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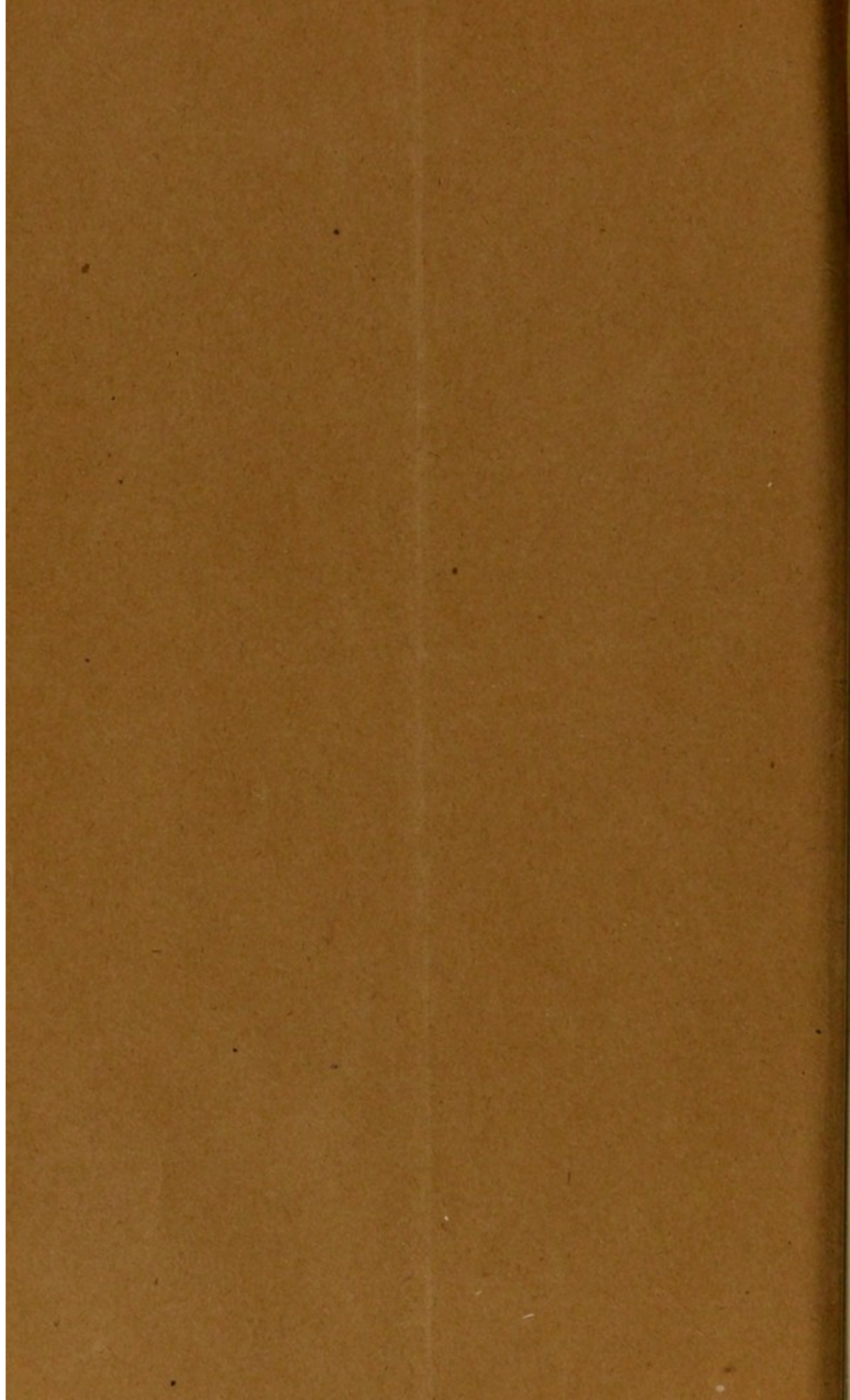
With the Author's Case

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Brachial Plexus

Arrangement of Brachial Plexus
by

R. Clement Lucas



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ON THE NORMAL ARRANGEMENT
OF THE
BRACHIAL PLEXUS OF NERVES.

BY R. CLEMENT LUCAS, B.S.

