge of the pronator teres running obliquely outwards from the inner condyle; make a mesial incision and reflect the fascia so as to expose the biceps and, under it, the brachialis anticus, being careful to leave the brachial artery and median nerve undisturbed.

E. MUSCLES.

1. The Biceps.

Origin.—The short head arises along with the coraco-brachialis from the coracoid process (Pl. I. and III.).

The long head issuing from within the capsule of the joint arises from the upper part of the glenoid cavity (Pl. I.) and the glenoid ligament.

Insertion into the posterior rough surface of the tubercle of the radius (Pl. XIII.), and by the semilunar fascia into the aponeurosis of the forearm.

Action.—It supinates the hand and bends the forearm on the upper arm, so that the hand approaches the shoulder.

The inner head very slightly adducts, and the outer abducts the hanging arm.

Nerve.—Musculo-cutaneous.

Artery.—Muscular branches from the brachial and anterior circumflex.

Note the direction and shape of the muscle, and that it is easily split into two portions. Cut through the insertion into the fascia of the forearm, and follow the rounded tendon to the radial tubercle. Note that the muscle covers the brachialis anticus, the musculo-cutaneous nerve, and the upper part of the humerus; and especially that its middle third is the guide to the brachial artery. Between it and the artery above is the—

2. Coraco-Brachialis Muscle.

Origin.—It has a fleshy origin from the tip of the coracoid process (Pl. III.) and from the tendon of the biceps.

Insertion into the inner side of the humerus (Pl. VIII.), from which a slip passes upwards to the bicipital groove and lesser tuberosity.

Action.—Adducts the hanging limb, and when the arm is fixed it depresses the scapula.

Nerve.—The musculo-cutaneous, which pierces the muscle on its way to the biceps.

Artery.—Branches from the brachial.

Note that the coraco-brachialis passes from under the pectoralis major between the axillary artery and the biceps muscle, crossing the subscapularis, the tendons of the latissimus dorsi and teres major, and the anterior circumflex artery.

F. Clean now the **BRACHIAL ARTERY** from above downwards, and note that it runs along the inner side of the upper two-thirds, but crosses obliquely the lower end, of the humerus; that it is separated by the musculo-spiral nerve and superior profunda artery from the long head of the triceps, and that it rests on the inner head of the triceps, the insertion of the coraco-brachialis, and on the brachialis anticus.

On its **inner side** note the ulnar nerve until it pierces the intermuscular septum, the upper part of the internal cutaneous nerve, the median nerve below, and the basilic vein above.

At its **outer side**, above, note the median nerve and the coraco-brachialis muscle, and at the lower two-thirds the inner edge of the biceps.

Note in **front** that it is crossed obliquely by the median nerve, that the semilunar fascia and median basilic vein crossed its lower part, and that in the rest of its course it was covered only by skin and fascia.

Note the venæ comites accompanying the artery and their numerous intercommunications.

The **Branches** of the brachial artery should next be looked for and followed as far as possible.

1. **The Superior Profunda**, which will afterwards be found accompanying the musculo-spiral nerve round the humerus to appear between the brachialis anticus and supinator longus and anastomose with the radial recurrent in front of the external condyle. It supplies the biceps, coraco-brachialis, and triceps muscles, and sends a branch to the deltoid and a branch to the anconeus, which anastomoses with the interosseous recurrent (Pl. IX. and XIX.).
2. **The Inferior Profunda**, which accompanies the ulnar nerve through the intermuscular septum to anastomose with the posterior ulnar recurrent and anastomotic and supply the triceps.
3. **The Nutritious branch**, which enters the large foramen to run towards the elbow-joint.
4. **The Anastomotic**, which pierces the inner septum to supply the triceps and anastomose with the inferior profunda and posterior ulnar recurrent behind the inner condyle, and, with a branch from the superior profunda, to form an arch across the back of the humerus. An anterior branch supplies the pronator teres and anastomoses with the anterior ulnar recurrent.
5. **Muscular** branches to coraco-brachialis biceps and brachialis anticus.

G. Examine next the **NERVES**.

1. **The Median.** Note again that it is derived by two roots, which embrace the artery, and that it passes obliquely from the outer to the inner side of the vessel, sometimes under it, to disappear beneath the pronator teres. It may communicate with, or take the place of, the musculo-cutaneous nerve (Pl. VII.).

2. **The Ulnar Nerve.** Note that it passes downwards from the inner cord internal to the axillary and brachial arteries, leaving the latter about the middle of the arm, to pierce the septum, and, along with the inferior profunda artery, reach the groove between the olecranon and internal condyle (Pl. VII.).

3. **Musculo-cutaneous Nerve.** Note that it passes from the outer cord to supply and pass through the coraco-brachialis, that it runs along the outer side of the arm between the biceps and brachialis anticus to become cutaneous near the elbow, and that it reaches the forearm by passing under the median cephalic vein. Trace branches from it into the biceps and brachialis anticus, and observe if it communicates with the median.

Either pull aside or reflect the biceps muscle by cutting through its tendon near the elbow in order to examine the

4. **Brachialis anticus Muscle.** Note its

Origin from the anterior surface of the humerus (Pl. VIII. and IX.); from all the inner but only the upper part of the outer intermuscular septum; and its

Insertion into the impression below the coronoid process of the ulna (Pl. XIII.).

Action.—By pulling on the ulna it bends the elbow, approximating the forearm to the arm, and when the ulna is fixed, as in climbing, it raises the humerus.

Nerves.—Musculo-cutaneous and musculo-spiral.

Artery.—Branches from the brachial.

Note that the muscle covers the humerus and the front of the elbow-joint, that at its origin it embraces the deltoid, and at its insertion lies between the origins of the flexor profundus digitorum; at its outer side observe the supinator longus and the extensor carpi radialis longior, and note that the biceps muscle, with the median, musculo-cutaneous and musculo-spiral nerves, rests on it.

By means of blocks and hooks make tense the muscles at the back of the arm, and then expose them by cutting through the fascia along the middle line.

5. Examine the three heads of the **Triceps**, noting the

Origin of (1) the **long head** by a wide tendon from the inferior border of the scapula (Pl. I. and III.) and the capsule of the shoulder-joint.

(2) The **outer head** from a narrow surface on the back of the humerus, extending from the insertion of the **teres minor** to the musculo-spiral groove (Pl. X.).

(3) The **inner head** from the back of the humerus below the groove, extending from the tendon of the **teres major** to the lower end of the humerus as far externally as the outer condyle, but internally to within an inch of the inner condyle (Pl. VIII. and X.). It also arises from the intermuscular septa.

Insertion into the upper surface and along the outer margin of the olecranon process (Pl. XVII.).

Action.—It extends the flexed arm until the ulna is in a line with the humerus. The long head adducts the arm by depressing the raised humerus.

Nerve.—The musculo-spiral.

Artery.—Branches from the brachial, especially the superior profunda.

Note that the triceps covers the humerus and conceals the musculo-spiral nerve and superior profunda artery; that it was at its upper part covered by the deltoid; and that below it crosses the elbow-joint to be continuous with the small anconeus muscle at the outer side of the olecranon. Also note its connection with the intermuscular septa, the relations of these septa, and the vessels and nerves piercing them.

6. To see the musculo-spinal nerve (Pl. XI.) and superior profunda artery winding round the back of the humerus, cut through the middle or long head of the triceps obliquely downwards and outwards in the direction of the groove. Clean the vessels and nerve, and trace from the **artery** by cutting between the outer and middle head of the triceps:—

(1) An anterior branch to anastomose with the radial recurrent.

(2) Branches behind the septum to anastomose with the radial recurrent and the interosseous recurrent.

(3) A small branch to the anconeus.

The muscular branches anastomose with the inferior profunda, anastomotic, and recurrent branches, and several small branches accompany the cutaneous nerves.

Trace the **nerve** along the groove through the septum to the interval between the brachialis anticus and the supinator longus, where it divides into the radial and posterior interosseous nerves, and note—

(1) **Muscular** branches to the triceps, brachialis anticus, supinator longus, extensor carpi radialis longior, and a slender branch to the anconeus.

And (2) the **external** and **internal** cutaneous branches already described.

Look under the triceps for two small muscular slips passing to the synovial sac of the joint which, like the subcrureus, raise the capsule when the joint is extended.

The shoulder-joint should be now examined (unless this has already been done, p. 31), so that the scapula and upper limb may be removed.

In this section the following structures have been examined, viz.:—

1. The **Basilic** and **Cephalic Veins.**

2. The **Cutaneous Branches** from the circumflex, musculo-spiral, and musculo-cutaneous nerves at the outer side of the arm. The internal cutaneous nerves, the intercosto-humeral, and a branch from the musculo-spiral at the inner side of the arm.

3. The **Fascia** enveloping and dipping in between the flexor and extensor muscles to reach the condyloid ridges, as intermuscular septa.

4. The **Biceps** and **Coraco-brachialis Muscles** supplied by the musculo-cutaneous nerve and the brachial artery.

5. The **Brachial Artery**, its relations and branches. The anastomoses around the elbow-joint, viz.:—

The superior profunda with the radial recurrent in front, and the interosseous recurrent behind.

The anastomotic with the anterior ulnar recurrent, the anastomotic and inferior profunda with the posterior ulnar recurrent.

6. The **Median Nerve** crossing obliquely from without, inwards, the brachial artery.
7. The **Ulnar Nerve** running towards, and disappearing behind, the internal condyle.
8. The **Musculo-cutaneous Nerve**, passing obliquely outwards through the coraco-brachialis and under cover of the biceps.
9. The **Brachialis Anticus** supplied by the musculo-cutaneous and musculo-spiral nerves, and brachial artery.
10. The **Triceps** (the outer head extending as far as the insertion of the teres minor, the inner as far as the teres major) supplied by the musculo-spiral nerve and superior profunda artery.
11. The **Musculo-spiral Nerve** winding round the back of the humerus along with the superior profunda artery, to divide between the brachialis anticus and supinator longus into the radial and posterior interosseous nerves, and send cutaneous branches to the outer side of the arm.

SECTION V.

THE FRONT OF THE FOREARM.

A. EXTERNAL ANATOMY.

Beginning at the olecranon, carry the fingers along the shaft of the ulna to its small rounded lower end, from which the styloid process projects downwards; the rounded projection of the ulna is best seen when the hand is in the prone position. Below the styloid process feel first the cuneiform, and below it the fifth metacarpal bone. Beyond the end of the ulna, in front is the prominence formed by the pisiform bone and the hook of the unciform.

Feel again at the bottom of the pit below the external condyle the head of the radius, and note that a small portion of the upper end of the shaft is subcutaneous, that the middle portion is covered by the extensor muscles, and that the lower end is crossed by the extensor tendons. Projecting downwards, half-an-inch lower than the process from the ulna, note the styloid process of the radius, and trace to it the tendon of the supinator longus, between which and the tendon of the flexor carpi radialis is the part of the radial artery where the 'pulse' is generally felt.

Extend the thumb, feel for, and trace to their insertions, the extensor metacarpi and the extensor primi internodii passing over the styloid process, and the extensor secundi passing obliquely from the ridge on the back of the radius. Note the triangular hollow between these tendons. Passing over this space is the radial vein, and, lying in it, the radial artery. Note that the lower end of the radius, external to the flexor tendons, projects forwards, and that beyond this projection is the tubercle of the scaphoid.

On the front of the wrist feel for the tendon of the flexor carpi ulnaris over the ulna, external to it the flexor sublimis, and between them the ulnar artery. In the middle line, the palmaris longus—the guide to the median nerve.

Examine the tendons on the back of the wrist with the aid of Pl. XX.

In the **hand** note the ball of the thumb and the shallow furrow internal to it; and a deep furrow running across the hand, near the level of the metacarpo-phalangeal joints. Halfway between this furrow and the wrist is the line of the superficial palmar arch, and half-an-inch nearer the wrist the line of the deep arch. The dissector should trace in his own hand the course of the radial artery from the end of the radius (Pl. XX.) until it disappears between the heads of the first dorsal interosseous muscle at the apex of the angle formed by the first two metacarpal bones.

Note the movements which take place at the wrist, the metacarpo-phalangeal and phalangeal joints, that the furrows on the palmar surface of the fingers are opposite the joints, those on the dorsal surface being above the joints.

Note if there is any contraction of the palmar fascia.

B. Observe the two furrows along the sides of the forearm which indicate the direction of the two main vessels; and then, with the palm upwards, make first an incision through the skin along the middle of the forearm, and an anterior incision across the wrist, at the root of the thumb; from each end of this cross incision carry the knife along the dorsal aspect of the second and fifth metacarpal bones as far as the knuckles.

C. Reflect carefully the skin from the front and back of the forearm and from the back of the hand, and look for

1. **The Radial Vein**, originating from the outer side of the arch formed by the superficial digital veins on the back of the hand and from the small veins at the root of the thumb, to pass upwards and unite with the external division of the median to form the cephalic vein.
2. **The Ulnar Veins.**
   (1) The anterior, from the front of the wrist, which unites with
   (2) The posterior, from the inner side of the arch formed by the digital veins, and from a vein originating over the end of the ulna, to aid in forming the basilic vein.
3. **The Median**, from the root of the thumb, which after receiving a communication from the profunda vein divides into median basilic and median cephalic branches.

D. Next look for the **Cutaneous Nerves.**

1. The continuation of the **Internal Cutaneous** along the front of the arm (anterior branch) to join a branch from the ulnar which pierces the fascia three inches above the wrist, and a branch (posterior) which runs along the back of the forearm as far as the wrist.
2. **The External Cutaneous** branch of the musculo-spiral, which passes along the outer aspect of the back of the arm.
3. **The Radial** (musculo-spiral), which is found at the outer margin of the lower third of the arm. Trace one branch (external) joining the musculo-cutaneous to supply the ball of the thumb, and a second (internal) which supplies the rest of the thumb and three and a half fingers and unites with the ulnar and musculo-cutaneous nerves.
4. The branches from the **Ulnar** which supply the little and half the ring fingers in front and behind and communicate with the radial.
5. The branch from the **Median**, which pierces the fascia two or three inches above the wrist and passes into the palm.

E. Examine the **deep fascia**, noting its attachment to the ulna, that it forms at the wrist the posterior annular ligament, and is in connection in front with the anterior annular ligament. Processes will be afterwards found passing from it between the muscles, and the muscles will be seen partly arising from it. Expose the muscles, leaving the annular ligaments, the branches to the palm from the median and ulnar nerves, and the fascia near the elbow from which the muscles arise; and then clean out and examine the hollow in front of the elbow, noting the supinator longus externally, the pronator teres internally, and the brachialis anticus and supinator brevis forming the floor and concealing the bones. In the space note—

The Tendon of the Biceps passing to the tubercle of the radius.

