LECTURES ON HUMAN MYOLOGY.

*Delivered at the Royal College of Surgeons
of England.*

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LECTURE II.—*June 19th, 1872.—(Concluded.)*

I PASS on now to speak of the subjacent muscular stratum, which may be called the "girdle-sheath" or the "deep ventro-appendicular sheath". It may be called the girdle-sheath, because it consists of muscular fibres passing from the girdle in each limb, ensheathing the joint of the limb with the girdle and ensheathing also the upper part of the limb. It may be called the deep ventro-appendicular sheath, because, forasmuch as the girdles are ossifications in the septa of the ventral part of the lateral muscles, they, together with the muscles passing to and from them, form parts of the system of that muscle.

The components of the girdle-sheath in each limb are segmented into a greater number of muscles than those of the overlying ventro-appendicular sheath. These muscles may be conveniently arranged into four groups or sectors—a dorsal, a palmar or a plantar, an anterior, and a posterior group. Of these, the palmar or the plantar, and the dorsal, underlie, and, as regards the stratification, correspond respectively with the palmar, or the plantar and the dorsal divisions of the superficial ventro-appendicular sheath.

The dorsal group is formed, in the one limb, by the infraspinatus and the teres minor, and, in the other, by the gluteus medius and minimus. These run, in each instance, to the part of the upper segment of the limb which is directed towards the dorsum of the girdle. This is different in the two limbs owing to the opposite direction in which the limbs are rotated upon their respective girdles, the dorsal surface of the upper limb being turned backwards, while that of the lower limb is turned forwards. Too much has, I think, been made of this circumstance of the insertion of the dorsal muscles of the scapula into the radial or pre-axial tubercle of the humerus, and of the dorsal muscles of the ilium, into the fibular or post-axial tubercle of the femur, as an argument against their comparison homologically. But a similar variation in the insertion of corresponding muscles in the two limbs of the same animal, or in the same limb in different animals, is so common (I need only refer to the biceps brachii, which passes, as it were indifferently, to the radius, the ulna, or both bones), that it should be no matter of surprise to find that the dorsal girdle-muscles are attached to that edge of the humerus or to that edge of the femur, in the upper or the lower limb, which, being directed dorsally, presents itself in the most favourable manner to them. We may learn from this disposition of parts the lesson which is confirmed by so many facts in anatomy, and by the disposition of the nerves most particularly, that special adaptation is attended with free modification of general developmental process, freer, perhaps, and deeper, than we have lately accustomed ourselves to think; and we may learn from the discussions which have taken place on this question, that, if we strain, as has been too much the tendency, at the gnats of homology, we shall find it necessary to swallow many camels. If we make, I mean, too much of the minor objections to certain homological comparisons, we shall find major difficulties lying across our path.

The gluteus medius offers a good illustration of the manner in which the length of fibres arising at different distances from the point of insertion is equalised. The upper and posterior corner of the ilium is further removed from the trochanter than the other parts of the ilium which give origin to this muscle; and, accordingly, a tendon runs up in this direction into the middle of the muscle, and receives, in a peninsular manner, the fibres derived from this part of the pelvis.

The palmar group is formed by the coraco-brachial and subscapular muscles. I have elsewhere shown that the subscapularis may be regarded as an extension of the coraco-brachialis, beneath the coracoid, upon the under surface of the scapula. In Man, the two members of the group are inserted into the ulnar edge and ulnar tubercle of the humerus; and the coraco-brachialis are small in accordance with the smallness of the coracoid. In animals in which this element of the girdle is abortive, the coraco-brachialis are absent; and in the animals in which it is large and reaches to the sternum, they are of proportionate size and number, and are divisible into two series. Of these, one, derived chiefly from the precoracoid, passes in front of the biceps, upon

the pre-axial or radial ridge and tubercle of the humerus; and the other extends along the post-axial or ulnar side of the humerus, and is perforated by the brachial artery and the median nerve. In Man, a thin sheet of the subscapular tendon passes over the biceps to the great or preaxial tubercle. It is to be regarded scarcely as a representation of the pre-axial division of the coraco-brachialis of *Ovipara*, but merely as an extension of the tendon of insertion from one tubercle to the other.

