

THE MUSCLES OF MAMMALS, WITH SPECIAL RELATION TO HUMAN MYOLOGY: A COURSE OF LECTURES DELIVERED AT THE ROYAL COLLEGE OF SURGEONS OF ENGLAND, by F. G. PARSONS, F.R.C.S., *Hunterian Professor*.

LECTURE I.—THE SKIN MUSCLES AND MUSCLES OF THE HEAD AND NECK.

MR PRESIDENT AND GENTLEMEN,—As the whole subject of mammalian myology is too large to be dealt with in three lectures, I have had some difficulty in making up my mind what points I should bring before your notice, and what I should leave out. It seemed to me that it would be more in keeping with the spirit of the man in whose memory these lectures are given if I laid special stress on the chief points which I have myself observed, and the deductions I have drawn from them.

If I fail to call sufficient attention to the writings of others, writings often more worthy of being recorded than my own, it is because I feel that the honour of a Hunterian Professorship of this College calls for as much original work as the holder is capable of giving.

The muscles to which I have decided to call your attention have been chosen, as far as possible, because they have some bearing on human myology; because they seem to explain either the constant arrangement of man's muscles, or the commoner variations met with in him. My own acquaintance with the muscles of monkeys and anthropoid apes has been greatly added to by the kindness of my friend Mr Keith, who has placed at my disposal a mass of, as yet, unpublished work on these animals.

I must disclaim any intention of giving a complete account of all that is known about any muscle: such a proceeding would not, I think, be suitable for a short course of lectures. I shall rather try to call your attention to certain disjointed facts which seem to me suggestive, and which I hope may prove interesting.

*Panniculus carnosus*.—This is found throughout the mam-

malia, and forms a more or less complete investment of the trunk, as well as being prolonged for some distance on the extremities. It is important to realise that this skin muscle consists of several layers, the fibres of which run in different directions. It thus happens that in some places as many as three, or even four, planes of fibres may be detected, while elsewhere it may be wanting entirely, and nothing intervenes between the skeletal muscles and the skin. In many places the panniculus becomes attached to subjacent bony points; and when these special fibres are of use to the animal, they increase and form bundles sufficiently marked off from the rest to induce an observer to give them a special name. Some of these bundles are of interest to the human anatomist, although I know of no mammal that is less well adapted for studying the skin muscles than man.

If we select a mammal in which the panniculus is fairly, but not very strongly, developed, such as one of the carnivores, a racoon for instance, we find the platysma running from the mouth region backward and upward, that is, dorsally and caudalward. Deep to this is another muscle which rises from the fascia over the masseter, and passes ventrally and caudalward, ending in the mid line of the throat, where it blends with its fellow of the opposite side: this muscle, from its appearance, is known as the sphincter colli. On the lateral part of the trunk of the same animal we find a layer of muscle which shades off into the skin posteriorly, while anteriorly it passes deep to the pectoralis major, to be inserted into the humerus. The dorsal part of this layer is known as the dorso-humeralis; the ventral part, feebly developed in carnivores, as the abdomino-humeralis. The dorso-humeralis, of course, lies superficial to the latissimus dorsi; and its fibres, to reach the humerus, have to wind round the ventral border of that muscle, and then cross the axilla. The shoulder region, it will be seen, has no panniculus at all over it (fig. 1).

A dissection of an ungulate would show nearly the same arrangement of dorso-humeralis, but the sphincter colli is ill developed, and in the horse there is a vertical bundle of fibres over the shoulder, which enables the animal to wrinkle the skin of that region in the manner familiar to everyone. If we next examine the panniculus of a rodent, a porcupine or guinea-pig for instance, we shall find that the platysma and dorso-humeralis are nearly identical with the same muscles in the carnivore, except that part of the latter is continued over the shoulder region, while the abdomino-humeralis is much more strongly developed and covers the external oblique muscle; as we trace it forward toward the pectoral, we find that, with care, it can be separated into two sheets, the more superficial of which passes ventral to the pectorals, while the deeper is interwoven with the fibres of

that muscle; we further see that there is no sharp line of demarcation between the abdomino- and dorso-humeralis. The sphincter colli in rodents rises from the fascia over the masseter, as in carnivores,