The Brachial dividing into the radial and ulnar arteries.

The Median Nerve at the inner side.

The Musculo-spiral Nerve, between the supinator longus and the brachialis anticus, dividing into the posterior interosseous and radial nerves, and passing upwards the radial recurrent artery. At the inner side, note at a deeper level the anterior and posterior ulnar recurrent arteries (Pl. XII. and XIV.).

F. Next examine the muscles passing from the internal condyle (Pl. XII.), viz. pronator radii teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, and the flexor sublimis digitorum, all of which arise by a common tendon from the internal condyle.

1. **Pronator radii teres.**

Origin.—From inner condyle by the common tendon, and from the condyloid eminence above the other muscles (Pl. VIII.); from the fascia and intermuscular septum between it and the flexor carpi radialis; by a second head from the inner part of the coronoid process (Pl. XIII.).

Insertion into the posterior aspect of the outer surface of radius about its middle (Pl. XVII.).

Action.—Pronates hand, and assists in bending the elbow when the radius is fixed.

Nerve.—Median.

Artery.—Muscular branches of ulnar.

Note the shape and direction of the pronator, and that it is crossed at its insertion by the radial artery, and partly overlapped by the supinator longus and the radial extensor; that it lies on the brachialis anticus, ulnar artery, and median nerve, and the flexor sublimis digitorum; that the small head passes between the brachial artery and median nerve; that the inner border is in contact with the flexor carpi radialis and palmaris longus; and that the outer bounds the space at the bend of the elbow.

2. **Flexor carpi radialis** (Pl. VIII. and XII.).

Origin.—From inner condyle by the common tendon, from the fascia and intermuscular septa.

Insertion into base of metacarpal bone of index, and by a narrow slip, into base of metacarpal bone of middle finger (Pl. XV.).

Action.—First flexes the wrist-joint and then bends the elbow.

Nerve.—Median.

Artery.—Branches from the ulnar.

Note that it crosses the median nerve and ulnar artery and rests on the flexor sublimis and flexor longus pollicis, having the pronator teres and radial artery at its outer and the palmaris longus and

median nerve at its inner margin; that on its way to the metacarpal bones it passes through a separate compartment of the outer part of the annular ligament and along the groove of the trapezium.

3. **Palmaris longus**—often absent (Pl. VIII. and XII.).

Origin.—From the common tendon, fascia, and intermuscular septa.

Insertion into the palmar fascia. It may send a tendinous slip to the short muscles of the thumb.

Action.—Makes tense the palmar fascia and aids in flexing the wrist and elbow.

Nerve.—Median.

Artery.—Ulnar.

Note that the tendon is very long, slender, and capable of being unfolded so as to form a thin fibrous band; that the short fleshy part lies between the flexor radialis and flexor carpi ulnaris; and that the tendon crosses the flexor sublimis.

4. **Flexor carpi ulnaris** (Pl. VIII. and XII.).

Origin.—(1) From the internal condyle, the fascia, and intermuscular septum.

(2) From the aponeurosis attached to the inner border of the olecranon and the upper two-thirds of the posterior border of the ulna.

Insertion into the pisiform bone, or rather into the fifth metacarpal bone, unciform bone, and annular ligament, the pisiform being a sesamoid bone developed in its tendon (Pl. XV.).

Action.—It bends the wrist, leads to ulnar flexion of the hand, and flexes the elbow.

Nerve and Artery.—Ulnar.

Note at its outer side the palmaris longus and flexor sublimis, that the muscular fibres extend to near the wrist, and that the tendon may be taken as a guide to the ulnar nerve and artery.

Cut through its origin from the inner condyle, and note the ulnar nerve entering the forearm between the two heads, and that the muscle rests on the ulnar nerve and artery and the flexor sublimis and profundus digitorum.

G. Trace now from the bifurcation of the brachial over the neck of the radius the **Radial Artery** until it disappears from the front of the forearm to reach the first interosseous space and enter the palm as the deep palmar arch (Pl. XII. and XIV.).

Note that its course may be indicated by a line drawn from the middle of the hollow in front of the elbow to the end of the radius; that the supinator longus lies at the **outer** side and in the upper third of the arm partly overlaps the artery; that the pronator teres and flexor carpi radialis are at the **inner** side; and that the artery **crosses** from above downwards the supinator brevis, the pronator teres, the flexor sublimis, the pronator quadratus, the flexor longus pollicis, and the end of the radius. Externally, the radial nerve is in contact with it in the middle of the arm, and a vein lies on each side. Trace from it:—

1. **Muscular branches.**
2. **The Radial Recurrent,** to anastomose with the superior profunda and supply the adjacent muscles.
3. **The Superficial Volar** to enter the muscles of the thumb, ending in them or completing the superficial arch by joining the ulnar artery.
4. **The Anterior Carpal,** which runs under the tendons to form an arch with the anterior ulnar carpal. Branches pass from the arch to the wrist-joint.

In this section the superficial structures in the forearm have been considered, viz.:—

1. The **Cutaneous Veins** and **Nerves.**
2. The **Hollow** in front of the elbow, its boundaries, and contents.
3. The **Pronator Teres,** the **Flexor Carpi Radialis,** and the **Palmaris Longus,** supplied by the median nerve and ulnar artery.
4. The **Flexor Carpi Ulnaris** supplied by the ulnar nerve and artery.
5. The **Radial Artery** and its muscular, radial, volar, and anterior carpal branches.

SECTION VI.

PALM OF THE HAND.

A. Make first an incision along the centre of the palm, and at right angles to this, another across the root of the fingers, and carry the knife along the centre of the middle and forefingers. Reflect the skin, noting in the inner flap the small **palmaris brevis** muscle passing inwards from the outer side of the palmar fascia over the ulnar nerve and artery to the skin at the inner side of the hand, which, on contracting, it draws outwards, and thus deepens the hollow of the palm.

Look for and trace into the palm the small cutaneous branches from the **median** and **ulnar nerves**, and then clean the **palmar fascia**, noting that the strong central triangular portion passes from the annular ligament, where it receives the palmaris longus, to the fingers, to divide into three different sets of fibres.

1. **Longitudinal fibres**, which pass to the skin at the clefts of the fingers.
2. **Transverse fibres**, which form arches in the rudimentary web across the digital vessels and nerves (superficial transverse ligament).
3. **Strong slips**, which are inserted into the sides of the sheaths of the tendons, into the deep transverse ligament of the metacarpal bones, and into the edge of the metacarpal bones.

Reflect the skin from the middle finger and note the sheath of the flexor tendons, strong, except opposite the joints, where it is thin to admit of free movement.

Remove the thin lateral portions of the palmar fascia covering the muscles of the thumb and little finger; detach the central portion from the annular ligament, throwing it forwards so as to expose the median and ulnar nerves, the superficial palmar arch, and the tendons of the flexor sublimis.

B. **The Flexor sublimis digitorum** (perforatus), (Pl. VIII. and XII.).

Origin.—(1) Internal condyle, internal lateral ligament, intermuscular septa,

(2) Inner part of coronoid process (Pl. XIII.), and

(3) From oblique line (Pl. XIII.) and anterior margin of radius.

Insertion into middle phalanges of fingers (Pl. XV.).

Action.—It first bends the second phalanx; next, in virtue of its sheath, when the extensor is inactive, it flexes the first phalanx; and, finally, aids in flexing the wrist and elbow.

Nerve.—Median.

Artery.—Branches from the ulnar.

Note that the flexor sublimis lies under the muscles already examined; that the radial artery crosses its origin from the radius; that on detaching it from the coronoid and condyloid processes it is seen to rest on the flexor pollicis and to be separated from the flexor profundus by the median nerve and ulnar artery.

C. Follow the four tendons through the compartments of the annular ligament—the tendons for the middle and ring fingers lying in front of those for the index and little finger—through the palm, under the superficial palmar arch and median nerve, until they enter the sheath along with the tendons of the deep flexor. Split up the sheath of the middle finger and note its synovial lining, the tendon of the superficial flexor splitting opposite the first phalanx to embrace the deep flexor and be inserted into a ridge at the lateral border of the second phalanx (Pl. XV.). The tendon of the deep flexor is inserted into the base of the terminal phalanx.

D. Follow the **ulnar artery** under all the superficial muscles but the flexor carpi ulnaris, over the brachialis anticus and flexor profundus, until it reaches the space between the tendon of the flexor carpi ulnaris and the innermost tendon of the flexor sublimis, and note that it passes over the annular ligament on the radial side of the pisiform bone to form an arch across the palm, from which branches pass to supply the fingers (Pl. XII. and XIV.).

Note that it is crossed by the median nerve, and that the ulnar nerve,

passing from between the heads of the flexor carpi ulnaris, reaches the artery in the middle of the arm, and accompanies it to the palm.

Examine the branches of the artery.

I. In the **Forearm** (Pl. XIV.).

1. **The Anterior ulnar recurrent,** which passes in front of the condyle to anastomose with the inferior profunda and anastomotic, and give branches to the brachialis and pronator teres.
2. **The Posterior ulnar recurrent,** which passes under the flexor sublimis and behind the inner condyle, between the heads of the flexor carpi ulnaris, to anastomose with the inferior profunda, anastomotic, and interosseous recurrent.
3. **The Interosseous,** which passes towards the interosseous membrane to divide into anterior and posterior branches, to be afterwards examined.
4. **Muscular branches** to the muscles on the inner side of the arm.
5. **Anterior ulnar carpal,** which crosses the carpal bones under the flexor profundus to supply the carpal bones and the wrist-joint and anastomose with the radial carpal.
6. **Posterior ulnar carpal,** which winds to the back of the wrist under the tendon of the flexor carpi ulnaris.

II. In the **Hand.**

Note that the arch begins at the annular ligament and crosses from within, outwards, the special muscles of the little finger, the tendons of the flexor sublimis, the median and ulnar nerves, to join the superficial volar and radial branch to the index finger.

The branches are:—

1. **The Profunda** (Pl. XVI.), which, with a branch of the ulnar nerve, passes between the abductor and short flexor of the little finger to complete the deep palmar arch formed by the radial artery.
2. **Four Digital branches.** The inner branch runs along the ulnar side of the hand and little finger without dividing, but the other three divide near the web of the fingers to supply both sides of the middle and ring fingers, the radial side of the little and the ulnar side of the index finger.

Follow the branches towards the fingers, noting that an offset from the deep arch (radial) joins the inner branch near the middle of the hand, and that each of the other three receives an offset from the radial at its point of bifurcation (Pl. XV.).

The branches to one of the fingers (middle) should be followed to their termination on the last phalanx, over which they freely anastomose and send branches to the ball of the finger and to the nail pulp on the dorsal surface.

E. **The Ulnar Nerve**, already seen entering the forearm between the heads of the flexor carpi ulnaris, should now be followed over the flexor profundus from the middle of the arm, where it reaches the artery to the palm of the hand (Pl. XIV.).

In the **Forearm** look for—

1. Small branches to the elbow-joint.
2. Branches to supply the flexor carpi ulnaris and the half of the flexor profundus: the other half is supplied by the median.
3. The origin of the small cutaneous branch already seen passing to the palm.
4. A dorsal branch, which passes under the tendon of the flexor carpi ulnaris to be distributed to the back of the hand, the little, and half the ring finger.

The ulnar nerve, still at the inner side of the artery, but somewhat deeper, on reaching the annular ligament divides into:—

1. A deep branch which accompanies the profunda artery between the flexor brevis and abductor minimi digiti (Pl. XV.).
2. A superficial branch which sends twigs to the skin and supplies the palmaris brevis and digital branches to—
   (*a*) The inner side of the little finger, and
   (*b*) The outer side of the little and the ulnar side of the ring finger, communicating with a branch of the median.

Note that, like the artery, the inner branch is undivided; that, under the artery in the palm, the nerves are superficial to them along the sides of the fingers; and that, like the artery, they form a network over the ball of the finger. Small offsets from both the arteries and the nerves pass to the joints, the sheaths of the tendons, and form arches over the bones.

F. **The Median Nerve**, already seen passing from the hollow in the front of the arm, between the heads of the pronator teres and the origins of the flexor sublimis, to cross the ulnar artery and lie between the superficial and deep flexors, should now be followed under the annular ligament along with, but superficial to, the flexor tendons into the hand (Pl. XVI.).

Note that in the hand it expands, and then divides into two, and that from the outer of the two divisions

1. A muscular branch passes to supply the abductor opponens and half of the flexor brevis pollicis.
2. A branch to each side of the thumb, the external branch communicating with the radial nerve.
3. A branch to the radial side of the index finger and to the outer lumbrical muscle.

From the inner division

1. A branch passes to supply the adjacent sides of the fore and middle fingers and the second lumbrical.
2. A branch which communicates with the ulnar nerve to supply the contiguous sides of the middle and ring fingers. The branches from the median have the same distribution to the fingers as those of the ulnar. Some of the fine filaments should be followed to the nail pulp on the dorsum of the last phalanx.

Divide the superficial palmar arch below the profunda and at its junction with the superficial volar; and the median nerve below the annular ligament and throw both forward; divide the annular ligament in the middle line and throw the cut-ends outwards and inwards; and after noting that the superficial flexors in the palm are on the same level, and not in pairs, as they were in passing through the annular ligaments, and that they, along with the other flexors, are surrounded by a loose synovial membrane, which extends from the palm into the forearm, divide them above the wrist and throw them downwards, observing the thin slips (vincula and accessoria) they send to the sheaths and the ligamenta brevia passing to the first phalanges.

Examine now the deep muscles.

1. **The Flexor profundus digitorum** (Pl. XIV.).

Origin.—Anterior and inner three-fourths of the ulna, embracing the coronoid process (Pl. XIII.), half of the interosseous ligament,

and along with the flexor carpi ulnaris from the fascia attached to the border of the ulna (Pl. XVII.).

Insertion.—The distal phalanges of the fingers (Pl. XV.).

Action.—After the sublimis has bent the second, the profundus bends the terminal phalanges and then aids the other muscles in flexing the metacarpo-phalangeal and wrist-joints.

Nerve.—Anterior interosseous of median and a branch from the ulnar nerve.

Artery.—Anterior interosseous (ulnar).

Note that the flexor sublimis, flexor carpi ulnaris, and the ulnar vessels and nerves were over the muscle; that it lies on the ulna and pronator quadratus, and is separated from the flexor pollicis by the interosseous vessels and nerves; that the four tendons spring from the muscle near the upper border of the pronator quadratus and pass beneath the annular ligament (the tendon for the index finger being separate from the other three), and, after giving origin to the lumbricales and entering the common sheath of the flexor tendons, they pass between the split tendons of the sublimis to reach the bases of the distal phalanges (Pl. XV.).