WHEN I first attempted, as a student, to unravel the cords of the brachial plexus, my disappointment was great on finding that the arrangement of these in no way agreed with the description given of them in any text-book. The demonstrator to whom I appealed, after examining my dissection, assured me that the nerves were abnormally disposed, and assisted me out of my difficulty by means of an orthodox drawing in chalk. In my subsequent dissections I was equally unfortunate, and I left the dissecting-room with the impression that the brachial plexus was a confused bundle of nerves, only to be learnt for examination purposes from books and diagrams. More recently as demonstrator I encountered the same difficulty in teaching as I had before experienced in studying, until the repeated observation of a nearly constant arrangement convinced me, that the description of the brachial plexus given in our most trustworthy text-books on anatomy is not applicable to the plexus as usually found in the body.

Before proceeding to detail the result of a considerable number of observations made in the dissecting-room at Guy's,

I will first quote the descriptions of the brachial plexus to be found in our English works on Anatomy. In the last edition of 'Quain's Anatomy,' edited by Sharpey, Thomson, and Cleland, the arrangement of the plexus is given as follows:—

"The fifth and sixth cervical are joined at the outer border of the scalenus, and a little farther out receive the seventh nerve; the three nerves giving rise to one large cord. The eighth cervical and first dorsal nerves are united into another lower cord, whilst they are between the *scaleni* muscles. The two cords thus formed lie side by side in the fore part of the plexus, and external to the first part of the axillary vessels. At the same place, or lower down, a third intermediate or posterior cord is produced by the union of fasciculi from each of the other two cords, or separately from the nerves forming them. The three cords of which the plexus now consists are placed one on the outer side of the axillary artery, one on the inner side, and one behind that vessel, and are continued into the principal nerves of the arm."¹

A diagram of the brachial plexus on p. 637 does not agree with the description in the text, but represents the posterior cord as formed by four branches of equal size, furnished by the fifth, sixth, seventh, and eighth cervical nerves.

The description in 'Gray's Anatomy,' edited by Holmes, runs thus:—

"The fifth and sixth nerves unite near their exit from the spine into a common trunk. The seventh joins this trunk near the outer border of the *scalenus medius*; and the three nerves thus form one large single cord. The eighth cervical and first dorsal nerves unite behind the anterior *scalenus* in a common trunk. Thus two large trunks are formed, the upper one by the union of the fifth, sixth, and seventh cervical, and the lower one by the eighth cervical and first dorsal. These two trunks accompany the subclavian artery to the axilla. Opposite the clavicle, and sometimes in the axilla, each of these trunks gives off a fasciculus, by the union of which a third trunk is formed, so that in the middle of the axilla three trunks are formed."²

¹ 'Quain's Anatomy,' 7th edition, vol. ii, p. 641.

² 'Gray's Anatomy,' edited by Holmes, 6th edition, p. 527.

The description given in 'Ellis's Anatomy,'¹ agrees almost exactly with the preceding, and differs only in the points of origin of one or two nerves from the cords of the plexus.

In a foot-note to the last edition of 'Gray's Anatomy' there occurs the following remark:—"This is the most common mode of formation of the plexus; but it is also very common for the third or posterior cord to be formed by the seventh cervical nerve, *running undivided*, and receiving a branch from each of the other cords."

In 'Heath's Anatomy' a similar description is given to that found in the works of Quain, Gray, and Ellis. After remarking that the arrangement is inconstant, the author proceeds to say: "The seventh nerve very frequently bifurcates, one branch going to the upper and one to the lower cord, or it may itself form the posterior cord, being joined by branches from the other trunks."²

In 'Holden's Anatomy'³ the arrangement is thus given:—"The fifth and sixth cervical unite to form a single cord. The seventh cervical runs for a short distance alone, and then splits into two branches, one of which joins the cord formed by the fifth and sixth cervical, the other that formed by the eighth cervical and first dorsal. The branch joining the trunk formed by the eighth cervical and first dorsal, usually receives a large reinforcement from the conjoined fifth and sixth cervical. Thus two trunks are formed, which lie for some distance above and to the outer side of the subclavian artery. Beneath the clavicle a third cord is formed by the junction of a fasciculus from each of the two primary trunks, so that in the axilla there are three large cords."

The description given in the 'Vade Mecum' by Wilson and Buchanan differs slightly from the foregoing. It is as follows:—"The fifth and sixth unite to form a common trunk; the last cervical and first dorsal also unite to form a single trunk; the seventh cervical nerve lies for some distance apart from the rest, and then divides into two branches, which join the other cords. At the point of junction the plexus consists of two cords, from which a third is given off, and the

¹ 'Demonstrations of Anatomy,' by G. Viner Ellis, 7th edition, p. 81.