In the hind limb, the corresponding or plantar group is much larger and more subdivided, in accordance with the greater size of the corresponding elements of the girdle—the os pubis and the os ischii—from which they spring. They more nearly resemble the coraco-brachialis of *Ovipara* and *Monotremes*, and, like them, are inserted partly upon the pre-axial, and partly upon the post-axial side of the limb. Thus the pectineus and the adductors are inserted along the tibial edge of the linea aspera of the femur, which is the pre-axial line of the bone; and the obturators, with the gemelli and the quadratus, are inserted into the fibular edge of the linea aspera and the fibular trochanter, which constitute the post-axial line of the bone. I do not, however, wish to press this similarity to the establishment of any close homological correspondence; for the difference of disposition of the elements of the groups in the two limbs baffles the attempt to show any near parallelism between them. The internal obturator and the gemelli seem to be the nearest representatives of the subscapularis; and some of the other adductor elements appear to represent the coraco-brachialis. It will be remembered, however, with regard to the adductors, that, although some parts of them may extend upon the fibular side of the linea aspera, and though they are in great measure supplied by the obturator nerve, which is the nearest serial representative of the musculo-cutaneous nerve of the upper limb, yet no part of them passes upon the postaxial side of the flexor muscles, as does the coraco-brachial in Man; and the obturator nerve does not supply the flexor muscles of the leg as the musculo-cutaneous nerve does those of the forearm. Hence an exact comparison between either the muscles or the nerves is here out of the question; and we must be content with pointing out the general correspondence of the two groups.

The difficulty of comparing the muscles of this region in the two limbs is much increased by the disproportionate extent of the dorsal surface on the femur, and of the extensor cruris muscle arising from that surface, leaving the flexor or plantar surface to be represented only by the interval between the marginal lines of the linea aspera, including the popliteal space and the space between the two trochanters behind. This disposition, together with the forward curve of the femur and the projection of the tuber ischii, throws the flexors of the leg free from the thigh-bone, with the exception of the short or femoral part of the biceps, which contrives to insinuate itself into the narrow flexor interval between the edges of the linea aspera. Moreover, the muscles inserted into this surface readily pass (especially when, as is often the case in lower animals, the femoral part of the biceps is absent) from the one edge of the linea aspera, across the narrow flexor interval, to the other edge, so increasing the confusion and the difficulties of homological comparison. In the humerus, the ulnar marginal line maintains a nearly straight course from the ulnar condyle below, to the ulnar tubercle above, giving attachment to the subscapularis, latissimus dorsi, and teres major, and to the coraco-brachialis with the internal intermuscular septum. The radial marginal line of the humerus is distinct below, but ill-defined above the point at which it is crossed by the radial nerve; and neither the representative of this nerve nor the representatives of the deltoid or of the pectoralis, which occupy so much of the radial side of the humerus, have any connection with the femur.

An additional element of confusion is imported by the upper articular surface of the humerus presenting upon the post-axial side of the bone, while that of the femur is upon the pre-axial side. This difference is in accordance with the difference in the rotation of the two limbs; and it shows that the different direction of the corresponding surfaces of the two limbs does not depend, as has been supposed by some anatomists, upon a twist in the shaft of the humerus, but upon the fact that the rotation of the whole humerus upon the scapula is in an opposite direction to that of the femur upon the pelvis.

The anterior group is composed of the supraspinatus in the one limb, and of the iliacus in the other. The homology of these muscles has been pointed out by Mr. Mivart and Professor Flower; and I will not restate the arguments in support of that view. I have elsewhere given my reasons for thinking that they may be regarded as extensions respectively of the palmar and the plantar groups forwards, upon the anterior surfaces of the crests of the scapula and of the ilium; just as the subscapularis is an extension of the palmar group upon the inner surface of the scapula, and as the obturator internus is an extension of the plantar group upon the inner surface of the pelvis. The iliacus is accompanied by the psoas muscles, which are derivatives from the internal or trans-

versalis layer of the ventral part of the lateral muscle, specialised for the purpose of flexing the limb and also the lower part of the trunk upon the pelvis.