2. **The Lumbricales** are four small fleshy slips which *arise* from the deep flexor tendons and pass to the radial side of each finger to be *inserted* on the dorsal surface of the proximal phalanges into the expansion of the extensor tendons (Pl. XX.).

Action.—They bend the metacarpo-phalangeal joints so as to bring the fingers to a right angle with the palm.

Nerves.—The first and second (two outer) arise from a single tendon, and are supplied by the median. The third and fourth arise from the adjacent sides of two tendons and are supplied by the ulnar.

3. **The Flexor longus pollicis.**

Origin.—From anterior surface of the radius (Pl. XIII.), from the outer part of the interosseous membrane, and from the inner side of the coronoid process internal to the insertion of the brachialis anticus.

Insertion.—Terminal phalanx of thumb (Pl. XV.).

Action.—After bending first the distal and then the proximal phalanx of the thumb, it flexes the wrist.

Nerve.—Median.

Artery.—Anterior interosseous (ulnar).

Note that the muscle on its way to the distal phalanx passes under the flexor sublimis and the radial vessels, over the pronator quadratus, beneath the annular ligament, external to the flexor profundus, and between the heads of the flexor brevis. The sheath binding it to the bones, like the sheath of the flexors of the little finger, communicates with the synovial space for the flexor tendons.

Divide the tendons of the deep flexor and throw them forwards (noting the delicate nerves passing from the ulnar to the inner lumbricales), so as better to expose the special muscles of the thumb and little finger, the deep palmar arch, a branch from the ulnar nerve, and the interosseous muscles.

Clean and define the muscles of the thumb.

1. **The Abductor pollicis** (Pl. XVI.).

Origin.—From upper part of annular ligament and from ridge of os trapezium (Pl. XV.).

Insertion into base of first phalanx of thumb near the insertion of the outer half of the flexor brevis.

Action.—Draws the thumb from the fingers and assists in bending the metacarpo-phalangeal joint.

Note that it rests on the opponens pollicis, and observe whether it receives a slip from the extensor ossis metacarpi pollicis.

2. **Opponens pollicis** (Pl. XVI.).

Origin.—From the annular ligament, the os trapezium (Pl. XV.), and its ridge.

Insertion into an elliptical surface at the outer border of the metacarpal bone (Pl. XV.).

Action.—Draws the metacarpal bone backwards and inwards across the palm.

Note that the opponens has the flexor brevis at its inner side, and that it slightly projects beyond the abductor on the outer side.

3. **Flexor brevis pollicis** (Pl. XVI.).

Origin.—Lower part of annular ligament, from the ligament over

the os trapezoides, from the os magnum, and the bases of the second and third metacarpal bones.

Insertion.—By two heads into the base of the first phalanx; the outer along with the abductor and the inner along with the adductor, the tendon of the long flexor lying between them; a sesamoid bone will be found in each tendon (Pl. XV.).

Action.—Flexes the thumb at the metacarpo-phalangeal joint and assists in drawing it forwards and inwards.

Note the deep palmar arch passing under the inner head to reach the palm and the long flexor crossing it.

4. **Adductor pollicis** (Pl. XVI.).

Origin.—Anterior surface of middle metacarpal bone (Pl. XV.).

Insertion.—Along with short flexor into inner side of first phalanx (Pl. XV.).

Action.—Draws abducted thumb to outer side of index finger.

Note that it crosses the first palmar and first and second dorsal interossei muscles and the second and third metacarpal bones, and that it is crossed by the deep flexors and lumbricales, the digital vessels, and nerves.

The muscles of the little finger:—

1. **Abductor minimi digiti** (Pl. XVI.).

Origin.—Pisiform bone and tendon of flexor carpi ulnaris (Pl. XV.).

Insertion.—Inner side of base of first phalanx (Pl. XV.).

Action.—It first draws the little finger from the others, and then flexes the metacarpo-phalangeal joint.

Note that it is partly concealed by the palmaris brevis.

2. **Flexor brevis minimi digiti** (Pl. XVI.).

Origin.—From tip of unciform process and annular ligament (Pl. XV.).

Insertion.—Along with abductor into base of first phalanx (Pl. XV.).

Action.—Carries first phalanx towards thumb and flexes metacarpo-phalangeal joint.

Note that it is separated from the abductor by the deep branches of the ulnar nerve and artery.

3. **Opponens minimi digiti** (Pl. XVI.).

Origin.—From unciform process and lower part of annular ligament.

Insertion into inner margin of shaft of first metacarpal bone (Pl. XV.).

Action.—It corresponds to the opponens pollicis. By drawing the first metacarpal bone in front of the second it helps to deepen the palm of the hand.

Note that this triangular-shaped muscle lies under the flexor and abductor, and has passing under it the profunda branch of the ulnar nerve and artery.

Nerves.—The abductor and opponens pollicis and the outer half of the flexor brevis pollicis are supplied by the median, the other half of the flexor brevis pollicis by the ulnar. All the short muscles of the little finger are supplied by the deep branch of the ulnar nerve.

Arteries.—The **radial artery** has already been seen to wind below the radius to the back of the hand. Note that it lies on the external lateral ligament as it passes under, first, the extensor ossis metacarpi and extensor primi internodi, and next the extensor secundi (Pl. XX.), in order to reach the first interosseous space, where it disappears between the origins of the first dorsal interosseous muscle to reach the palm.

The dorsal-carpal branch and the branches to the thumb and index finger will be afterwards examined. Turn the palm of the hand again upwards to reflect the flexor brevis pollicis and look for the radial artery entering the palm to form the deep palmar arch and communicate with the profunda branch of the ulnar at the base of the first metacarpal bone.

On entering the palm the artery gives off:—

1. A branch to the thumb (princeps pollicis), (Pl. XVI.), which runs along the metacarpal bone to divide between the insertions of the short flexor and be distributed like the branches to the fingers from the superficial arch.
2. A branch (radialis indicis) which runs along the abductor indicis (first dorsal interosseous) under the short flexor and adductor pollicis to the radial side of the forefinger. Note that it communicates with the superficial arch over the abductor indicis and at the tip of the finger.

From the slightly convex distal side of the arch :—

1. Three branches (palmar interosseous arteries) arise and run along the three palmar interosseous muscles to join the digital branches of the superficial arch. They supply the interossei and the inner lumbricales.
2. Three perforating arteries pierce the three inner dorsal interossei to join the interossei branches from the radial on the back of the hand.
3. Recurrent branches from the concavity of the arch pass to supply the carpal bones and anastomose with the carpal arteries.

Follow now the deep branch of the **ulnar nerve** between the flexor and abductor minimi digiti obliquely across the metacarpal bones and trace its branches to all the interossei, the two inner lumbricales, the adductor, and half of the flexor brevis pollicis (Pl. XVI.).

Note—1. The attachments of the annular ligament to the unciform and pisiform bones internally, and to the scaphoid and trapezium externally; that it was connected with the fascia of the forearm above and with the palmar fascia below, and crossed by the palmaris longus and ulnar artery and nerve. The anterior annular ligament binds down and serves as a guide for the flexor tendons.

2. The ligament connecting the heads of the metacarpal bones (transverse metacarpal ligament) lying over the interossei muscles.
3. The tendon of the flexor carpi radialis passing through the groove of the os trapezium to be attached to the base of the metacarpal bone of the index and slightly to the base of the metacarpal bone of the middle finger (Pl. XV.).

The palmar interossei will be examined along with the dorsal interossei after the muscles on the back of the arm have been dissected.

In this section the dissector has examined :—

1. The **Palmar fascia** and its prolongations.
2. The **Flexor sublimis digitorum**, supplied by the median nerve and the **Ulnar Artery**.
3. The **Ulnar Artery**, its branches in the fore-arm and in the hand.

4. The **Ulnar and Median Nerves** and their branches.
5. The **Flexor profundus digitorum**, supplied by the anterior interosseous artery and nerve, and branch from the ulnar nerve.
6. The **Lumbricales Muscles**, the two outer supplied by the median, the two inner by the ulnar nerve.
7. The **Flexor longus pollicis**, supplied by the median nerve and anterior interosseous artery.
8. The **Abductor opponens**, and outer half of the **Flexor brevis pollicis**, supplied by the median nerve. The other half of the flexor brevis pollicis, and all the muscles of the little fingers, supplied by the ulnar nerve.
9. The **Radial Artery** supplying the thumb and index finger, and forming the deep palmar arch.
10. The **Deep branch** of the ulnar nerve; and
11. The **Insertion** of the tendon of the flexor carpi radialis.

SECTION VII.

THE BACK OF THE FOREARM.

The back of the hand uppermost, place a small block under the wrist and look for the cutaneous nerves.

1. The continuation of the musculo-spiral, internal, and musculo-cutaneous nerves, along the sides of the arm.

2. The radial nerve (musculo-spiral), which has already been seen in the forearm, external to the radial artery. Trace it from under the supinator longus to the back of the arm, where, about three inches above the wrist, it becomes cutaneous at the posterior border of the tendon of the supinator longus and divides into two branches:—

   (1) An outer, which communicates with the musculo-cutaneous and passes to the radial border of the thumb.

   (2) An inner, which passes to the ulnar side of the thumb, both sides of the index and middle fingers, and to the radial side of the ring finger, communicating with the ulnar and musculo-cutaneous nerves. Observe that the ulnar nerve supplies both palmar and dorsal aspects of the $1\frac{1}{2}$ inner fingers, and that the median corresponds to the radial and supplies the palmar aspect of the thumb and $2\frac{1}{2}$ outer fingers.

The dorsal branch of the ulnar nerve should be looked for, piercing the fascia to reach the back of the hand over the styloid process of the ulna.

Reflect the skin from the fingers and all the fascia from the arm, except the strong band (posterior annular ligament) stretching from the radius across the ulna to the cuneiform and pisiform bones, and then examine the supinator and extensor muscles.

A. **THE SUPERFICIAL MUSCLES** which arise from the external condyle or condylar ridge, are the supinator longus, the extensor carpi radialis longior and brevior, the extensor communis digitorum and extensor minimi digiti, the extensor carpi ulnaris, and the anconeus.

1. **The Supinator longus** (Pl. XII.).

Origin.—The upper two-thirds of the outer condylar ridge (Pl. VIII.) and the front of the intermuscular septum.

Insertion into the radius immediately above the styloid process (Pl. XIII.).

Action.—It first draws the hand into a position midway between pronation and supination, and then forcibly bends the elbow.

Nerve.—A branch from the musculo-spiral.

Artery.—Superior profunda, and recurrent branches.

Note the relation of the supinator to the triceps, to the extensors, and biceps, to the hollow in front of the elbow and the pronator teres; that it lies against the humerus, concealing the musculo-spiral nerve, superior profunda artery, and brachialis anticus muscle; and that in the forearm it partly covers the radial nerve and artery, and is crossed by the special extensors of the thumb.

2. **The Extensor carpi radialis longior** (Pl. XVIII.).

Origin.—The lower third of outer condylar ridge, the external intermuscular septum, and the fascia between it and the brevior (Pl. VIII.).

Insertion into base of metacarpal bone of index finger (Pl. XX.).

Action.—It is a radial extensor of the hand and a flexor of the elbow.

Nerve.—A branch from the musculo-spiral.

Arteries.—Recurrent and posterior interosseous.

Note that the radial artery lies along its outer border, and that after passing obliquely beneath two extensors of the thumb, and along with the brevior under the annular ligament (Pl. XX.), the tendon is crossed by the third extensor of the thumb.

3. **The Extensor carpi radialis brevior** (Pl. XIX.).

Origin.—The outer condyle, along with the extensors of the fingers and the ulnar extensor of the wrist, the external lateral ligament, intermuscular septa, and the fascia covering it.

Insertion into the base of the third metacarpal bone (Pl. XX.).

Action.—It is a radial extensor of the wrist, and it aids in extending the elbow.

Nerve.—Posterior interosseous (musculo-spiral).

Artery.—Branches of the posterior interosseous (ulnar).

Note that it is partly concealed by the supinator and extensor longior, that it rests on the supinator brevis and pronator teres, and that its tendon is crossed by the extensors of the thumb, which appear from under the common extensor.

4. **Extensor communis digitorum** (Pl. XVIII.).

Origin.—Like extensor brevior, from outer condyle, intermuscular septa, and fascia (Pl. VIII.).

Insertion.—Each of the four tendons expands over the base of the first phalanx and is joined by the tendons of the lumbricales and interossei muscles. From this expansion

(1) Lateral slips pass to the base of the first phalanx;

(2) A thin central slip passes to the base of the second phalanx;

(3) Strong lateral slips run along the sides of the first to meet and form an expansion over the second and be inserted into the base of the third phalanx (Pl. XX.).

Action.—The wrist fixed by the flexors, the extensor extends and aids the interossei in separating the fingers; it can extend the first when the second and third phalanges are bent, or the second and third when the first is bent. The fingers fixed, it aids in extending the wrist and elbow.

Nerve.—Posterior interosseous.

Artery.—Posterior interosseous.

Note that it lies between the radial extensors and the extensor of the little finger, that it rests on the deep extensors, and has the extensors of the thumb appearing between it and the extensor brevior; that it first divides into three tendons and passes through the fourth compartment of the annular ligament along with the special extensor of the index finger. The inner division again divides, and the four tendons radiate towards the fingers, the three inner ones being connected by cross slips, so that the ring finger cannot be extended while the others are flexed.

5. **Extensor minimi digiti** has the same origin as, and may be considered

a part of, the communis. It passes through a separate division (the fifth, between the radius and ulna) of the annular ligament, and divides into two slips, which join the common expansion over the little finger.

Note its relations and the small branch of the posterior interosseous nerve passing to it.

6. **Extensor carpi ulnaris** (Pl. XVIII.).

Origin.—Outer condyle, septa, and fascia, and from the aponeurosis attached to the ulnar ridge.

Insertion into the base of the metacarpal bone of the little finger (Pl. XX.).

Action.—It is an ulnar extensor of the hand. The hand fixed, it extends the elbow.

Nerve and Artery.—Posterior interosseous.

Note that this is the most internal muscle, that the fleshy fibres extend to near the annular ligament, and that its tendon passes through the sixth division of the ligament, behind the styloid process of the ulna.

7. **The Anconeus** (Pl. XVIII.).

Origin.—From the posterior aspect of the outer condyle (Pl. X.).

