A Synopsis of
REGIONAL ANATOMY

By

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C.B.E., M.D.

Emeritus Professor of Anatomy, University of London.

This volume presents in compact form much information of vital importance to the student revising after practical dissection, and is complementary to the larger textbooks of anatomy and osteology.

The contents have again been carefully revised but the alterations are only such as may help lay more stress on facts which modern surgical and medical practice have rendered of increasing value to the average practitioner.

In addition to the plates which were a feature new to the last edition, two new diagrams showing the segmental distribution of nerves in the limbs are included.

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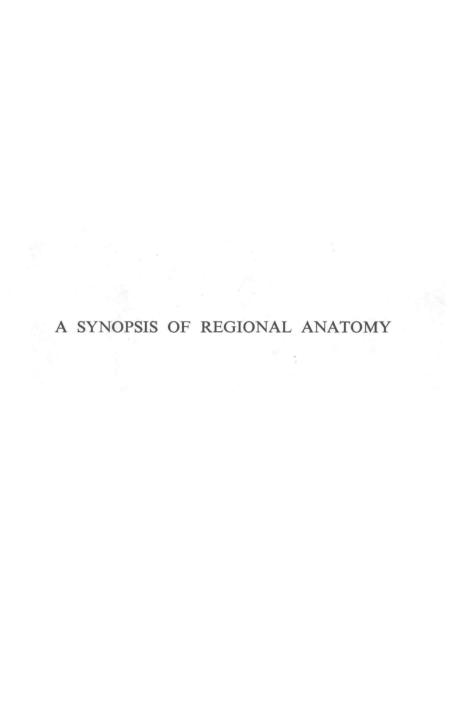
Eighth Edition

WITH 20 PLATES AND 19 TEXT-FIGURES

A SYNOPSIS OF REGIONAL ANATOMY

PREFACE TO THE EIGHTH EDITION

On account of the continuing demand for this little book, I have made no attempt to introduce any matter or illustrations which would be at variance with the purpose I had in mind when I wrote it originally. The contents have been carefully revised but the alterations are only such as may help to lay more stress on facts which modern surgical or medical practice has rendered of increasing importance to the average practitioner.

Although, in earlier editions, I warned readers that the book should not be consulted until the actual work of dissecting the whole body had been completed, my attention has been drawn to the fact that dissectors often do find it useful in revising a "part" they have just finished. So long as the book is not consulted at any earlier stage, there can be no reasonable objection to the individual sections being used in this way.

I have felt that it is still too early to introduce the N.A. Paris (1955) in a book of this character, but it would be my intention to do so in any future editions that may be called for. Meantime I have discontinued the use of the misleading term, "lymphatic gland" and adopted the N.A.P. "Nodus lymphaticus", or "Lymphatic node" in the English translation.

In preceding editions many students and others have helped me by drawing attention to errors in the text, typographical or otherwise and I have always been very grateful for this help, which, I hope, may continue to be forthcoming. Further, I have received so many letters expressing admiration for the clarity of the X-ray Plates, which were a new feature in the Seventh Edition, that I feel it is only fair to repeat my warmest thanks to Dr. T. H. Hills, Director of the Department of Diagnostic Radiology at Guy's Hospital and the Staff of the Department, for the care and trouble which they took in selecting suitable material in the first instance.

*Guy's Hospital, S.E.*1   T. B. JOHNSTON

FOREWORD TO THE READER

BEFORE beginning to revise the facts of which you have gained information at first hand by dissecting the human body, you should first of all refresh your memory of the general principles which govern anatomical structure. You can do this very conveniently by reading again the introductions to the various sections (osteology, arthrology, myology, neurology, etc.) in your textbook of systematic anatomy, not once but several times, and you will find that it will be well worth while to do so, for you are now in a much better position to appreciate their content and to understand the examples which you will find cited. Further, if you stop occasionally to think, you will be able to recall many additional examples from your own observations. This may help you to correlate your knowledge and to get a better understanding of the meaning of anatomical structure and, after all, correlation and understanding are the best aids to memory.

In this edition you will find a number of X-ray Plates, and I hope that, when you examine them, you will not be content to concentrate only on the structures specifically indicated, for, if you try, you will be able to recognize many other important features. Do not forget that, when the field shown covers a large area, a certain amount of distortion is unavoidable in the peripheral parts.