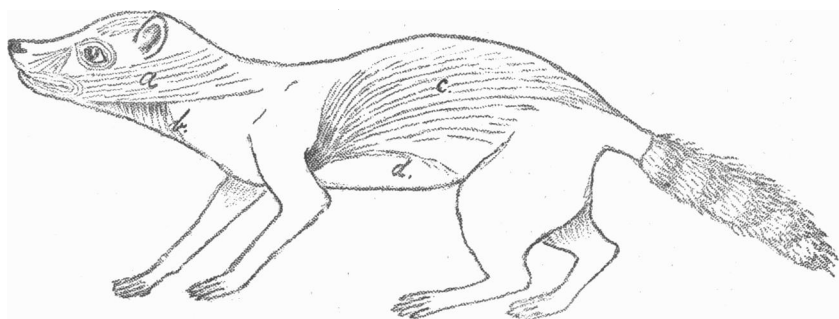


FIG. 1.—Panniculus of Racoon (*Procyon*). *a*, platysma; *b*, sphincter colli; *c*, dorso-humeralis; *d*, abdomino-humeralis.

but, as a rule, the muscle, instead of being inserted into the mid line of the throat, is continued to the anterior part of the manubrium sterni, and consequently Dobson proposed the name of 'sterno-facialis' for it; this arrangement is very well seen in *Octodon*, one of the

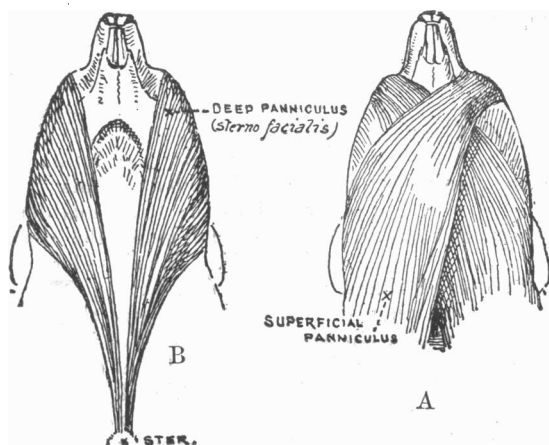


FIG. 2.—Platysma (A) and Sterno-facialis (B) of *Octodon*. (From the *Proceedings of the Zoological Society*.)

porcupine-like rodents (fig. 2). The strand mole or mole rat (*Bathyergus maritimus*) shows us that the sterno-facialis of rodents and the sphincter colli of carnivores are one and the same muscle. Here some of the fibres are inserted in the mid line of the throat, while the more

posterior, instead of ending in the manubrium sterni, are continued back over the surface of the pectorals, and blend with the superficial plane of the abdomino-humeralis (fig. 3).

Let us next consider the arrangement of these parts in an insectivore. The hedgehog (*Erinaceus*) is an animal in which, as one would expect, the panniculus is extremely well developed: in it the sphincter colli is so strongly marked that it no longer covers the