Insertion into the outer side of the olecranon and into the impression on the upper third of the posterior surface of the ulna (Pl. XVII.).

Action.—Assists the triceps in extending the elbow, or, if the ulna is fixed, it draws back the humerus.

Nerve.—Musculo-spiral.

Artery.—Superior profunda.

Note that its upper fibres are parallel to the triceps, and that under it are the recurrent vessels and the supinator brevis muscle.

B. Reflect the extensor carpi ulnaris and the extensors of the fingers, and clean the muscles forming the deep layer, viz. the supinator brevis, the special extensor of the index finger, and the three extensors of the thumb.

1. **The Supinator brevis** (Pl. XIX.).

Origin.—External condyle, external lateral ligament, orbicular ligament, the depression below the lesser sigmoid cavity, and two inches of the adjacent margin of the ulna.

Insertion into the posterior and outer aspect of the radius above the insertion of the pronator teres (Pl. XVII.).

Action.—Carries the radius from lying obliquely over to lie parallel to the ulna.

Nerve.—The posterior interosseous nerve (musculo-spiral) which pierces the muscle.

Artery.—Branch from the interosseous recurrent

Note that the supinator passes obliquely outwards under the superficial muscles to envelop the outer two-thirds of the radius, and in front to be crossed by the radial vessels and nerves.

Note that the posterior interosseous nerve pierces it, entering under a tendinous arch, and that the posterior interosseous artery passes between its lower border and the extensor ossis metacarpi. In the further dissection be careful to preserve the branches of the posterior interosseous nerve and artery (Pl. XIX.).

2. **The Extensor ossis metacarpi pollicis** arises from both radius and ulna (Pl. XIX.).

Origin.—From posterior surface of radius (Pl. XVII.), and from upper and outer part of posterior surface of ulna, between the anconeus and extensor secundi, also from the interosseous membrane.

Insertion into base of metacarpal bone of thumb and by a slip into the trapezium (Pl. XX.).

Observe that, separated from the supinator brevis above by the posterior interosseous artery, it passes obliquely downwards over the radius to the outer division of the annular ligament; that it becomes cutaneous at the lower third of the radius by appearing between the common extensor and the extensors of the wrist; and that the radial artery passes over the carpus under its tendon.

3. **Extensor primi internodii pollicis** (Pl. XIX.).

Origin.—From two inches of the radius below the extensor ossis, and from the adjacent interosseous membrane (Pl. XVII.).

Insertion into the base of the first phalanx of the thumb (Pl. XX.).

Note that the tendon of this muscle lies at the inner side of the tendon of the extensor ossis and passes through the same compartment of the annular ligament, crossing the tendons of the radial extensors and the radial artery, and near its insertion coming into contact with the extensor secundi.

4. **Extensor secundi internodii pollicis** (Pl. XIX.).

Origin.—The posterior surface of the ulna and the interosseous membrane between the extensor ossis and the extensor indicis (Pl. XVII.).

Insertion into the base of the first phalanx of the thumb (Pl. XX.).

Note that the muscle appears between the common extensor and the extensor primi to pass obliquely over the end of the radius through a separate compartment of the annular ligament.

Actions.—The extensor of the metacarpal bone draws the thumb away from the palm and then extends the wrist.

The extensor primi extends the first phalanx, the extensor secundi the second, and they then together act as radial extensors of the wrist.

5. **The Extensor indicis** (Pl. XIX.).

Origin.—Posterior surface of ulna and interosseous membrane below and internal to the extensor secundi (Pl. XVII.).

Insertion into the tendinous expansion on back of first phalanx of forefinger.

Action.—Aids common extensor in extending the forefinger, but can act independently and extend the index finger when the others are flexed.

Note that it accompanies the common extensor through the fourth division of the annular ligament, and that it is concealed by it as far as the annular ligament.

Nerves and Vessels.—The extensors of the thumb and the special extensor of the forefinger are supplied by the interosseous nerve and artery.

The Interosseous Nerve should now be traced from the division of the **musculo-spiral** over the outer condyle through the substance of the supinator brevis, over the deep muscles, to the middle of the forearm, where it passes under the extensor secundi to run along the interosseous membrane to the wrist-joint and its ligaments. It generally enlarges as it approaches the joint before dividing into its terminal branches (Pl. XIX.).

The Posterior Interosseous Nerve has already been seen to supply all the deep muscles and all of the superficial muscles except the supinator longus, extensor carpi radialis longior, and anconeus: these being supplied by branches from the musculo-spiral.

The Posterior Interosseous Artery should next be traced from the interosseous branch of the ulnar between the supinator brevis and extensor ossis metacarpi over the deep muscles, until it reaches the tendon of the extensor carpi ulnaris, which it accompanies to the wrist (Pl. XIX.).

Note 1. That it anastomoses with the anterior interosseous artery and the posterior carpal arteries at the wrist.

2. That it supplies branches to all the extensor muscles.

3. That it sends a recurrent branch towards the elbow under the anconeus, but over or through the supinator, to anastomose with the superior profunda and recurrent radial and send branches to the joint (Pl. XIX.).

Examine again the dorsal part of the **Radial Artery** (Pl. XX.), and note passing from it the posterior carpal branch across the back of the wrist to form an arch with the carpal branch from the ulnar artery, and anastomose with the anterior and posterior interosseous arteries. Trace from this arch

1. Branches to the third and fourth interosseous spaces (dorsal interosseous arteries), which communicate with the perforating digital arteries and with branches from the palmar arch.

2. A branch to the second interosseous space (first dorsal interosseous or metacarpal), which communicates with the perforating and digital arteries and ends on the dorsum of the fore and middle fingers.

3. A branch to the radial side of the index finger (dorsalis indicis).

4. Two branches to the thumb, one running along each side of the metacarpal bone.

Expose the tendons as they pass through the divisions of the posterior annular ligament, and compare them with the tendons indicated in Pl. XX., noting the six compartments and the tendons passing through them.

C. THE INTEROSSEOUS MUSCLES.

The Palmar interossei should be first examined. They, **three** in number, arise from the metacarpal bones of the fore, ring, and little fingers (Pl. XV.), and pass to the bases of the first phalanges of the same fingers and to the dorsal expansion formed by the

extensor tendons. On contracting, they **adduct** the fingers, i.e. draw them towards the middle finger.

The Dorsal interossei, **four** in number, arise from the adjacent sides of the metacarpal bones, and are so inserted that they act as abductors of the fingers. The first, arising from the metacarpal bones of the thumb and index finger, is inserted into the radial side of the base of the first phalanx of the forefinger. The second and third are inserted into the radial and ulnar sides of the middle finger; and the fourth into the ulnar side of the ring finger. If it be remembered that the palmar draw the fore, ring, and little fingers towards an imaginary line passing through the middle finger, and that the dorsal draw the fore, middle, and ring from the same imaginary line, their arrangement will be easily remembered.

Follow the radial artery into the palm between the two heads of the first dorsal or abductor indicis, and note its relation to the adductor pollicis.

The interosseous muscles are supplied by the deep branch of the ulnar nerve and by perforating branches of the palmar arch.

D. THE ELBOW JOINT.

Note the limited movement of this, a hinge joint, the structures which are immediately in connection with it, and that the capsule concealing the articular surfaces is made up of a thin anterior portion passing from above the coronoid fossa to the coronoid process and orbicular ligament; a loose posterior portion attached above the olecranon fossa and to the olecranon process; an internal lateral of a triangular form passing from the condyle to the margins of the coronoid and olecranon processes; an external lateral passing from the outer condyle to the orbicular ligament.

Open this capsule, and note that the synovial membrane lining it is continuous with the synovial membrane between the head of the radius and the lesser sigmoid cavity.

E. LIGAMENTS OF THE RADIUS AND ULNA.

1. Remove the external lateral ligament and observe the orbicular ligament passing from the lesser sigmoid cavity to embrace the neck of the radius.

2. Passing obliquely downwards from the radius to the ulna, the interosseous membrane, a space being left above and below for the interosseous arteries, sometimes the upper space is divided by a round ligament passing upwards from the radius to the ulna.

3. Between the lower ends of the radius and ulna, anterior and posterior ligaments, and between these a triangular articular fibro-cartilage.

F. LIGAMENTS OF THE WRIST AND HAND.

Connecting the radius to the first row of carpal bones, note anterior and posterior, internal and external lateral ligaments: connecting the carpal bones, vertical and transverse, dorsal and palmar, and lateral ligaments: and between the second row of carpal bones and the four inner metacarpal bones transverse dorsal and palmar and interosseous ligaments. The first metacarpal bone will be found to be connected with the trapezium by a capsular ligament.

Between the metacarpus and phalanges and the different phalanges are anterior, posterior, and lateral ligaments.

In order to understand the synovial membranes of the wrist, make a vertical section through the lower end of the radius and ulna, the carpal, and the ends of the metacarpal bones, and note that there are five synovial membranes:—

1. One between the radius and ulna.
2. One between the radius and triangular cartilage above, and the first row of the carpus below.
3. One between the first and second rows of carpal bones, between the lateral surfaces of the carpal bones, and between the carpal bones and the ends of the four inner metacarpal bones.
4. One between the pisiform and cuneiform.
5. One between the metacarpal bone of the thumb and the trapezium.

In the section note the interosseous ligaments between the carpal bones and between the four inner metacarpal bones.

In this the last section the following structures have been examined:—

1. The **Cutaneous nerves** on the back of the forearm.
2. The **Supinator longus**, supplied by the musculo-spiral nerve and the superior profunda and recurrent arteries.

3. The **Extensor carpi radialis longior**, supplied by the musculo-spiral nerve, the posterior interosseous and recurrent arteries.
4. The **Extensor carpi radialis brevior**, the **Extensor communis digitorum**, the **Extensor minimi digiti**, and the **Extensor carpi ulnaris**, supplied by the posterior interosseous nerve and artery.
5. The **Anconeus**, supplied by the musculo-spiral nerve and superior profunda artery.
6. The **Supinator brevis** supplied by the posterior interosseous nerve and interosseous recurrent artery.
7. The **Extensors** of the thumb and index finger, supplied by the interosseous nerve and artery.
8. The **Posterior interosseous nerve** (musculo-spiral), piercing the supinator brevis and reaching as far as the wrist-joint.
9. The **Posterior interosseous artery** (ulnar), passing between the supinator brevis and extensor ossis metacarpi, to end at the posterior carpal arch.
10. The **Dorsal** branches of the radial artery.
11. The **Interosseous muscles** supplied by the profunda branch of the ulnar nerve, and by branches from the deep palmar arch, the three palmar along with the adductor pollicis drawing little, ring, forefinger, and thumb towards the middle line (an imaginary line running through the middle finger): the four dorsal along with the abductor pollicis, and the abductor minimi digiti drawing the fore, middle, ring, thumb, and little finger away from the middle line. The interossei, together with the lumbricales, flex the metacarpo-phalangeal joints, and by acting on the extensor tendons they extend the middle and terminal phalanges.
12. The **Ligaments** of the elbow-joint, of the radius and ulna, and of the wrist and hand.

Plate I.

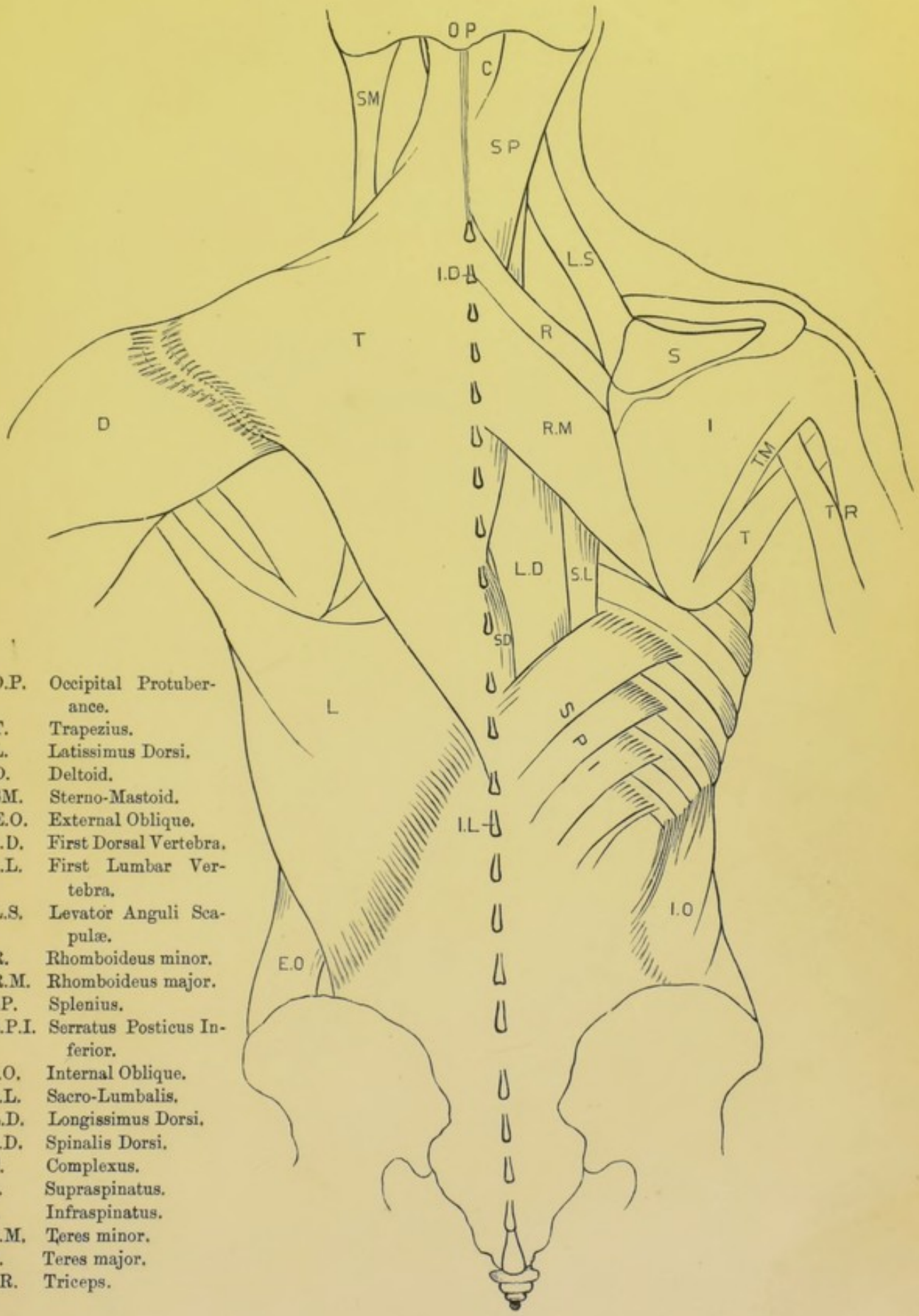
RIGHT CLAVICLE, FROM ABOVE.