I fear that you may underrate the value of this advice and that most of you will disregard it entirely, but even if only a few of you take it, I shall have been justified in devoting a whole page to this Foreword.

*Guy's Hospital, S.E.*1   T. B. JOHNSTON

CONTENTS

Section I.—THE UPPER LIMB

Section II.—THE LOWER LIMB

Section III.—THE THORAX

Section IV.—THE ABDOMEN

Section V.—THE HEAD AND NECK

Section VI.—THE CENTRAL NERVOUS SYSTEM AND ORGANS OF SPECIAL SENSE

Section VII.—OSTEOLOGY

THE UPPER LIMB

BEFORE beginning the revision of the detailed anatomy of the upper limb it is desirable to consider briefly the limb as a whole and the objects for which it is designed or may be adapted. Broadly speaking, the upper limb is a multi-jointed lever, freely movable at the shoulder and bearing at its opposite extremity a prehensile instrument—the hand. The movements of the hand, or of any tool, weapon, etc., held in the hand are controlled through the influence of the central nervous system, whether they are gross and powerful like the blows of a sledge-hammer or fine and delicate, like the strokes of an artist's brush. In order that these movements may produce the particular effect desired it is essential that the muscles and the joints concerned should be able to function normally and further that both the incoming and outgoing nervous impulses should be unimpeded in their passage from their source to their destination.

Muscles may act as *prime movers*, like the flexor muscles of the fingers when any object is being gripped, and every group of prime movers has a corresponding group of *antagonists*, which must be relaxed when the prime movers are called into action.

In addition, in order to ensure the steadiness of the grip when the hand is being used, a third group, termed *fixation muscles*, are called into action. For example, the muscles inserted into the upper part of the humerus ensure the stability of the shoulder-joint during active movements of the hand and fingers.

Finally, where the prime movers pass over more than one joint between their origin and their insertion, *e.g.*, the Flexores digitorum, there is a danger that they may waste power in producing movements at the intermediate joints at the expense of the efficiency with which they act. Thus when the fist is clenched tightly, it will be found that the hand always undergoes an appreciable amount of extension at the wrist joint. This movement is effected by the subconscious contraction of the radial and ulnar extensors of the joint and these muscles are then acting as *synergic muscles* and actively preventing flexion at the wrist joint, which would otherwise result in loss of power.

THE PECTORAL REGION AND THE AXILLA[1]

These regions can be revised satisfactorily only from a subject in process of dissection in which the arm has not yet been removed

[1] See Foreword.

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from the trunk. In addition, the student should have by him, and should constantly refer to, a clavicle, a scapula and a humerus, belonging to the same side of the body as the axilla of the subject he is examining.

Cutaneous Nerves. The skin over the upper part of the deltoid and from the clavicle down to the second rib is supplied by descending branches from the cervical plexus (C. 3 and 4). Below the second rib the skin is supplied by the terminal and the lateral cutaneous branches of the second to the sixth intercostal nerves. The inter-costo-brachial nerve, which is the lateral cutaneous branch of the second intercostal nerve, supplies the skin over the floor of the axilla.

Mammary Gland. The gland lies in the superficial fascia and possesses no true capsule in a young adult female. It is hemispherical in shape, but tongue-like processes extend upwards to the second rib and downwards to the sixth, medially to the edge of the sternum and laterally to the mid-axillary line. One of these processes, termed the "axillary tail," curls round the lower border of the pectoralis major and comes into close relationship with the axillary vessels.

The deep surface of the gland rests on the fascia covering the pectoralis major and serratus anterior.

The gland is ectodermal in origin and arises as a number (fifteen to twenty) of solid epithelial ingrowths. Their deeper portions divide, subdivide and proliferate to form the lobules of the gland, while the original stem ingrowths become canaliculised to form the lactiferous ducts which open on the nipple. The gland is small in the child. The enlargement which occurs in the young female at puberty affects the parenchyma only, but the glandular tissue itself proliferates when the gland increases in size during the first pregnancy. The maximum size is reached during lactation.

The *nipple* is traversed by the ducts of the gland and forms a small conical projection, usually placed over the fourth intercostal space. Its base is surrounded by a circular area of pigmented skin, termed the *areola*. Pinkish in the virgin, the areola becomes darker in colour during the first pregnancy and never regains its former tint. It contains a number of sebaceous—areolar—glands. At first a surface depression, the nipple becomes evaginated in the last months of fœtal life.