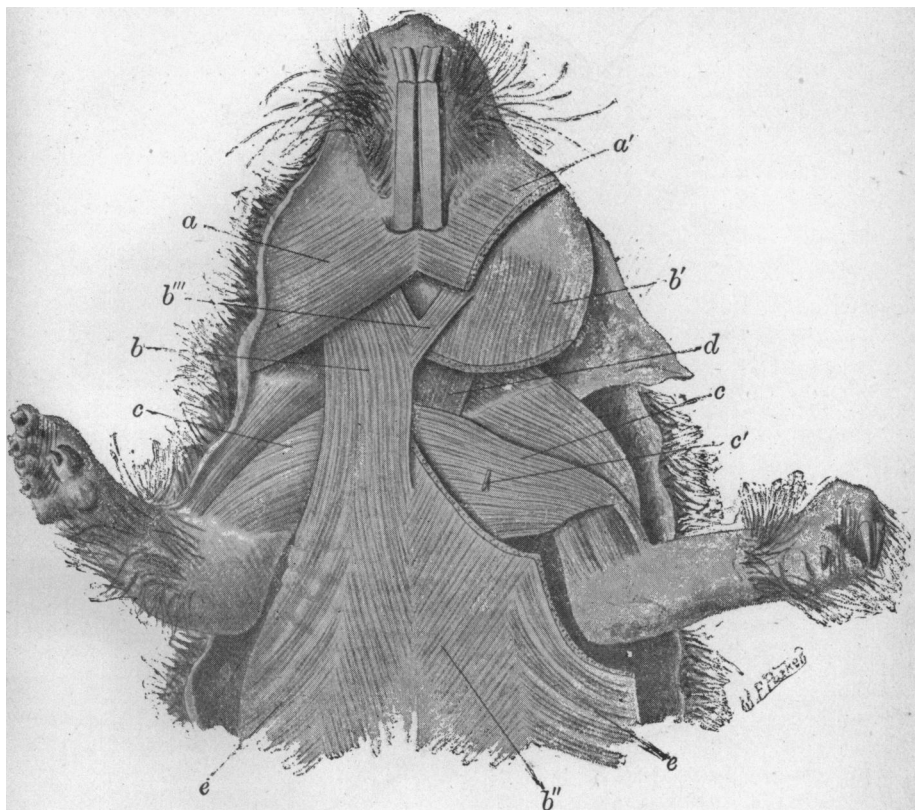


FIG. 3.—Panniculus of Strand Mole (*Bathyergus*).

*a*, platysma; *b*, sterno-facialis muscle; *b'*, sterno-facialis cut; *b''*, sterno-facialis cut; *b'''*, fibres decussating in mid line, foreshadowing the sphincter colli of the Primates; *c*, pectoral muscle; *c'*, branch of anterior thoracic nerve supplying the sterno-facialis; *d*, sterno-mastoid muscle; *e*, superficial fibres of the abdominal panniculus carnosus continuous with the sterno-facialis.

ventral part of the throat only, but the whole of the pectoral mass, and meets its fellow in the mid line from close to the symphysis menti to as far back as the xiphisternum (fig. 4). There can, I think,

be no doubt that this is the same muscle as the sphincter colli of the carnivore or the sterno-facialis of *Octodon* or *Bathyergus*. The dorso-humeralis is enormously developed, and most of its fibres pass over

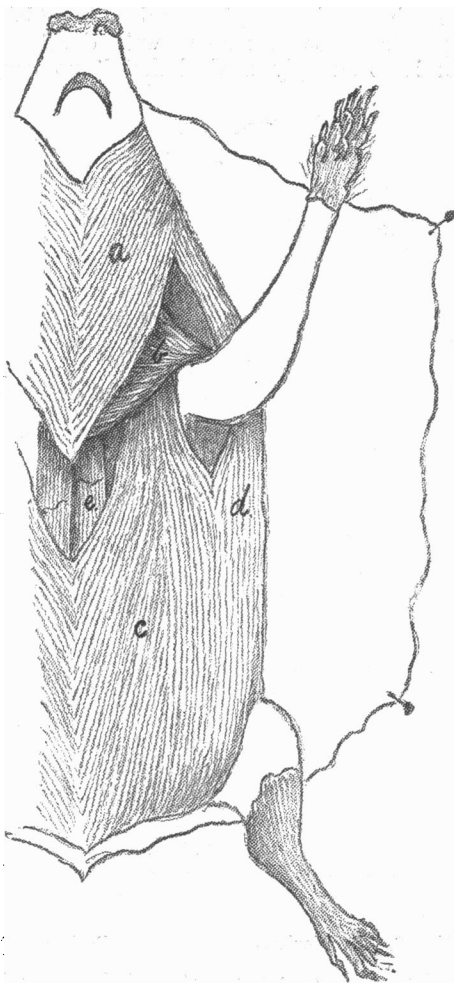


FIG. 4.—Panniculus of Hedgehog (*Erinaceus*). *a*, sterno-facialis or sphincter colli; *b*, pectoral; *c*, abdomino-humeralis; *d*, dorso-humeralis; *e*, rectus ventralis.