The three flattened, closely adjusted tendons which the obturator internus presents as it passes over the smooth surface of the ischium, have often attracted attention. They are the result of a division of the muscle within the pelvis into three flat fan-shaped portions. Of these, one, lying internal to the others (in a superficial plane when dissected from the inner side), arises from the inner surface of the angle formed by the horizontal and the descending portions of the os pubis. It is situated internally to the obturator vessels and nerve, and the arch of fascia which covers them, and therefore away from the obturator foramen. The tendon proceeding from this is the middle tendon of the three. The second division of the muscle, from which the lowest tendon proceeds, arises from the ossa pubis and ischii bounding the lower half of the obturator hole, and from the surface of the obturator ligament. The third division arises from the upper half of the obturator ligament, and from the ossa pubis and ilii above the obturator hole and beneath the brim of the pelvis. It extends upon the ilium nearly to the sacro-iliac synchondrosis. This tendon is the upper of the three. It occupies a groove commonly seen just below the spine of the ischium; and it sometimes presents a division into two for a short distance, giving the appearance of four tendons upon the internal surface of the muscle. The two last-mentioned divisions, which may be called respectively "pubischiatic" and "pubiliac", approach one another upon the obturator ligament beneath the first-mentioned, which may be called the "pubic" division. Having passed over the ischium, the tendons unite into one, the edges of which are joined above and below by the gemelli. If traced backwards from the trochanter, the tendon of the obturator gives off, first, in a penniform manner, the fibres of the gemelli; then, in like manner, those of the "pubiliac" and "pubischiatic" portions; and, lastly, in like manner, the fibres of the pubic portion.

The posterior group consists of the *teres major* in the fore limb, and of the *pyriformis* in the hind limb.

Thus it is seen that the deep ventro-appendicular muscles—the muscles passing from the girdles to the limbs—form sheaths over the shoulder and hip-joints, underlying and resembling the sheaths formed by the superficial ventro-appendicular muscles, though the latter take a wider range upon the trunk and upon the limbs.

It may be remarked, in passing, that the striking difference in the physical characters of the *psaos* and *iliacus* as compared with the muscles on the exterior of the girdles, the *gluteus maximus* and the *deltoid* more particularly, and which is caused by the layers of areolar tissue penetrating the latter and investing their bundles, appears to have no relation to the action of the muscles, but to the sheltered position of some as compared with others. It is an interesting illustration of the provision for, and the adaptation to, external contingencies, similar to that of the structure of the liver and kidneys on the one hand, and of the mammary gland on the other.

There remain to be considered the connections of the girdles with the middle, or internal oblique, stratum of the ventral division of the lateral muscle, constituting the "ventro-scapular" and the "ventro-pelvic" muscles. The pelvic girdle retains its primitive position as an ossified intermuscular septum in the ventral part of the lateral muscle, and extends through the entire thickness of the muscle, all the strata of which are extensively attached to it, as already mentioned. The part beneath the crural arch is indeed the only region in which this is not the case.

The same may be said with regard to the shoulder-girdle in the Fish, where the coracoids and epicoracoids† meet in the middle line, and intercept the deeper strata of the ventral muscle on their way to the hyoid bone and the head. In most other vertebrates, however, the sternum intervenes between the girdles of opposite sides, and intercepts the middle parts of the ventral muscle. Where this is the case, and where the coracoid reaches the sternum, a portion of the ventral muscle is often continued on from the sternum or the ribs to the coracoid, forming the sterno- or costo-coracoideus, which is a serial continuation of the intercostals. The only approach to a muscle answering to this in connection with the pelvis, and that in a very distant manner, is the ischio-coccygeus or coccygeus. When, as in Man, the coracoid is short, and the epicoracoid or clavicle takes its place as the medium of connection between the girdle and the sternum, the representative of the costo-coracoid muscle runs on to the clavicle and

forms the subclavius. Forasmuch, however, as the clavicle is in a plane superficial to that of the coracoid, so is the subclavius in a plane superficial to that of the costo-coracoideus. Indeed it is nearly on a level with, and is in some animals blended with, the *pectoralis minor*; and it is now and then continued upon the surface of the *supraspinatus*. In some animals, the hyoidean muscles, which are also parts of the deep ventral strata, are likewise attached to the clavicle; and traces of this connection are shown in Man by the fascial band which attaches the tendinous intersection in the *omo-hyoid* to the clavicle.