Ducts. About fifteen ducts open independently of one another on the surface of the nipple. Each possesses a dilated ampulla just prior to its termination.

Lymphatics. The lymphatic vessels, which may act as channels for the spread of malignant disease from the breast to the associated

lymph nodes (glands),[1] are of the greatest importance to the surgeon.
(*a*) A *superficial plexus* of lymph vessels lies under the skin superficial
to the gland. It receives afferents from the gland and sends its effer-
ents, some to the pectoral lymph nodes, some to the infraclavicular
lymph nodes, and others to (*b*) the *deep, or mammary plexus* of
lymph vessels, which is closely related to the deep fascia on which
the mammary gland rests. In addition the deep plexus receives,
directly, most of the lymph vessels of the gland. The efferents from
the deep plexus pass: (1) To the pectoral lymph nodes (p. 10); (2)
to the subscapular lymph nodes (p. 10) (from both these groups
efferent vessels pass to the lateral axillary and apical lymph nodes);
(3) to the infraclavicular lymph nodes, and thence, *via* the apical
lymph nodes, to the postero-inferior group of the deep cervical
lymph nodes; (4) to the lymph nodes along the internal mammary
vessels, and thence to the mediastinal lymph nodes; (5) to the sub-
diaphragmatic plexus, crossing the costal margin and piercing the
abdominal wall; and (6) to communicate with the deep plexus of
the opposite side.

The *Blood Supply* is derived from branches of the internal mam-
mary and intercostal arteries and from the external mammary
branches of the lateral thoracic artery.

The **Axilla** is the space between the upper part of the arm and
the side of the chest. It contains numerous lymph nodes and all the
principal vessels and nerves of the limb. These enter the axilla from
the neck through the narrow *apex*, bounded in front by the clavicle
(middle third), behind by the upper border of the scapula and
medially by the outer border of the first rib.

The size of the space is very much exaggerated after dissection
because the fascial floor, which is normally drawn upwards by its
connection with the clavipectoral fascia and so produces the natural
hollow of the arm-pit, has been removed together with a quantity
of fat. In addition, the subscapularis has been freely separated from
the serratus anterior, with which it is normally in direct apposition
over its lower and medial two-thirds.

The *Anterior Wall of the Axilla* consists of two layers: (1) the
pectoralis major; and (2) the subclavius, the clavipectoral fascia,
the pectoralis minor and the suspensory ligament of the axilla.

The **Pectoralis Major** has (1) a clavicular head of origin from the
medial half of the clavicle; and (2) a sterno-costal head from the
sternum and the upper six costal cartilages. The fibres converge on
the upper part of the humerus, the lower fibres turning upwards

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[1] The term "lymph gland," which is an obvious misnomer, has been replaced by the
term "lymph node" throughout the book.

behind the upper fibres so as to form a bilaminar tendon, which is inserted into the lateral lip of the bicipital groove.

Actions. The pectoralis major adducts the arm and rotates it medially. The clavicular head, acting with the anterior fibres of the deltoid, flexes the arm to a right angle (p. 13), but the sterno-costal head assists the latissimus dorsi to depress the flexed arm when the movement is carried out against resistance. When the arms are fixed above the head, the sterno-costal head draws the trunk upwards, as in climbing.

Nerve Supply. It receives branches from the lateral and medial pectoral nerves, which arise from the corresponding cords of the brachial plexus (C. 5, 6, 7, 8, T. 1). C. 6 is the predominating segment for the clavicular head, and C. 7 for the sterno-costal head.

The **Subclavius** arises from the first costal cartilage and is inserted into the groove on the inferior surface of the clavicle.

It steadies the clavicle in its movements, and is supplied by a supraclavicular branch of the brachial plexus (C. 5 and 6).

The **Clavipectoral Fascia** is a thickened sheet of deep fascia which fills up the gap in the deep layer of the anterior wall between the subclavius and the pectoralis minor. It is continuous with the fascial covering of both muscles, and so, when traced laterally, is found to blend with the coraco-clavicular ligament. At its medial end it reaches the first and second costal cartilages and anterior intercostal membranes.