the shoulder to the neck, where they fuse with the lateral part of the sterno-facialis, forming the huge sphincter muscle of the body which rolls the animal up into a ball, and which has so often been described.

The abdomino-humeralis is present, but is, in comparison, feeble: it passes entirely deep to the pectorals,—at least, I have never been able to find a superficial layer corresponding to that of *Bathyergus*. The ventro-humeralis and pectorals of all these animals are supplied by a large nerve which runs back (caudalward) from the internal cord of the brachial plexus. In the bats the platysma is extremely well marked, and is divided into two or three separate portions, but the sterno-facialis is entirely wanting as far as I have been able to find out (fig. 5). In the lemurs and cynomorphous monkeys the platysma is well developed, and reaches dorsally nearly to the mid dorsal line of the

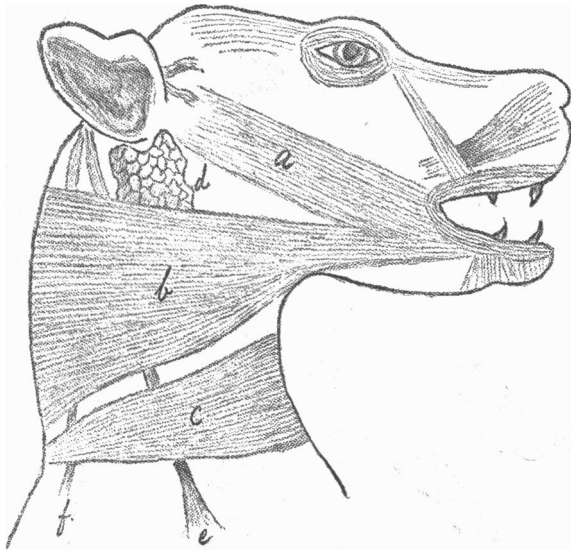


FIG. 5.—Neck of Fruit Bat (*Pteropus*), showing tripartite platysma and absence of sphincter colli. *a*, *b*, *c*, platysma; *d*, parotid gland; *e*, *f*, slips of panniculus to patagium.

neck: it passes close behind the ear, and some of its anterior fibres in the lemur are evidently separated to form a transversus nuchæ. The sphincter colli, as Ruge has shown, is practically identical with that of carnivores. As the anthropoid apes are reached the sphincter colli disappears, until in man only vestiges of it remain. The abdomino-humeralis disappears in the primates, and probably becomes the sheath of the abdominal muscles; while the dorso-humeralis is present in lemurs and cynomorphous monkeys as a small flat muscle, lying superficial to the trapezius, and ending in a tendon which winds round that of the latissimus dorsi to cross the axilla, and become inserted into the humerus, in its usual place, deep to the pectorals (fig. 6). In the higher apes and man this too disappears.

Now to apply these facts to man. There can be little opposition to the view that the achselbogen or muscular slips so often found running across the axilla, and uniting the latissimus dorsi with the pectorals, are remains of the dorso-humeralis passing across from the superficial surface of the latissimus dorsi to the deep surface of the pectoral (fig. 6).