Whichever of these (costo-coracoid or costo-clavicular) portions of the ventral muscle, connected with the girdle on the mesial side of the glenoid cavity, is present, it is separated by the vessels and nerves of the limb from the costo-scapular portion of the ventral muscle; *i. e.*, the portion which passes to the girdle on the lateral side of the glenoid cavity, and which is ordinarily named *serratus magnus*. This latter muscle spreads upon the chest in proportion as the scapula grows downwards over the ribs; and the prolongation both of the angle of the scapula and of the muscle in this direction have relation to the growth of the spine of the scapula forwards. The increased power which the overhanging spine or acromion gives to the *deltoid* in Man necessitates the leverage which the long inferior angle of the scapula affords in him to enable the *serratus* to combine effectually with the other muscles in fixing the scapula during the effort of raising the arm. The necessity thus arising for combining the *serratus*, and especially the lower part of it, in action with the *deltoid* (the importance of which is forced upon our attention in the cases in which from paralysis of the *serratus* this combination fails), is probably the reason for the muscle being supplied, even to its lowermost part, by a branch from the brachial plexus. Some such explanation is required for this departure from the usual rule, that a muscle is supplied by the nerves of the region which it covers.

It will not fail to be remarked that some of the fibres of the *serratus* are continuous with those of the external oblique, and that this indicates that the two muscles belong to the same stratum. It indicates, perhaps, rather that our divisions into strata and otherwise are, after all, to a considerable extent, artificial, and must not be too strongly insisted on. Though thus connected with the external oblique the position and general relations of the *serratus* are deep, and connect it rather with the deeper, or internal oblique, layer of the ventral muscle.

The *serratus* in many of the lower animals is divided into two or more parts; and in man the upper one or two digitations are often more or less separate from the remainder; and the upper one is supplied by a separate cervical nerve, while the second digitation and the rest of the muscle are supplied by the special *serratus* nerve, misnamed "external respiratory". In a specimen lately dissected the muscle was in two parts; an upper, with three digitations, of which two were derived from the second rib; and a lower with seven digitations. The upper portion was inserted beneath the upper angle of the scapula and into the upper half of the dorsal edge; and the lower portion was inserted into the under surface of the inferior angle. The length of the fibres increased from above downwards but not quite in regular sequence. Those of the upper portion were much shorter than those of the lower portion. The fibres of the first digitation measured 3.5 inches; of the second, 4; of the third, 4.5; of the fourth, 6; of the fifth, 7; of the sixth, 8; of the seventh, 8.4; of the eighth, 8; of the ninth, 7.6; of the tenth, 7.5. The fibres of the seventh digitation being the longest, and those of the first being the shortest, we may infer that the greatest range of movement of the scapula effected by this muscle is in the axis of the seventh digitation, and that the least range of movement is in the axis of its first digitation. The lower portion of the muscle is commonly a large thick mass of fibres converging in such a manner that their action is concentrated upon the lower angle of the scapula. They thus combine most effectually in fixing the scapula, and preventing its rotation when the *deltoid* contracts in the action of raising the arm.

The continuation of the costo-scapular, or *serratus*, portion of the ventral muscle, forwards upon the cervical transverse or costal processes, with a slight interval scarcely perceptible in many animals, constitutes the *levator scapulae*. The serial homologue of this muscle, connected with the pelvis, is found in the *quadratus lumborum*.

The *omohyoideus* is an interesting reminder, and it is the only one usually met with in mammals, of the extensive connection which the middle layers of the ventral muscle, passing backwards from the hyoid, have with the shoulder-girdle, in the lowest vertebrates. The tendon which divides it into two parts is on a level with the inscription not unfrequently met with in the sterno-hyoid, and is apparently, like that inscription, a derivative from the intermuscular septum, which forms an element in the portion of the lateral muscle from which both these muscles are derived. Its elongation, conversion into tendinous tissue, and fascial connection with the clavicle, together with the bend or

* The word "scapular" is here meant to comprise the coracoid as well as the scapular part of the girdle.