RIGHT SCAPULA, FROM BEHIND.

Plate II.

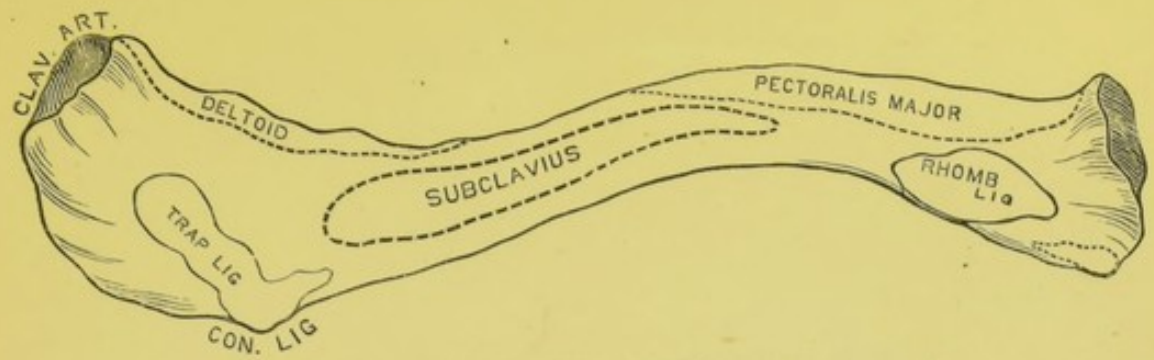
MUSCLES CONNECTING THE UPPER LIMB WITH THE TRUNK POSTERIORLY.

Fill in cutaneous nerves on the left side, and the nerves and vessels supplying the muscles passing from the trunk to the shoulder girdle on the right side.

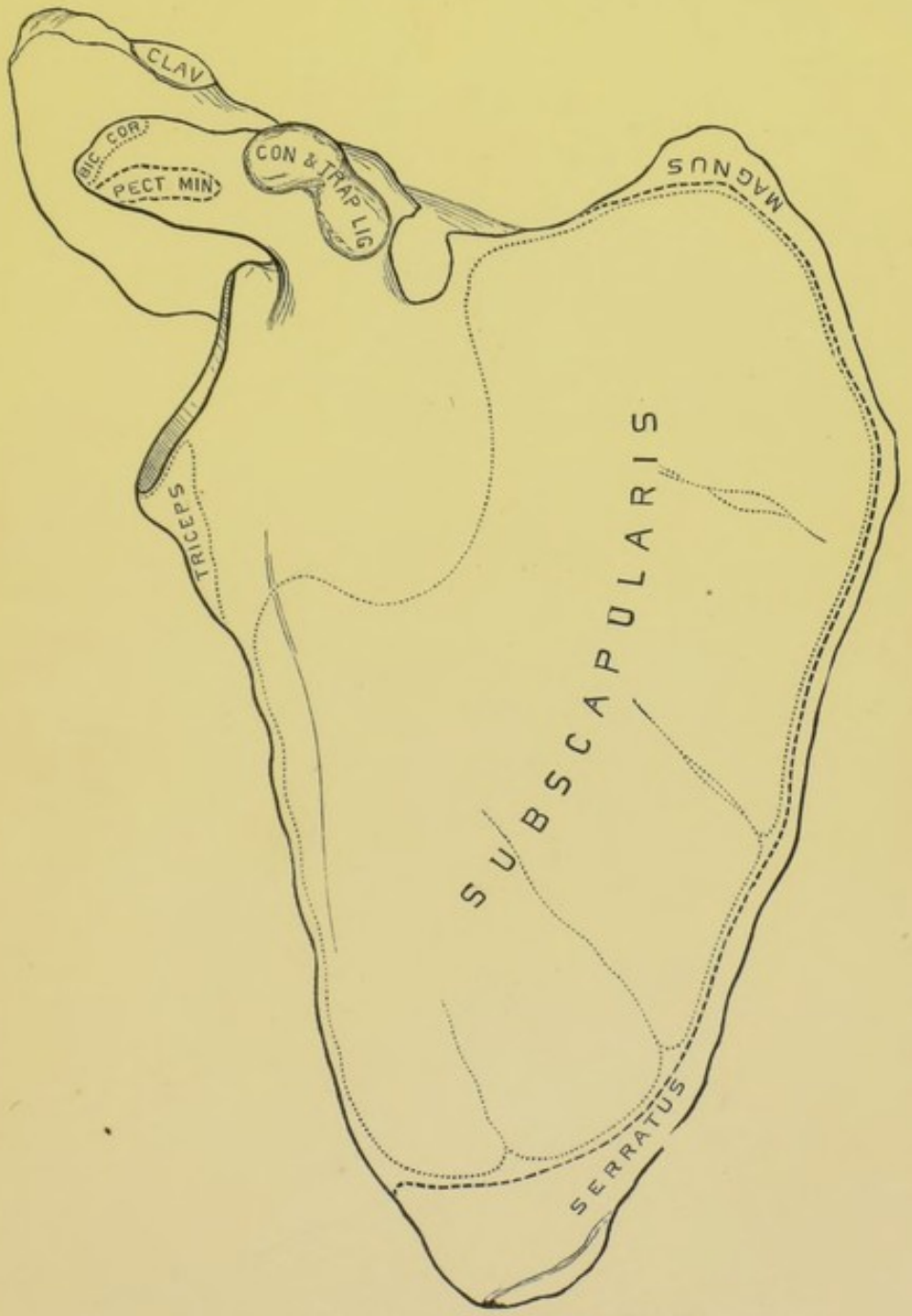


O.P. Occipital Protuberance.
T. Trapezius.
L. Latissimus Dorsi.
D. Deltoid.
SM. Sterno-Mastoid.
E.O. External Oblique.
1.D. First Dorsal Vertebra.
1.L. First Lumbar Vertebra.
L.S. Levator Anguli Scapulæ.
R. Rhomboideus minor.
R.M. Rhomboideus major.
SP. Splenius.
S.P.I. Serratus Posticus Inferior.
I.O. Internal Oblique.
S.L. Sacro-Lumbalis.
L.D. Longissimus Dorsi.
S.D. Spinalis Dorsi.
C. Complexus.
S. Supraspinatus.
I. Infraspinatus.
T.M. Teres minor.
T. Teres major.
TR. Triceps.

Plate III.



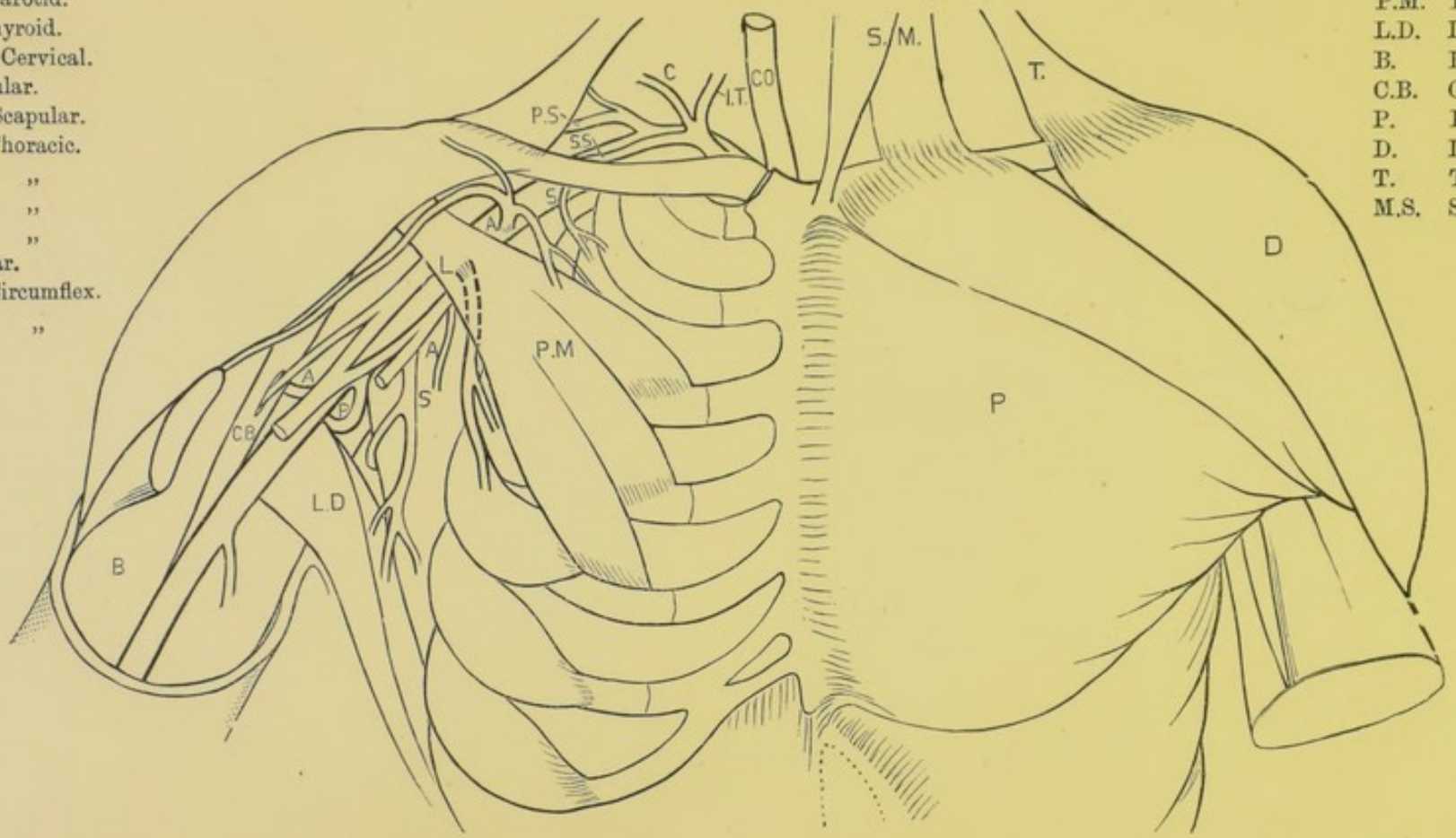
RIGHT CLAVICLE, FROM BELOW.



RIGHT SCAPULA, FROM BEFORE.

Complete and name the branches of the axillary artery.

C.O. Common Carotid.
I.T. Inferior Thyroid.
C. Ascending Cervical.
SS. Suprascapular.
P.S. Posterior Scapular.
S. Superior Thoracic.
A. Acromial ,,
L. Long ,,
A. Alar ,,
S. Subscapular.
A. Anterior Circumflex.
P. Posterior ,,

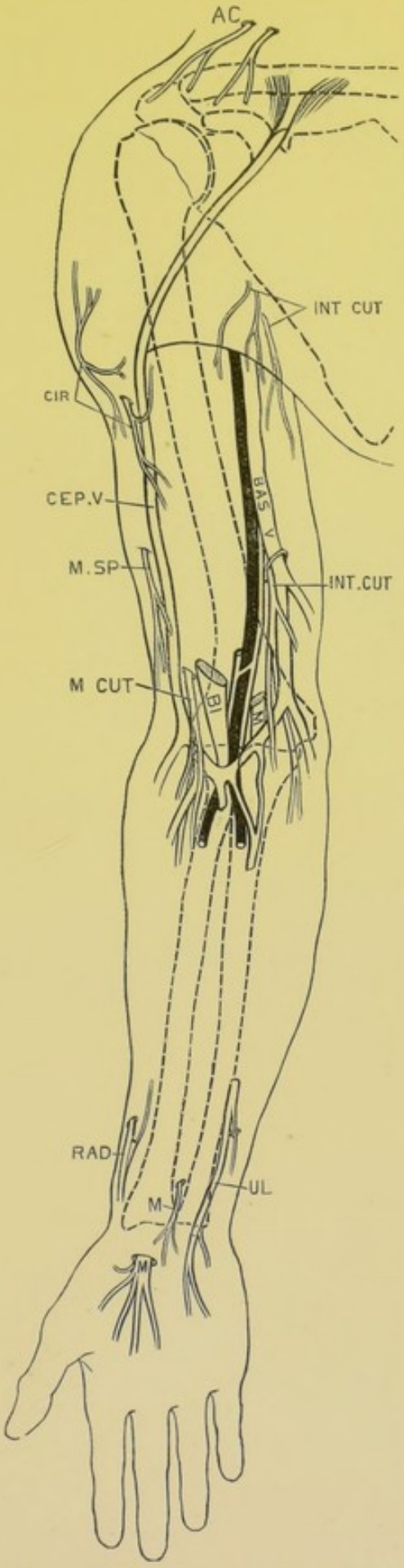


P.M. Pectoralis minor.
L.D. Latissimus Dorsi.
B. Biceps.
C.B. Coraco-Brachialis.
P. Pectoralis major.
D. Deltoid.
T. Trapezius.
M.S. Sterno-Mastoid.

Plate IV.

Plate V.

The vessels and nerves of the forearm and hand to be filled in from the dissection.