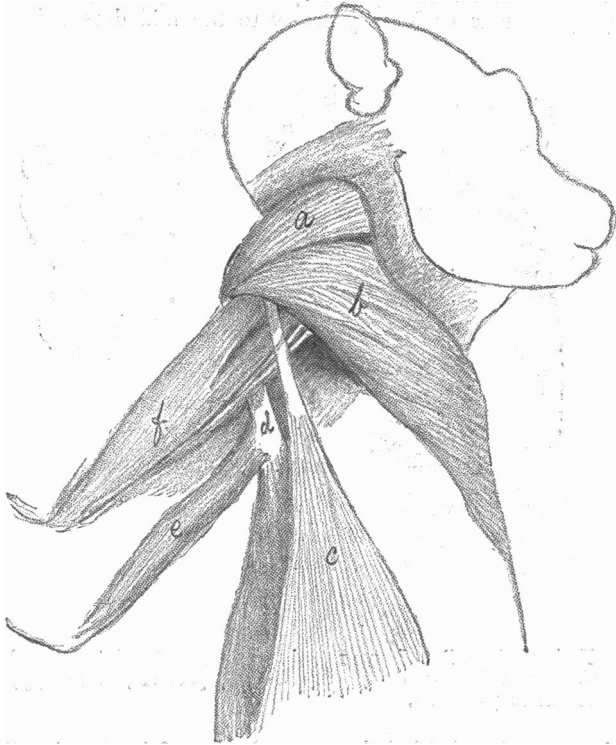


FIG. 6.—Axilla of Macaque Monkey. *a*, deltoid; *b*, pectoral; *c*, dorso-humeralis; *d*, latissimus dorsi; *e*, dorso-olecranalis; *f*, biceps.

Ruge has shown that the transverse muscular fibres, which are sometimes found under the chin in man, superficial to the mylohyoid and digastric, are probably relics of the most anterior part of the sterno-facialis or sphincter colli; while I have contended that the musculus sternalis, that curious abnormality in man about which so much has been written, is nothing more than a survival of the thoracic fibres of the same muscle; and I think

that anyone who looks at the position and relations of the sternofacialis of either the hedgehog or the African mole rat (*Bathyergus*) must be struck by the fact that if the neck portion (sphincter colli) were removed, a typical sternalis would remain (see figs. 3 and 4). The human sternalis is probably completed caudally by the superficial layer of the abdomino-humeralis, and this explains its tendency to merge in the fascia covering the abdominal muscles. In addition to this, a branch of the internal anterior thoracic nerve has been found piercing the pectoral in *Bathyergus*, and supplying the superjacent portion of panniculus. I am glad of the opportunity of advancing this theory again, because, since I first suggested it at a meeting of the Anatomical Society in 1895, I have been more and more convinced of its probability. The chief points made by those who do not agree with my views are, firstly, that a good explanation for the sternalis has already been given by Prof. Cunningham, who regards it as some of the fibres of the pectoral which have become twisted at right angles to their proper course; secondly, that in the animals nearest man—apes and monkeys—a sternalis has never been found; and thirdly, that there is no reason why connective tissue should not become muscular whenever and wherever the need for it may occur, without necessarily being a reversion to an ancestral arrangement. Into the merits and demerits of these objections I do not now propose to enter: I only wish to put my own hypothesis, with the facts on which it is based, before you.

We have noticed that in some animals the abdomino-humeralis passes both superficial and deep to the pectorals, and that some of its fibres may even pierce the pectoral, to be inserted with the fibres of that muscle. It is also a fact that in many mammals the hinder (caudal) fibres of the pectoral rise from the linea alba, a considerable distance behind the xiphisternum, and cover a good deal of the external oblique and rectus ventralis (abdominis). Further, it is known that the abdomino-humeral and pectoral muscles are supplied by the same nerve from the internal cord of the brachial plexus, while the obliques, rectus, and intercostals are supplied by intercostal nerves. All these facts make me regard the pectoral muscles as part of the panniculus; and although the theory sounds somewhat startling at first, when one