The fascia is covered medially by the clavicular head of the pectoralis major, but laterally it is related to the infraclavicular fossa. It is pierced by (1) the cephalic vein, *en route* to join the axillary vein; (2) the lateral pectoral nerve; (3) the acromiothoracic artery; and (4) the efferents from the infraclavicular lymph nodes.

The **Pectoralis Minor,** almost entirely covered by the pectoralis major, arises from the anterior ends of the third, fourth and fifth ribs, and narrows as it passes to be inserted into the medial border and upper surface of the coracoid process.

Actions. Under ordinary conditions it swings the shoulder forwards and downwards, but when the shoulder is fixed it acts as an elevator of its ribs of origin. Acting with the serratus anterior it draws the scapula forwards round the chest wall, as in pushing and punching movements.

Its *Nerve Supply* is derived from the medial pectoral nerve, which pierces it to reach the pectoralis major.

The *Suspensory Ligament of the Axilla* is a fascial sheet continuous above and medially with the fascial sheath of the pectoralis minor. It joins the fascial floor of the axilla and keeps it retracted.

biceps

The *Lateral Wall of the Axilla* is very narrow, as the tendons of pectoralis major and latissimus dorsi come very close together at their humeral attachments. It is formed by a strip of the bicipital groove, hidden by the biceps and coraco-brachialis muscles.

The great vessels and nerves are all closely related to the lateral wall.

The *Posterior Wall of the Axilla* is formed, medially, by the subscapularis muscle and, laterally, by the latissimus dorsi and a very small part of the teres major.

The latissimus dorsi, as it passes to be inserted into the floor of the bicipital groove, sweeps round the lower border of the teres major and covers nearly the whole of its anterior surface. Trace the latissimus dorsi and observe that, as a result of this sweep, its surfaces are reversed.

All the muscles on the posterior wall of the axilla are supplied by branches from the posterior cord of the brachial plexus.

The *Medial Wall of the Axilla* is formed by the outer surface of the thoracic wall, but the ribs and intercostal spaces are hidden by the serratus anterior muscle.

The **Serratus Anterior** arises from the upper eight ribs and passes backwards, closely applied to the chest wall, to be inserted into the ventral aspect of the medial border of the scapula. The lower four digitations are attached to the inferior angle.

Actions. The serratus anterior draws the scapula forwards round the chest wall, at the same time, by virtue of the greater pull exerted on the inferior angle, *rotating* it so that the inferior angle passes laterally and forwards. As a result the glenoid cavity is directed upwards. This rotation occurs when the arm is raised from the side, and reaches its maximum when the arm is elevated above the head. The serratus anterior and the trapezius co-operate to produce the movement. The force of a blow delivered straight "from the shoulder" is the result of the drawing forward of the scapula by the serratus anterior acting in association with the pectoralis minor.

When the shoulders are fixed, the muscle acts as an elevator of its ribs of origin.

It derives its *Nerve Supply* from the *nerve to the serratus anterior* (C. 5, 6 and 7). The nerve descends along the medial wall of the axilla between the serratus anterior and its covering fascia. It enters the axilla through the apex, where it lies behind the great vessels and nerves.

The *Intercosto-brachial Nerve*, which is the lateral cutaneous branch of the second intercostal nerve, pierces the medial wall of the

axilla and crosses the space in the axillary fat. It supplies branches to the skin over the axillary floor, communicates with the medial cutaneous nerve of the arm (T. 1), and is distributed finally to the skin over the dorsal aspect of the arm.

The **Axillary Artery** begins at the outer border of the first rib, where it is continuous with the subclavian artery. It runs downwards and laterally (when the arm is by the side), and terminates at the lower border of the teres major, where it leaves the axilla and becomes the brachial artery. Throughout its course it is closely associated with the cords of the brachial plexus and their branches to the arm, being enclosed with them in a dense sheath of deep fascia. When this axillary sheath is traced upwards through the apex of the axilla, it will be seen to be continuous with the prevertebral fascia.

The axillary artery is crossed superficially by the pectoralis minor, which serves to divide it, for descriptive purposes, into three parts.