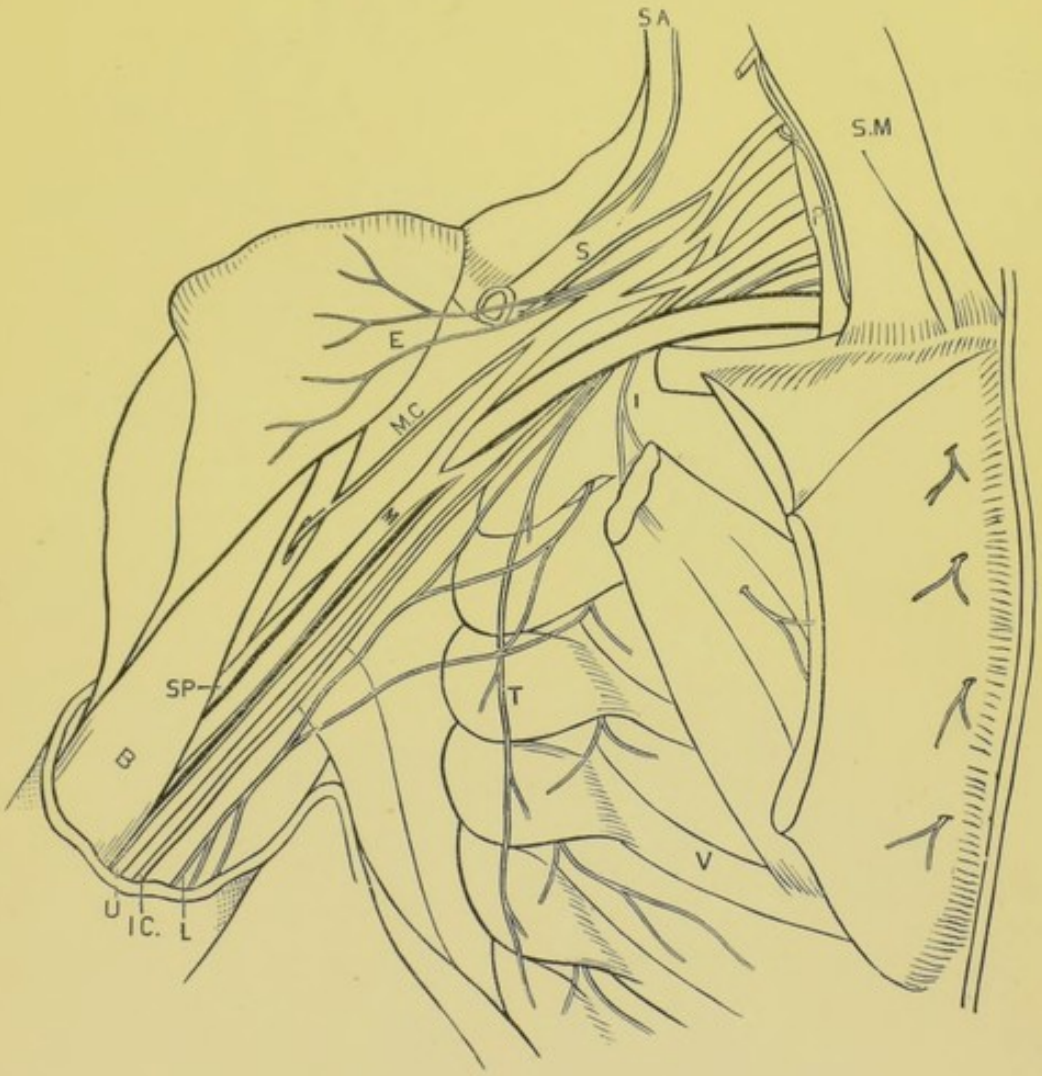


This Plate is especially intended for the superficial veins and nerves, and may be referred to when studying the surgical anatomy of the arm.

Plate VI.

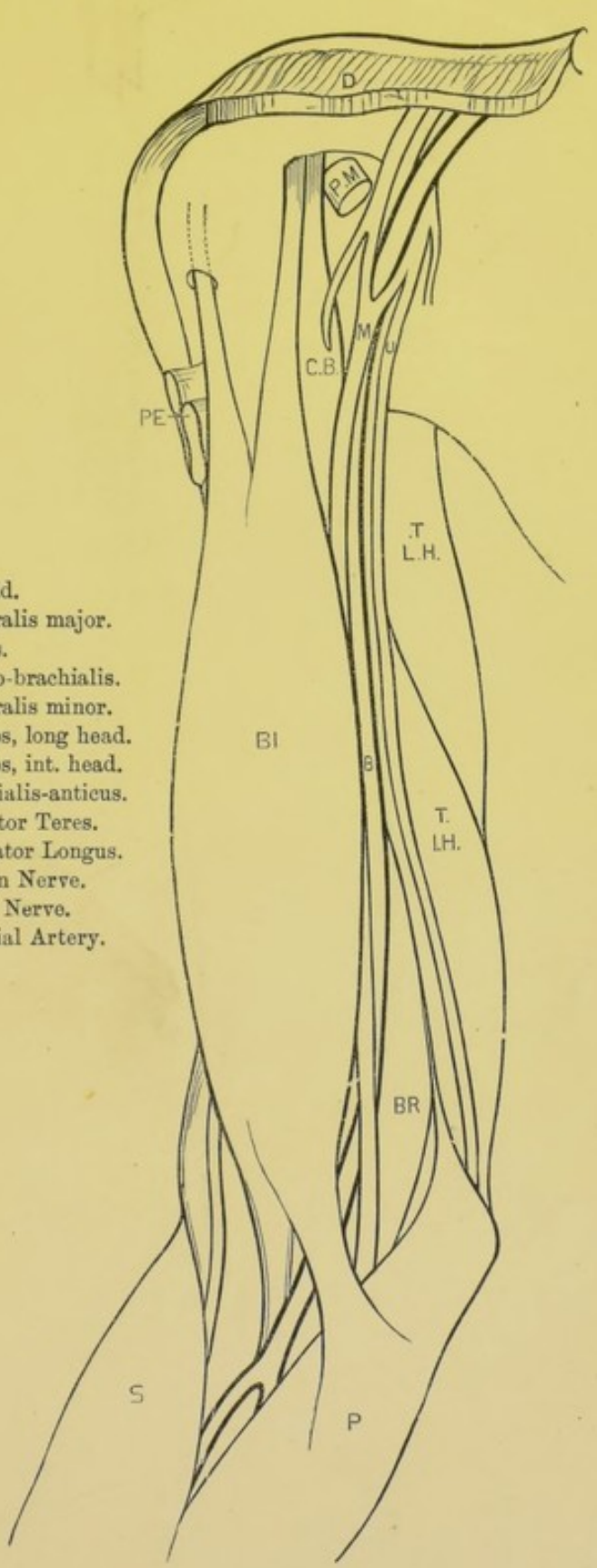
BRACHIAL PLEXUS.

Make a diagram of the brachial plexus from the dissection.



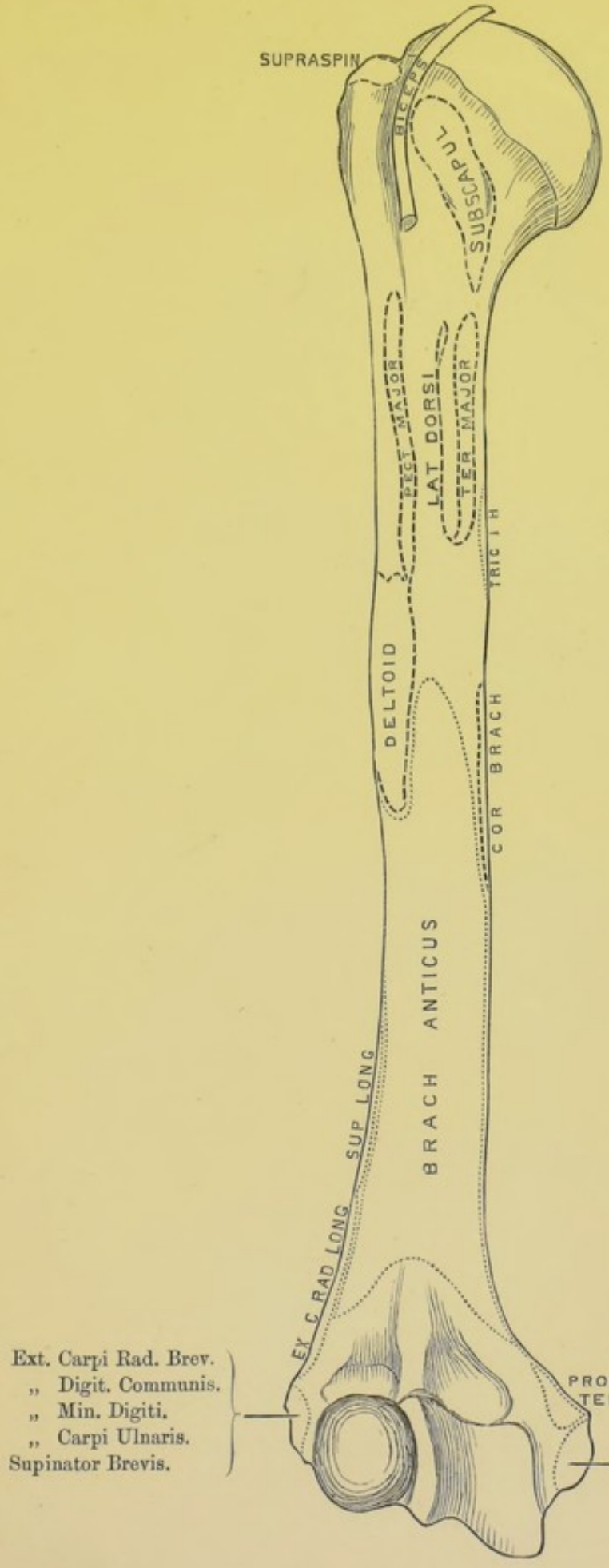
S.A.	Spinal Accessory.	U.	Ulnar.
S.	Suprascapular.	I.C.	Internal Cutaneous.
P.	Phrenic.	L.	Lesser Internal Cutaneous.
E.	External Thoracic.	T.	Posterior Thoracic.
I.	Internal ,,	S.M.	Sterno-Mastoid.
M.C.	Musculo-cutaneous.	B.	Biceps.
M.	Median.	V.	Fifth Rib.
SP.	Musculo-spiral.		

Plate VII.



D. Deltoid.
P.E. Pectoralis major.
BI. Biceps.
C.B. Coraco-brachialis.
P.M. Pectoralis minor.
T.L.H. Triceps, long head.
T.I.H. Triceps, int. head.
BR. Brachialis-anticus.
P. Pronator Teres.
S. Supinator Longus.
M. Median Nerve.
U. Ulnar Nerve.
B. Brachial Artery.

Plate VIII.

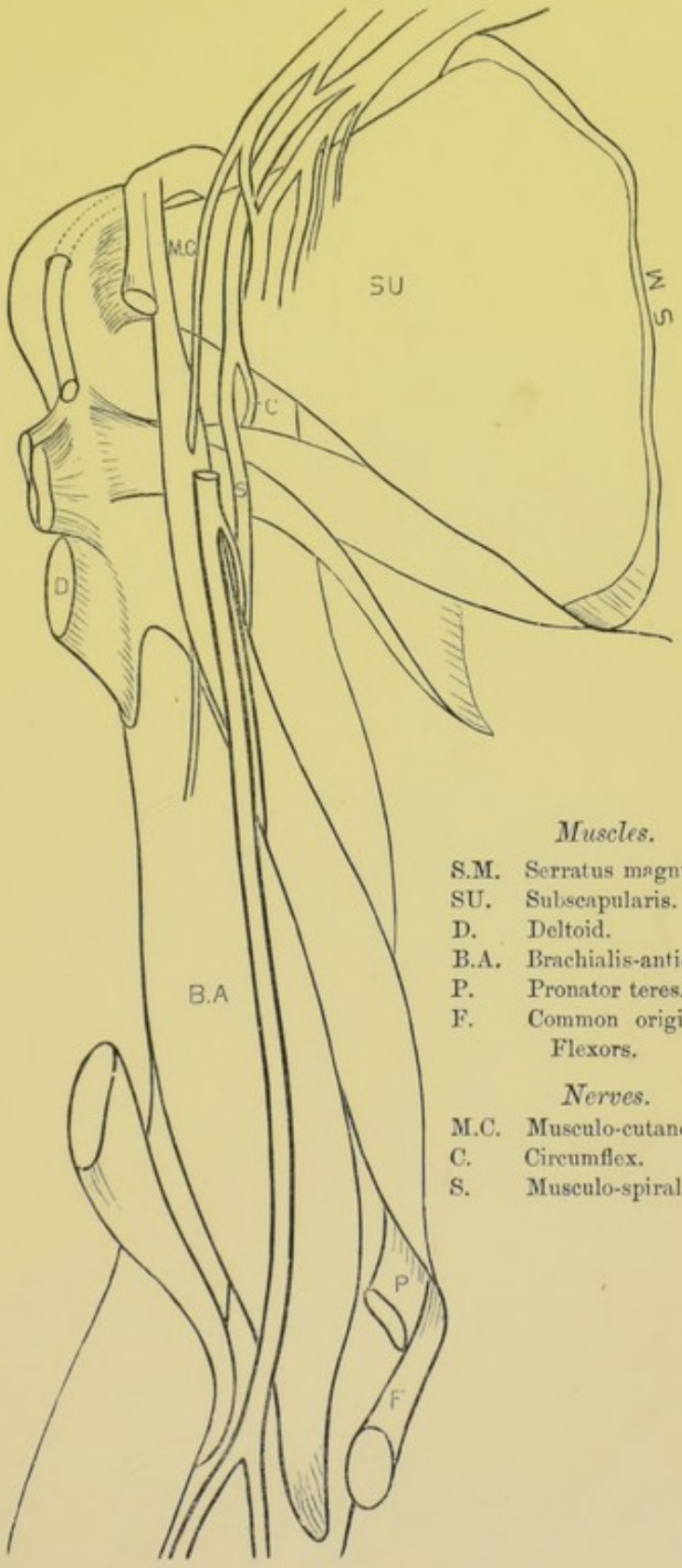


Ext. Carpi Rad. Brev.
„ Digit. Communis.
„ Min. Digiti.
„ Carpi Ulnaris.
Supinator Brevis.

Flex. Carpi Radialis.
Palmaris Longus.
Flex. Digit. Sublimis.
„ Carpi Ulnaris.

Plate IX.

Fill in from the dissection the musculo-cutaneous and musculo-spiral nerves and the superior profunda artery.



Muscles.

S.M. Serratus magnus.
SU. Subscapularis.
D. Deltoid.
B.A. Brachialis-anticus.
P. Pronator teres.
F. Common origin of Flexors.

Nerves.

M.C. Musculo-cutaneous.
C. Circumflex.
S. Musculo-spiral.

Plate X.