considers the embryology of the parts it does not appear so unlikely. It is admitted that the ventro-lateral muscles of the trunk are divided into four planes, of which the deepest is formed by the transversalis and triangularis sterni, the second by the internal oblique and internal intercostals, the third by the external oblique, the external intercostals, and, I have no hesitation in adding, the supracostalis; the fourth layer is the panniculus. It is further asserted that the panniculus, or most superficial layer, is a delamination from the third layer, after the three others have been formed. The mesial ventral mass of muscle does not show the division into layers so well; it consists of the rectus and its sheath. The pectoralis is usually regarded as a delamination from the surface of the third layer. I, on the other hand, prefer to regard it as part of the fourth or pannicular layer, itself a delamination of the third layer, so that what appears at first sight a revolutionary suggestion, becomes on examination a matter of very slight moment.

*Digastric* (Depressor mandibulæ).—The most important point to bear in mind, in considering this muscle, is that it is not always really digastric, but that, even when it appears monogastric, it has a double nerve supply. The anterior portion of the muscle is supplied by the fifth nerve, the posterior by the seventh. Our knowledge of the anatomy of the fish tells us that the muscles developed in the first or mandibular visceral arch are supplied by the fifth nerve, while those formed in the second or hyoid arch derive their nerves from the seventh. Nerve supply is not always to be relied upon in determining the homologies of muscles, but there is good reason to agree with Humphry in regarding the anterior belly of the digastric as a portion of the myotome belonging to the mandibular arch, of which the temporal, masseter, and pterygoids are part, and of looking upon the posterior belly as part of the myotome of the second arch, from which are also derived the stylo-hyoid and most of the facial muscles. The central tendon is a remnant of the connective-tissue interval or myocomma between the two myotomes.

In dissecting three Ornithorhynchi, I found a muscle running from the sub-hyoidean septum, outward and a little forward to the mandible, not far from the angle: it was supplied by the fifth nerve, and lay superficial to the mylo-hyoid muscle, of which it

appeared a delamination, and with which its fibres had nearly the same direction (fig. 7). In the same animal a single muscle runs from the long tubular external auditory meatus to the sub-hyoidean septum: it is supplied by the facial nerve, and probably corresponds to the combined stylo-hyoid and posterior belly of the digastric. From this I am inclined to think that the anterior belly is an older muscle than the posterior, or, in other words,

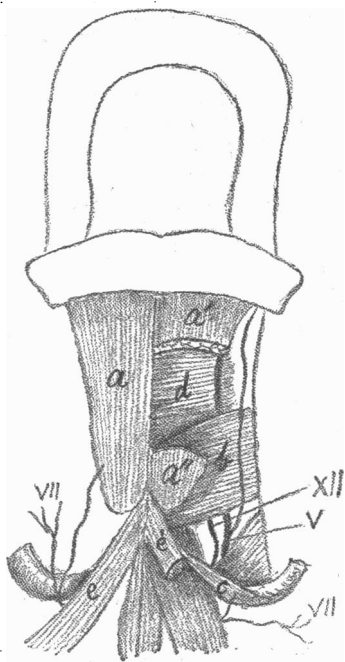


FIG. 7.—Throat muscles of *Ornithorhynchus*. *a. a'*, part of panniculus; *b*, anterior belly of digastric; *c*, posterior belly of digastric; *d*, mylo-hyoid; *e. e'*, part of panniculus.

that the anterior belly is differentiated from the mylo-hyoid layer before the posterior belly is split off from the stylo-hyoid. This possibly may be the reason why absence of the anterior belly of the digastric is very rare in man, but absence of the stylo-hyoid is fairly common.

Excluding the monotremes, the digastric muscles of mammals may, I think, be divided into three classes.