² 'Practical Anatomy,' by C. Heath, F.R.C.S., 3rd edition, p. 331.

³ 'Manual of Anatomy,' by L. Holden, F.R.C.S., 3rd edition, p. 62.

three become placed, one to the inner side of the brachial artery, one behind, and one to the outer side.”¹

It will be observed that all these descriptions agree in one particular, that at a certain point the nerves entering into the formation of the brachial plexus are so united as to form only two cords. This I believe to be an arrangement of extremely rare occurrence.

Quain, Ellis, Gray, and Heath agree in stating that one of the two cords alluded to is formed by the junction of the fifth, sixth, and seventh cervical nerves, and the other by the union of the last cervical and first dorsal nerves. The subsequent formation of the posterior cord, according to the same authorities, is brought about by the union of two branches, one from the cord formed by the junction of the fifth, sixth, and seventh nerves, the other from that composed of the eighth cervical and first dorsal.

Wilson describes a symmetrical arrangement:—the two upper nerves uniting to form one cord, the two lower to form another, and the middle one dividing into a branch for each; a branch is given off from each of these two cords to form a posterior, so that one can imagine a diamond-shaped interval between the branches into which the seventh nerve divides and the roots of origin of the posterior cord. This arrangement I have never met with.

Holden has noted the bifurcation of the seventh nerve, as well as the division of the cord formed by the fifth and sixth cervical nerves, which I shall presently describe; but the lower branches resulting from these divisions do not join with the cord formed by eighth cervical and first dorsal, as he mentions, but go direct to form the posterior cord.

The following description, which I venture to offer as that of the normal arrangement of the brachial plexus, is based upon a great many dissections made during the last three winters. Recently, I have noted the plexus in every subject brought into the dissecting-room, and have found that, out of *thirty* consecutive observations, the arrangement I am about to describe was present in *twenty-seven* cases.

The fifth and sixth cervical nerves unite at the outer border of the scalenus medius muscle to form a single cord; the

¹ ‘The Anatomist’s Vade-Mecum,’ Wilson and Buchanan, 9th edition, p. 513.

seventh nerve runs alone; the eighth and first dorsal, uniting close to their foramina, appear on the scalenus medius as a single trunk, so that the brachial plexus now consists of three cords, which may be distinguished as upper, middle, and lower.

The upper cord (that formed by fifth and sixth) next divides into two branches, an anterior, somewhat the smaller, which goes to form the "outer cord," and a posterior, which goes to form the "posterior cord." The middle cord (seventh nerve) also bifurcates into an anterior branch, which uniting with the anterior branch of the upper cord, completes the "outer cord," and a posterior which descends to assist in the formation of the "posterior cord." The lower cord (eighth and first dorsal) likewise divides into two branches, but of very unequal size; the upper, a small fasciculus, completes the "posterior cord," and the lower is continued on as the "internal cord." Thus the posterior cord is composed of three fasciculi, which decrease in size from above downwards, the upper large root being derived from the cord formed by the union of the fifth and sixth cervical nerves, the middle from the seventh nerve, and the inferior from the cord formed by the eighth cervical and first dorsal nerves. The outer cord is formed by the union of two branches of equal size, one furnished by the cord formed by the fifth and sixth nerves, the other derived from the seventh nerve. The internal cord obtains its fibres from the cord formed by the union of the eighth cervical and first dorsal nerves, of which it is the direct continuation.

The points at which the various nerves take origin from the plexus I have found to differ somewhat from those usually described.

The communicans phrenici is as often a branch from the phrenic nerve joining with the fifth cervical as one supplied by the latter to the phrenic. Sometimes there appears to be an interchange of fibres between the two nerves.

The nerve to the rhomboids and levator anguli scapulæ (R) arises from the fifth cervical nerve, and is frequently united with the highest root of the posterior thoracic nerve.

*The posterior thoracic nerve*¹ (Pt) arises by three roots

¹ On three occasions I have seen this nerve arise by four roots, the fourth root being a delicate fasciculus derived from the eighth cervical nerve.

which take origin from the fifth, sixth, and seventh cervical nerves. The two upper roots pierce the scalenus medius, uniting commonly within but sometimes external to that muscle; the third takes origin from the posterior surface of the seventh cervical nerve, and lies between it and the scalenus medius. The branch from the fifth often runs as a separate nerve to the two upper digitations of the serratus magnus muscle.