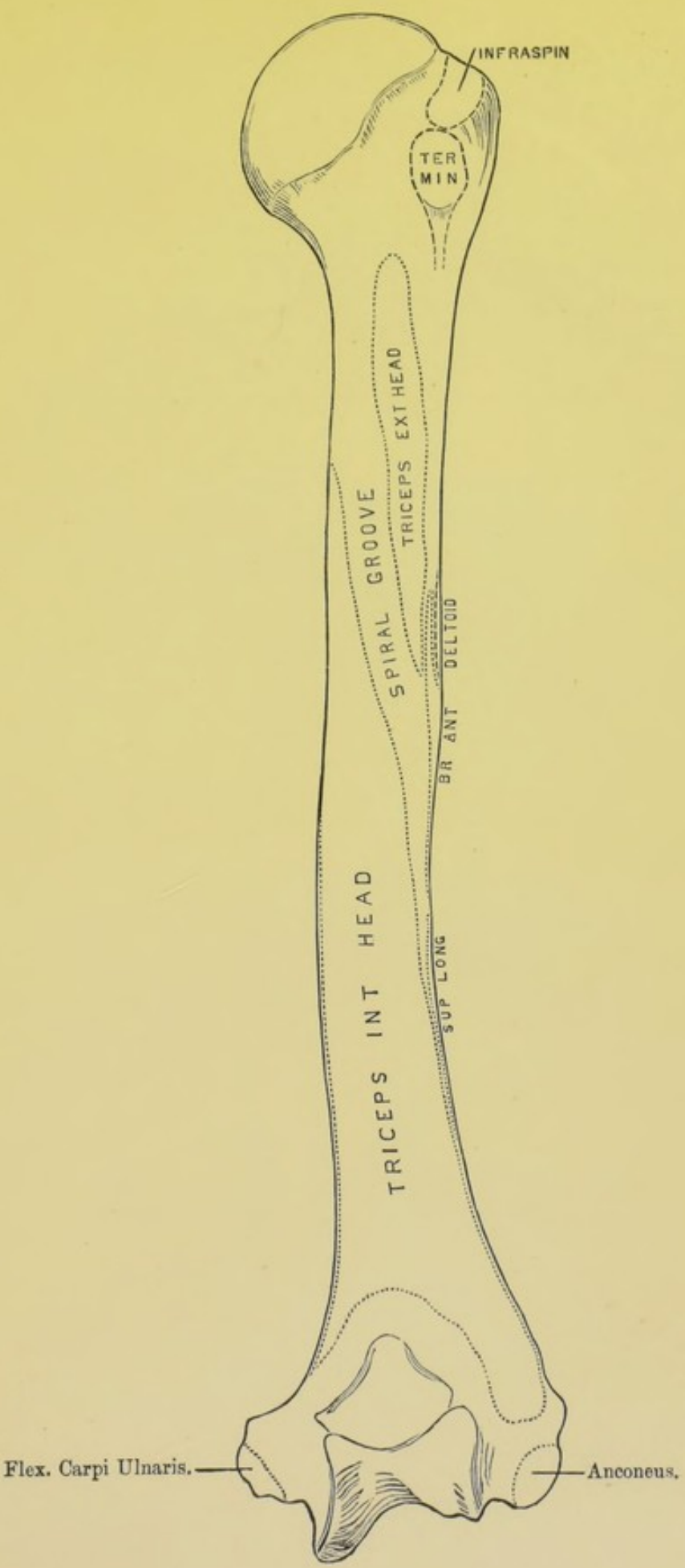
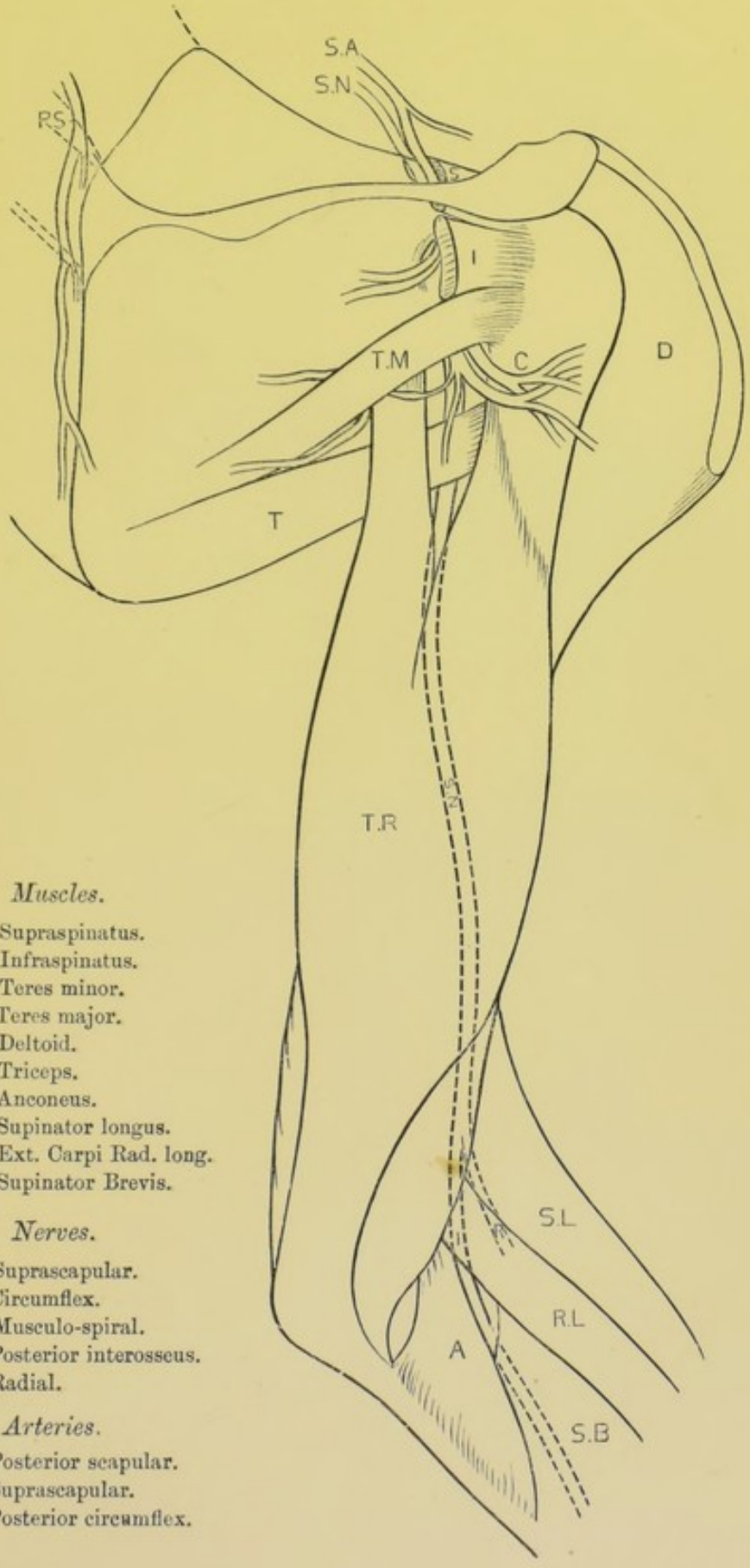

INFRASPIN
TER MIN
SPIRAL GROOVE
TRICEPS EXT HEAD
BR ANT DELTOID
TRICEPS INT HEAD
SUP LONG
Flex. Carpi Ulnaris.
Anconeus.

Plate XI.

Fill in the branches of the scapular and circumflex nerves and arteries.



Muscles.

S. Supraspinatus.
I. Infraspinatus.
T.M. Teres minor.
T. Teres major.
D. Deltoid.
TR. Triceps.
A. Anconeus.
S.L. Supinator longus.
R.L. Ext. Carpi Rad. long.
S.B. Supinator Brevis.

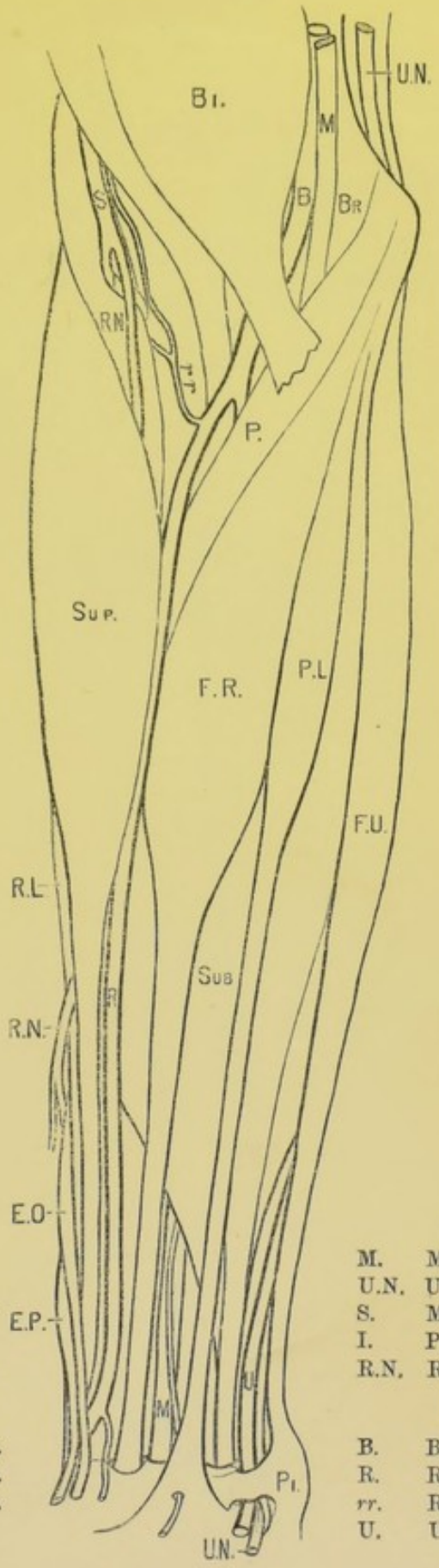
Nerves.

S.N. Suprascapular.
C. Circumflex.
S.N. Musculo-spiral.
I. Posterior interosseus.
R. Radial.

Arteries.

P.S. Posterior scapular.
S.A. Suprascapular.
C. Posterior circumflex.

Plate XII.



Muscles.

BI.	Biceps.
Br.	Brachialis-anticus.
P.	Pronator.
F.R.	Flex. Carpi Radialis.
P.L.	Palmaris longus.
Sub.	Flex. digit. sublimis.
F.U.	Flex. Carpi Ulnaris.
Sup.	Supinator longus.
R.L.	Ext. Carpi Rad. long.
E.O.	Ext. ossis meta. pollic.
E.P.	Ext. primi inter. pollic.

Nerves.

M.	Median.
U.N.	Ulnar.
S.	Musculo-spiral.
I.	Posterior interosseous.
R.N.	Radial.

Arteries.

B.	Brachial.
R.	Radial.
rr.	Radial recurrent.
U.	Ulnar.

Plate XIII.

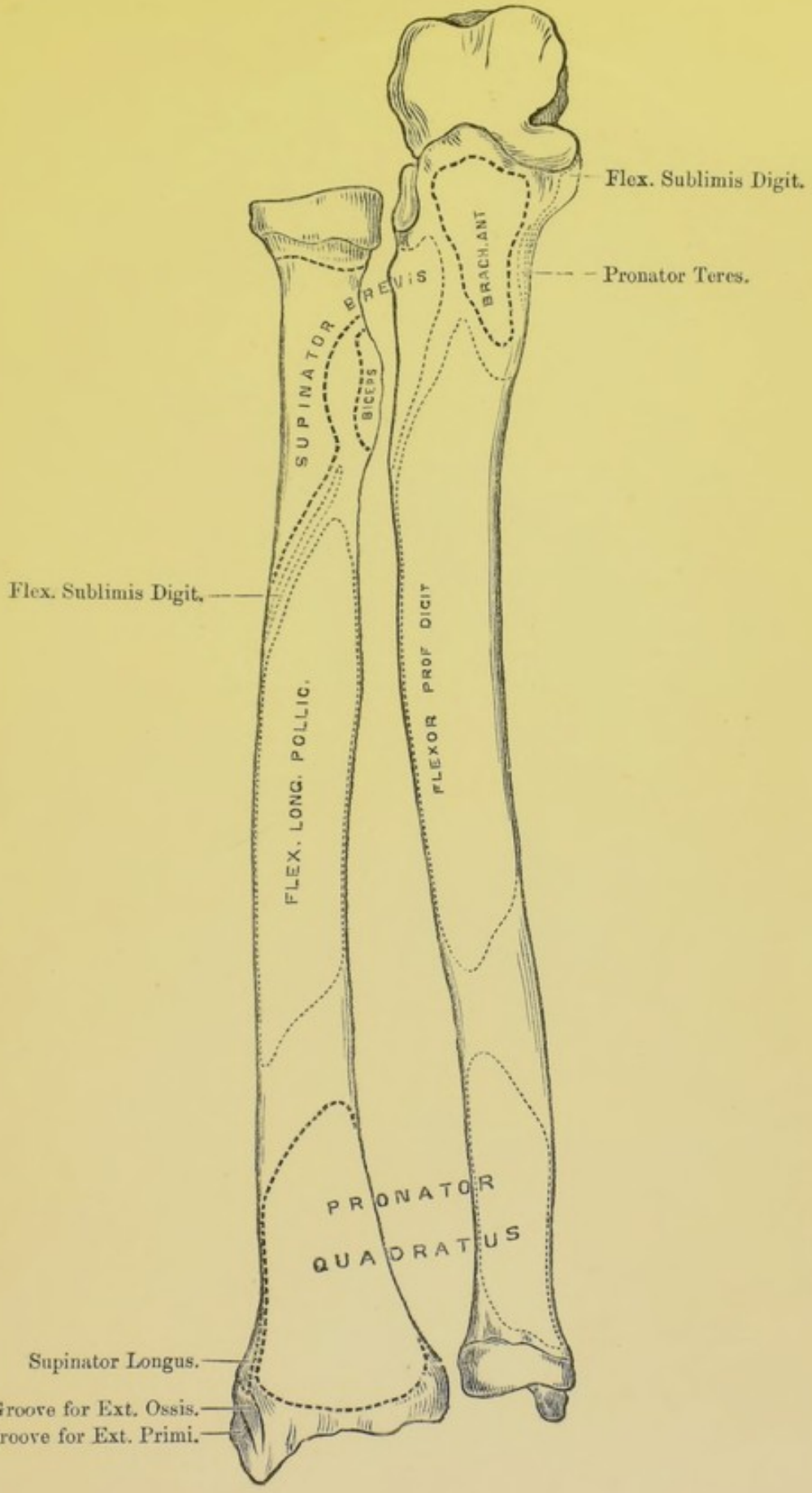
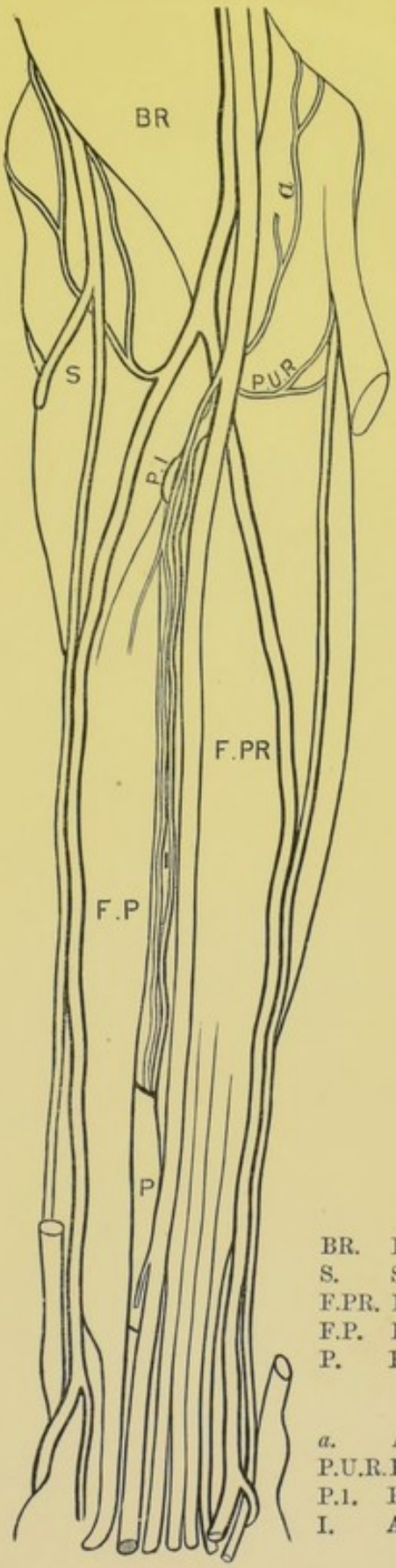

Flex. Sublimis Digit.
Pronator Teres.
SUPINATOR BREVIS
BICEPS
BRACH. ANT
Flex. Sublimis Digit.
FLEX. LONG. POLLIC.
FLEXOR PROF DIGIT
PRONATOR
QUADRATUS
Supinator Longus.
Groove for Ext. Ossis.
Groove for Ext. Primi.