The *First Part* of the axillary artery lies above the pectoralis minor and is related *anteriorly* to the clavipectoral fascia, the pectoralis major and the covering fasciæ and skin. It is crossed superficially by the lateral pectoral nerve and by the cephalic vein as it makes for the axillary vein. *Above, and to its lateral side*, lie the posterior and lateral cords of the plexus. *Posteriorly*, the medial cord of the plexus and the nerve to serratus anterior intervene between the artery and the first digitation of the serratus anterior. *Medially*, the axillary vein accompanies the artery and tends to overlap it anteriorly.

The *Second Part* of the axillary artery is covered *anteriorly* by the pectoralis minor and major muscles, fasciæ and skin. The three cords of the brachial plexus are related to the artery in the manner indicated by their names. *Posteriorly*, the artery and the posterior cord are separated from the subscapularis by a mass of fat. *Medially*, the medial cord intervenes between the artery and the axillary vein.

The *Acromio-thoracic* and *Lateral Thoracic* arteries arise from the second part. The acromio-thoracic pierces the clavipectoral fascia and sends two or more pectoral branches between the two pectoral muscles. The lateral thoracic artery runs along the lower border of the pectoralis minor.

The *Third Part* of the axillary artery lies below the lower border of the pectoralis minor. *As the posterior fold of the axilla extends to a lower level than the anterior fold (a fact readily confirmed on the living subject), it follows that the terminal part of the artery escapes from under cover of the pectoralis major and is covered anteriorly only by the skin, fasciæ and certain nerves*, although it is overlapped by the

coraco-brachialis muscle. The neuro-vascular bundle can therefore be palpated in this situation and the pulsations of the artery can be felt in the living subject. Higher up the artery is covered also by the pectoralis major.

The branches of the brachial plexus retain, as far as possible, the relationships which their parent cords bear to the second part of the artery. Thus, the radial and circumflex nerves lie behind the artery, the musculo-cutaneous and the lateral root of the median lie to its lateral side, the ulnar and the medial cutaneous nerve of the arm lie to its medial side. The medial root of the median nerve, however, has to cross in front of the artery to reach the lateral root, and the medial cutaneous nerve of the forearm gets displaced on to the anterior surface of the vessel.

In addition, the axillary vein lies to the medial side, the sub-scapularis, the latissimus dorsi and the teres major lie behind the artery, and the coraco-brachialis, which overlaps the vessel anteriorly, and the humerus lie to its lateral side.

Branches. The **Subscapular Artery** arises at the lower border of the subscapularis and follows it down to the chest wall. Near its origin it is crossed by the ulnar nerve and the axillary vein. It gives off a *circumflex scapular* branch, which winds round the lateral border of the scapula, deep to the teres minor, and reaches the infraspinous fossa (see p. 16).

The **Circumflex Humeral Arteries** arise just below the subscapular. The *anterior* passes laterally in front of the surgical neck of the humerus, while the *posterior* passes backwards through the quadri-lateral space (p. 15) in company with the circumflex nerve, and then winds round the posterior aspect of the surgical neck. These two arteries form an anastomosing circle round the surgical neck, from which branches ascend to the shoulder joint. The posterior is much the larger, as it is the main artery to the deltoid. It sends a branch downwards to anastomose with the profunda artery, thus *linking up the third part of the axillary with the upper part of the brachial artery.*

The **Brachial Plexus** is formed by the anterior primary rami of the fifth, sixth, seventh and eighth cervical and the first thoracic nerves, together with small communications from the fourth cervical and the second thoracic nerves. The union, separation, and reunion of these nerves in a definite manner constitute the plexus. It commences in the neck (p. 223) and is continued into the axilla.

In the neck, C. 5 and C. 6 unite to form the upper trunk; C. 7 forms the middle trunk; C. 8 and T. 1 form the lower trunk. Each trunk divides into anterior and posterior divisions, but these divisions are not always of equal size, and in the case of the lower

trunk the posterior division is relatively small. The three posterior divisions unite to form the posterior cord; the anterior divisions of the upper and middle trunks constitute the lateral cord, and the anterior division of the lower trunk is continued on as the medial cord.

The separation of each trunk into an anterior and a posterior division is an indication of the subdivision of the musculature of the primitive limb into a ventral, or flexor, and a dorsal, or extensor, group.