† By "epicoracoids", I mean the bone or bones developed upon the surface of the coracoids, to which the term "interclavicle" has been applied by Parker, in his very valuable monograph on the *Structure and Development of the Shoulder-girdle and Sternum in the Vertebrata*.

genu made at the part, are analogous to the tendinous conversion and connection with the hyoid, which we are familiar with in the middle part of the digastricus of Man. The special purpose of the arrangement, in this instance, is probably to afford an additional provision against a retraction of the tissues, and the consequent pressure upon the subjacent venous trunks, during strong inspiratory and other muscular efforts.

The fixity of the pelvic basis of the lower limb as compared, or rather contrasted, with the mobility of the scapular basis of the upper limb, is attended with a corresponding modification in the muscles—the ventro-pelvic muscles—which connect it with the deeper strata of the ventral muscle. They take origin from it as the fixed point. I have mentioned that the quadratus lumborum is the nearest serial homologue to the levator scapulae, and that the coccygeus presents some claim to be regarded in a like relation to the costo-coracoides or to the subclavius. The ilio-caudalis in tailed animals is the representative in this region of the serratus magnus; and the vessels and nerves to the hind limb, in such animals, take their course between the ischio-caudalis (*alias* coccygeus) and the ilio-caudalis, just as those to the fore limb take their course between the costo-coracoid, or the subclavius, and the serratus.

CLINICAL LECTURE

ON THE

RELATION BETWEEN MENSTRUATION AND THE CHLOROSIS OF YOUNG WOMEN.

By WILLOUGHBY FRANCIS WADE, F.R.C.P.,

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GENTLEMEN,—The patient whom you saw last week, and the notes of whose case I have just read to you,* presents a fair average example of the disease which is called chlorosis, or, popularly, green sickness. Both these names are derived from the greenish hue which the skin of many of these persons presents. This is but slightly marked in our present case, and in many others which are still no doubt essentially of the same nature as chlorosis, the skin is simply pallid. This difference of coloration probably depends somewhat on climatic causes. We know that amongst Negroes the degree of blackness is not directly proportioned to the temperature, but is influenced by other causes, some of which are probably hygrometric. Now in Birmingham, which is bracing in its climate, we do not often see highly developed cases of chlorosis; but I well remember that, when I was a pupil at the Derby Infirmary, they used to be common enough. The coloration, when it exists, is due to deposit in the skin of pigment found floating free in the blood, which ought probably to be used, instead, in the formation of red corpuscles, the diminished proportion of which corpuscles is one of the most essential elements of chlorosis—a fact which has been analytically proved by Andral and others. Having brought the subject of melasma before you lately, I need not now dwell on this part of the subject, further than to remind you that in every case *anæmia plus* melasma is always more serious and more intractable than simple *anæmia*. It is also well to remember that a complexion of this kind often leads patients, and sometimes practitioners, to imagine the existence of hepatic disorder where none exists.

As you knew last week that it was my intention to-day to lecture on this subject, you have no doubt taken my advice and read it up in your text-books. I shall not, therefore, weary you by a repetition of the usual phenomena of this complaint, but occupy the time in discussing some points which you will not have found there satisfactorily treated. These points are, the etiology of the disorder and its relation to menstruation. The fact that this disease is most common about the commencement of puberty, and for some years afterwards, long ago led to the supposition that there was some connexion between it and the menstrual function; and, inasmuch as in many of these young women this function is but irregularly performed, it has been supposed that chlorosis was caused by this irregularity. Others again, struck by the undoubted fact that in some of the worst cases there was no such irregularity, have concluded that the origin of the disease was wrapped in profound mystery. In one of the latest medical text-books (Niemeyer's) we find this passage: "In females between the ages of fourteen and twenty-four, chlorosis is one of the most common of disorders. It is very natural, then, to ascribe the disease to the effects of those processes which are going on in the bodies of young girls at the

period of puberty; but we are still ignorant as to what physiological connexion exists between these two conditions." This ignorance I hope to dissipate.