Plate XIV.



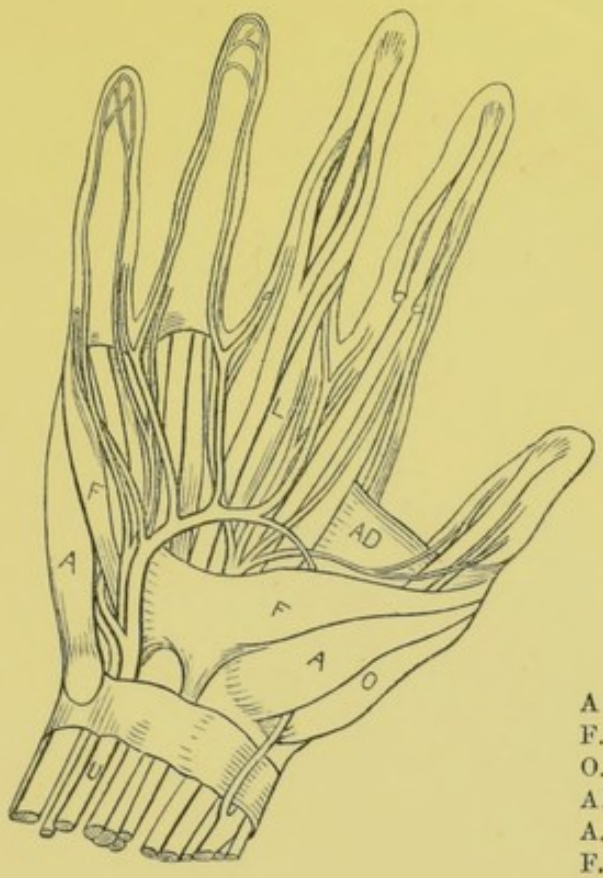
Muscles.

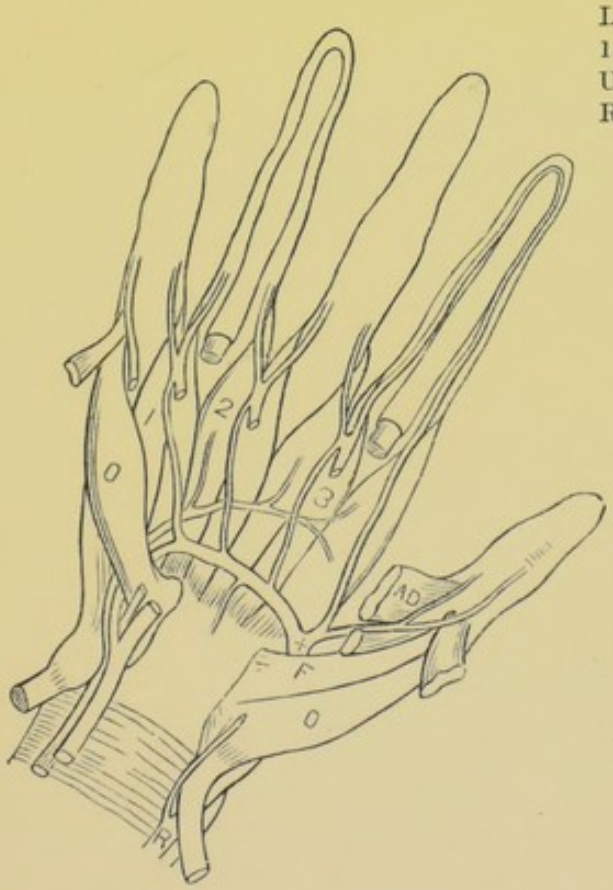
BR. Brachialis anticus.
S. Supinator brevis.
F.PR. Flex. profundus digit.
F.P. Flex. long. pollic.
P. Pronator quadratus.

Arteries.

a. Ant. ulnar. recurrent.
P.U.R. Post. „ „
P.I. Posterior interosseous.
I. Anterior „

Plate XVI.





A Abductor pollicis.
F. Flex. brev. ,,
O. Opponens ,,
AD. Adductor ,,
A. Abductor min. digit.
F. Flex. brev. ,, ,,
O. Opponens ,, ,,
L. Lumbricalis.
1. 2. 3. Palmar Interossei.
U. Ulnar Artery.
R. Radial Artery.
+ At origin of Princeps pollicis and Radialis indicis.

Plate XVII.

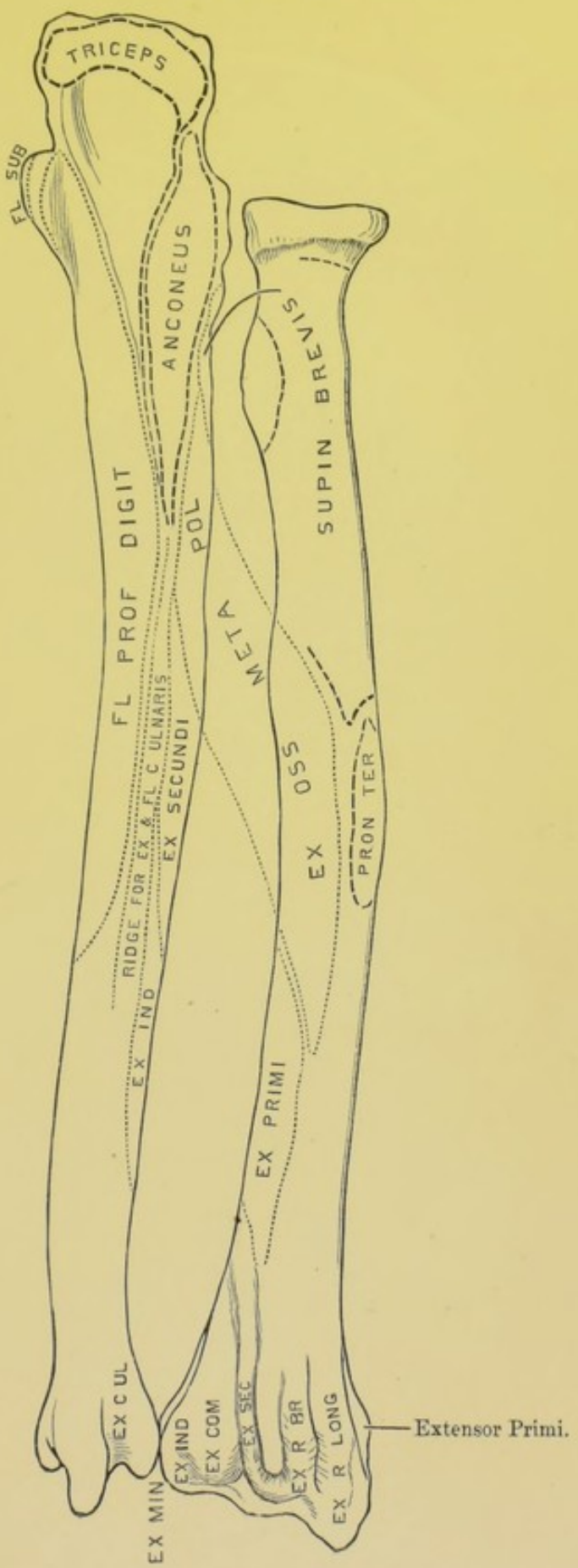
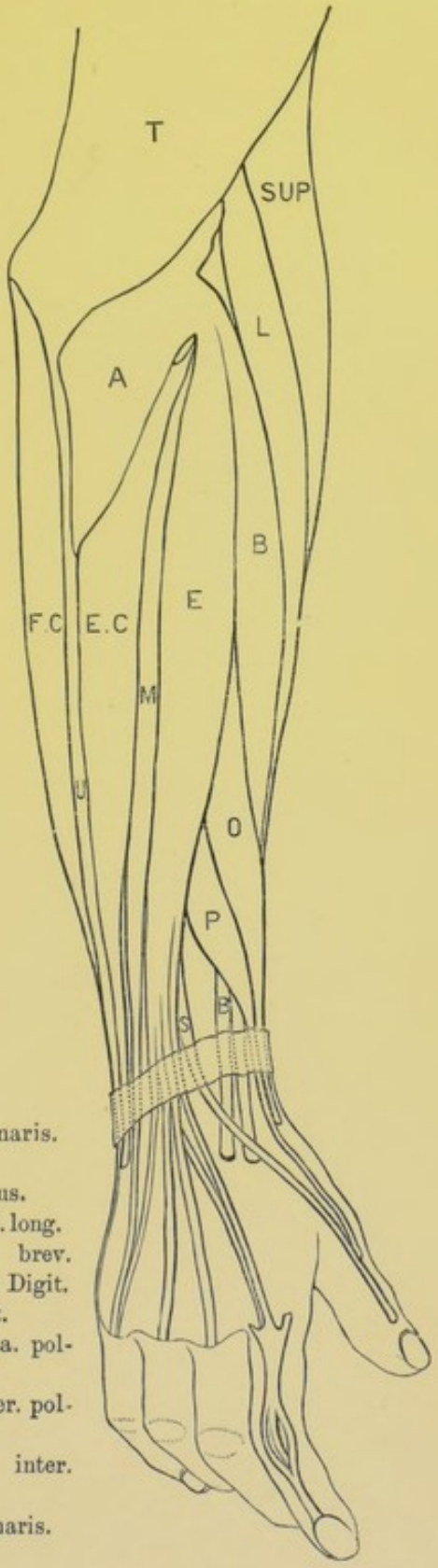

TRICEPS
FL SUB
ANCONEUS
FL PROF DIGIT
POL
SUPIN BREVIS
META
EX OSS
PRON TER
RIDGE FOR EX & FL C ULNARIS
EX SECUNDI
EX IND
EX PRIMI
EX C UL
EX IND
EX COM
EX SEC
EX R BR
EX R LONG
EX MIN
Extensor Primi.

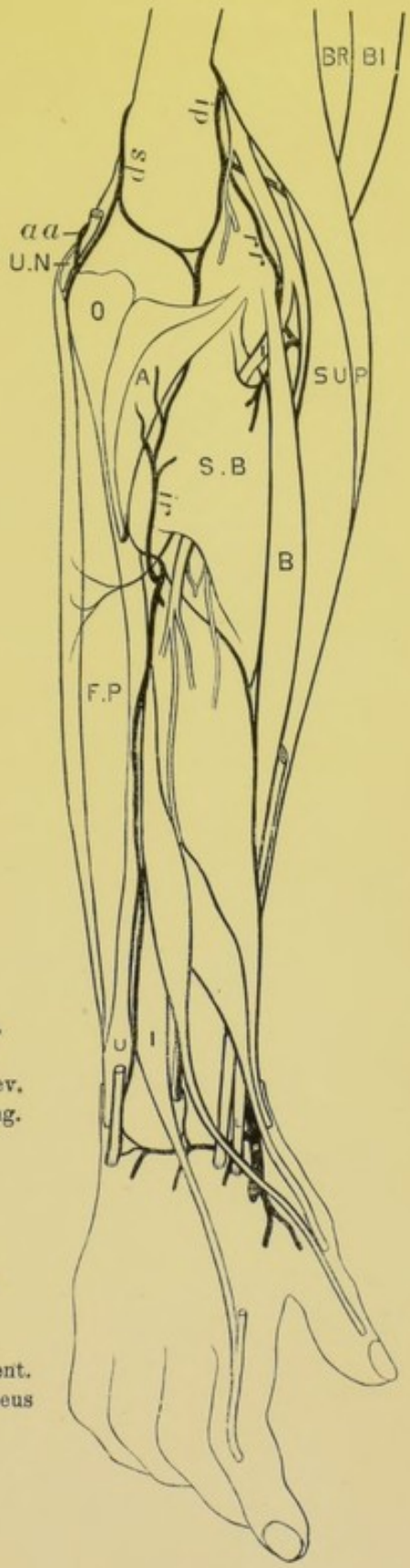
Plate XVIII.

Fill in branches of radial and ulnar nerves on back of hand.



T. Triceps.
A. Anconeus.
F.C. Flex. Carpi Ulnaris.
U. Ulna.
SUP. Supinator longus.
L. Ext. Carpi Rad. long.
B. Ext. „ „ brev.
E. Ext. communis Digit.
M. Ext. min. Digit.
O. Ext. ossis meta. pollicis.
P. Ext. primi inter. pollicis.
S. Ext. secundi inter. pollicis.
E.C. Ext. Carpi Ulnaris.

Plate XIX.



Muscles.

BI.	Biceps.
BR.	Brachialis anticus.
SUP.	Supinator longus.
B.	Ext. carp. rad. brev.
L.	Ext. carp. rad. long.
I.	Ext. indicis.
F.P.	Flex. prof. digit.

Arteries.

rr.	Radial recurrent.
ip.	Inferior profunda.
sp.	Superior „
aa.	Anastomotic.
ir.	Interosseus recurrent.
I.	Posterior interosseus nerve.
U.N.	Ulnar nerve.

O.	Olecranon.
U.	Ulna.