The supraclavicular branches of the plexus arise before the stage of cords is reached. They are four in number:—

1. The *Nerve to the Rhomboids* arises from the anterior primary ramus of C. 5 and pierces scalenus medius. Then it runs down the anterior border and surface of the levator scapulæ to reach the rhomboids.

2. The *Suprascapular Nerve* arises from the upper trunk (C. 5 and C. 6). When the brachial plexus is approached in the neck from its supero-lateral aspect, the suprascapular is the first branch that is encountered. It runs downwards and laterally, disappears behind the clavicle, and passes through the suprascapular notch to reach and supply the supra- and infraspinatus muscles.

3. The *Nerve to Serratus Anterior* arises from the anterior primary rami of C. 5, C. 6 and C. 7 soon after they emerge from the intervertebral foramina. Its upper two roots pierce the scalenus medius and then descend on the surface of that muscle, meeting the lower root, which does not pierce the muscle, and ultimately joining with it. *Both the nerve to serratus anterior and the nerve to the rhomboids lie deep to the prevertebral fascia in the neck* (p. 224). The nerve passes through the apex of the axilla behind the axillary vessels and the plexus, and runs downwards on the surface of serratus anterior, which it supplies.

4. The *Nerve to the Subclavius* arises from the anterior primary rami of C. 5 and C. 6 and descends in front of the plexus and the subclavian artery to reach the subclavius muscle.

In the Axilla, the cords of the plexus are closely related to the second part of the axillary artery. The medial cord crosses behind the artery to get to its medial side, the posterior cord runs down behind it, and the lateral cord lies along its lateral side. This relationship is maintained as far as possible by the branches of the cords.

The **Lateral Cord** of the plexus gives off: (1) The *lateral pectoral nerve*, which runs forwards lateral to the axillary artery, pierces the clavipectoral fascia, and supplies the pectoralis major muscle. (2) The *musculo-cutaneous nerve* runs downwards lateral to the artery and gradually deviating from it. It gives off a branch to the coraco-

brachialis and then *pierces that muscle*. (3) The *lateral root of the median nerve* is the direct continuation of the lateral cord along the lateral side of the artery. It is joined by the medial root, which crosses in front of the vessel.

The **Posterior Cord** of the plexus gives off the nerves to the muscles which form the posterior wall of the axilla. (1) The *upper subscapular nerve* arises high up in the space and supplies the subscapularis. (2) The *nerve to latissimus dorsi* runs downwards and laterally on the subscapularis to reach the subscapular vessels and lymph nodes, with which it is subsequently in close relationship. It supplies the latissimus dorsi. (3) The *lower subscapular nerve* runs laterally and slightly downwards across the subscapularis to reach the teres major. It gives branches to both muscles and crosses behind the subscapular vessels. (4) The *radial nerve* is the direct continuation of the posterior cord, and consequently intervenes between the axillary artery and the muscles on which it lies. It is the largest branch of the plexus and, before it leaves the axilla, it gives off branches to the long and the medial heads of the triceps, and the posterior cutaneous nerve of the arm. (5) The *circumflex nerve* runs laterally parallel to and just above the radial, with which it parts company at the lower border of the subscapularis. At this point it turns backwards through the quadrilateral space (pp. 15 and 17).

The **Medial Cord** of the plexus gives off: (1) The *medial pectoral*, which passes forwards medial to the artery, supplies and pierces the pectoralis minor and ends in the pectoralis major muscle. (2) The *medial cutaneous nerve of the arm* (T. 1) communicates with the intercosto-brachial nerve (T. 2), runs downwards along the axillary vein, and supplies the skin over the medial surface of the arm. (3) The *ulnar nerve* runs downwards medial to the axillary artery, intervening between it and the axillary vein; it is smaller than the median nerve, but much larger than (4) the *medial cutaneous nerve of the forearm*, which descends in front of the artery. (5) The *medial root of the median nerve* crosses the artery obliquely in order to join the lateral root. Neither the median nor the ulnar nerve gives off any branches until just above the elbow joint.

The **Axillary Vein** begins at the lower border of the teres major, where it is continuous with the basilic vein. As it ascends through the axilla, it lies to the medial side of the axillary artery and tends to overlap it anteriorly. It receives tributaries which correspond to the branches of the artery and, in addition, it is joined by the venæ comites of the brachial artery, near its commencement, and by the cephalic vein, near its termination. Throughout its course it is