The *nerve to the subclavius* (Sc) takes origin from the anterior aspect of the cord formed by the fifth and sixth cervical nerves immediately after their union, and appears to derive all its fibres from the fifth nerve.

The *suprascapular* (Sp) comes off from the outer side of the same cord, and, like the last, appears to get all or nearly all its fibres from the fifth nerve.

The *external anterior thoracic* (Eat) arises by two roots, one from each of the two branches which unite to form the outer cord, *i. e.* one from the branch of the upper cord (fifth and sixth) to the outer cord, the other from the branch of the middle (7th) which completes the outer cord.

The *upper subscapular nerve* (Uss) takes origin from the branch of the upper cord (fifth and sixth) which goes to form the posterior cord.

The *long* (Lss) and *lower* (Iss) *subscapular nerves* and *circumflex* (C) arise close together from the posterior cord, the lower and circumflex often coming off by a common trunk.

The remaining nerves I have found to take origin from the plexus in the manner usually described, and as I have shown in the accompanying diagram.

The object of this paper is simply to draw attention to normal arrangement of the brachial plexus. I have, therefore, omitted any description of the irregularities occasionally met with. These are much less frequent than has generally been supposed, and, when present, are commonly caused either by a further splitting of the cords above their usual points of separation or by closer union and delay in the bifurcation of the various cords. In the latter case the abnormality is apparent rather than real, the union being caused by the fascia surrounding the plexus, and not by any interchange of nerve-fibres between the several strands of which the plexus is

composed. Thus, a few days ago my attention was drawn to a plexus which, whilst lying on the scalenus medius, consisted apparently of only two cords, but on removing the fascia which bound the seventh nerve to the eighth and first dorsal, the bifurcation of the cords and their subsequent union was found to be quite normal.

Since writing the foregoing description of the brachial plexus I have referred to the works of such Continental authors as were at hand. Cruveilhier¹ correctly describes the bifurcation of the three cords which I have named "upper," "middle," and "lower." He then proceeds to state that the upper branch of the middle cord unites with the lower branch of the upper cord, and that the lower branch of the middle cord unites with the upper branch of the lower cord, so that in this way four cords would be formed. Beyond this he does not trace the cords, but ends his description by saying that "from these bifurcations and subsequent anastomoses results the interlacement known as the brachial plexus."

Sappey² describes an exactly similar arrangement, which, he says, "*pourrait être comparé à deux X réunis par un Y.*"

In Henle's³ magnificent work, however, which may fairly be said to be the representative book of modern anatomy, I have found, somewhat to my disappointment, that there is a description which agrees very closely with that I have given above.

It is my intention at a future time to describe the abnormalities that I have met with in the arrangement of the cords and in the origins of the nerves from them. These have already received the attention of Turner,⁴ Kaufmann,⁵ and others.

¹ 'Anatomie Descriptive,' par T. Cruveilhier, translated by Madden, vol. ii, p. 1045.

² 'Traité d'Anatomie Descriptive,' par Ph. C. Sappey, tome deuxième, p. 333.

³ 'Handbuch der systematischen Anatomie des Menschen,' von Dr. J. Henle Dritter band, p. 473.

⁴ 'Nat. Hist. Review,' 1864. 'Journal of Anatomy,' vol. vi, p. 103.

⁵ 'Die Varietäten des Plexus Brachialis,' Giessen, 1864.

DESCRIPTION OF PLATE,

*Illustrating Mr. R. Clement Lucas's Paper on the Normal
Arrangement of the Brachial Plexus of Nerves.*

5, 6, 7, 8, 1, mark the four lower cervical nerves and first dorsal.

R. Nerve to the rhomboids.

Sc. Nerve to the subclavius.

Pt. Posterior thoracic.

Sp. Supra-scapular.

Eat. External anterior thoracic.

Iat. Internal anterior thoracic.

Mc. Musculo-cutaneous.

M. Median.

Uss. Upper subscapular nerve.

Lss. Long subscapular nerve.

Iss. Lower subscapular nerve.

C. Circumflex.

Ms. Musculo-spiral.

Lic. Lesser internal cutaneous.

Ic. Internal cutaneous.

U. Ulnar.