About forty years ago, Dr. Marshall Hall published a medical work which is to my mind quite as sensational as any of the works of an at present very popular authoress. At that period it was the fashion to practise bleeding from the arm with the same recklessness and disregard of common sense as some persons now prescribe alcohol and tonics, and perhaps, on the whole, with not much more deleterious effects. Amongst other results produced by loss of blood, he noticed head-symptoms such as we see in chlorosis—photophobia, tinnitus aurium, headache, etc. But a much more curious circumstance was, that he discovered that another bleeding very often entirely cured these very symptoms which had been produced by the former one. This relief, however, was only temporary: after an interval, all the symptoms returned with increased intensity. This relapse, he found, strangely enough, might in its turn be cured by yet another venesection; and so on—bleeding, symptoms, bleeding, relief—for several successive repetitions. But after each bleeding the interval of relief was shorter; and, on each return of the symptoms, they were more intense, till at last bleeding failed to afford any relief, and the patient died—bled to death as surely as animals are bled to death by the butcher. Now you will have observed that in our patient, as I ascertained by minute inquiry from her and her mother, each menstrual flow produced just the same relief to her head-symptoms that venesection produced to those of the patients whose histories are given by Marshall Hall. This is not surprising, because this discharge contains red corpuscles in large quantities, altered to a certain extent, it is true, but still red corpuscles. Now it was shown by Andral that most of the symptoms, if not all, produced by hæmorrhage, depend upon the loss of the red corpuscles, and the consequent loss of their effects upon the system. This he proved by injecting red corpuscles into the veins of animals which had been bled, and by finding that their injection without that of any of the other constituents of the blood removed the symptoms which had been developed by the bleeding.

It is proved, then, that this girl, who is suffering from deficiency of the red corpuscles of the blood, and has certain unpleasant symptoms arising from that deficiency, is relieved by the menstrual discharge, just as she would be by a small bleeding; and, secondly, that in a little time the symptoms return, just as they would in a person suffering from loss of blood, who had been yet relieved by a small bleeding. I can assure you, from careful examination during the last twenty and more years of a very large number of cases, probably several hundreds, that what happens to this girl as a consequence of menstruation invariably happens in girls who are suffering from chlorosis; but you will not be able to corroborate this statement by casual, off-hand, or careless examination.

Here, then, we get a clue to the real relation between menstruation and chlorosis. If it be true, as above stated, that menstruation acts as a bleeding would do upon the symptoms of *anæmic* persons, may it not act as a bleeding would, and produce that *anæmia* in the first instance? It not only may do so, but it does so; and this not when it is apparently excessive, as in disease called *menorrhagia*, but even often when it is moderate in amount, or really, judged by ordinary standards, scanty. It is very strange that so able an observer as Marshall Hall should not have discovered this. In a very excellent book *On the Constitutional Diseases of Females*, he writes: "There is, indeed, a remarkable similarity between the effects of loss of blood and the state of bloodlessness which obtains in chlorosis. The general symptoms; the tendency to affections of the head resembling arachnitis, and to affections of the heart resembling organic affections of this organ; the condition of the general surface, and of the capillary and larger circulations; the proneness to oedema and serous effusions generally, are, indeed, identical in both these conditions." There are, however, many circumstances that have thrown observers off the scent.

In the first place, a belief, or rather prejudice, exists, that chlorosis is very common in girls who have never menstruated. Now, it is not true that it is much commoner in such girls than it is in boys. It very rarely occurs without obvious and sufficient cause in such girls. Some years ago, I examined the records of forty-six cases of my own with reference to this point. Of these, seven had never menstruated; but two of the seven had suffered from repeated attacks of epistaxis, the cause of which could not be determined. One, as well-marked a case of chlorosis as I ever saw, was a well-developed girl aged 16, who had always enjoyed good health till, falling accidentally, she struck her nose, and had epistaxis to the amount of ten or twelve ounces. Gastric irritation and some of the cerebral symptoms of hæmorrhagic reaction followed, and she fell into a chlorotic condition, which, when I saw her, had lasted for two months. The fourth case was that of a girl who had been nearly drowned some time before, and had never been well afterwards. This is no uncom-

* I do not consider it needful to burden the space of the JOURNAL by the details of an ordinary case of chlorosis, and therefore omit them.