In the first class the anterior and posterior bellies are separated

by a considerable length of tendon (fig. 8); the posterior belly narrows into a rounded tendon, which passes forwards until it reaches the region of the hyoid bone, then it runs inwards ventral to the hyoid bone and meets its fellow of the opposite side, forming an arch with the convexity forwards; this arch is quite independent of the hyoid bone, and is only attached to it by connective tissue. The anterior bellies of the digastric spring from the convexity of the arch and extend forward to the mandible close to the symphysis, touching one another in the

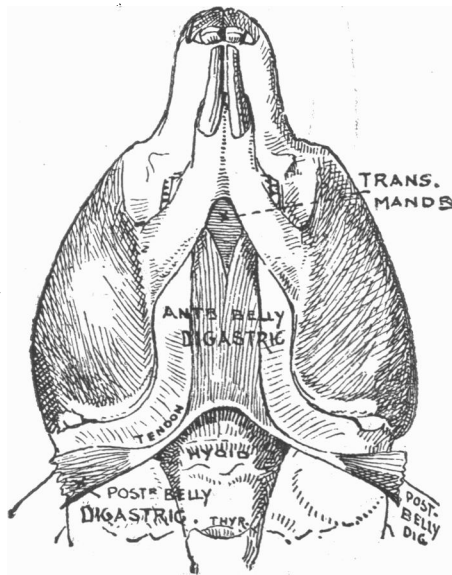


FIG. 8.—Digastric of Flying Squirrel (*Pteromys*). (From the *Proceedings of the Zoological Society*.)

middle line of the neck. This kind of digastric is not confined to any one order. It is found in all squirrel-like rodents (sciurormorphine), as well as in many of the mouse-like tribe or myomorphine, but it is never seen in the porcupine-like (hystricomorphine) or hare-like (lagomorphine) groups. It is also found in many of the insectivora, and in most of the cynomorphous monkeys and anthropoid apes, such as the macaques, cercopithecii, black apes (cynopithecii), baboons (cynocephali), orangs, and chimpanzees.

The second division of the muscle we may describe as pseudo-

monogastric (fig. 9). In this the muscle at first sight seems to consist of only one belly, but a closer inspection will, in my experience, always show some indication of a central tendon, usually in the form of a few tendinous fibres on the surface, though these seldom extend into the interior of the muscle when it is cut across, and there is only a very slight constriction of the muscle in the middle. The anterior bellies are usually attached to the mandible midway between the symphysis and the angle, and, instead of being flat planes meeting in the mid line of the neck,

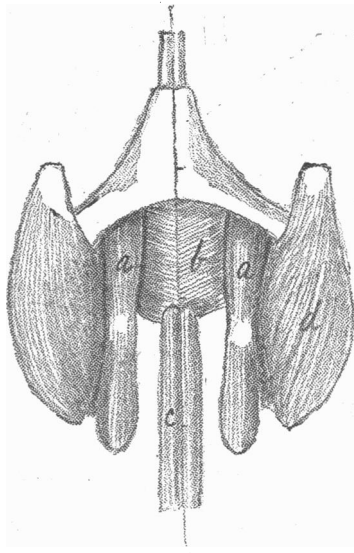


FIG. 9.—Digastric of Guinea-pig (*Cavia cobaya*), showing pseudo-monogastric type. *a*, digastric; *b*, mylo-hyoid; *c*, sterno-hyoid; *d*, masseter.

they are usually rounded and leave a considerable expanse of the mylo-hyoid exposed between them. As we have already noticed, the double nerve supply is always found. This kind of digastric is found in the porcupine-like (hystricomorphine) sub-order of rodents, in kangaroos, in all carnivora (fig. 10), and in the vesper-tilionine and pteropine bats. In the latter animals, which include the fruit bats and flying foxes, Macalister has drawn attention to an oblique intersection indicating the central tendon. The presence of this intersection I have verified.

The third kind of digastric is intermediate between the other

two. It is the typical digastric of man, and consists of anterior and posterior bellies connected by a definite central tendon, the anterior bellies failing to unite in the middle line of the neck, but usually reaching forward to near the symphysis. This variety of the muscle is found in most lemurs and many monkeys, especially the New World monkeys (platyrrhini), gibbons (hylobates), and many specimens of gorillas.

It is quite easy to find transitional stages between these three

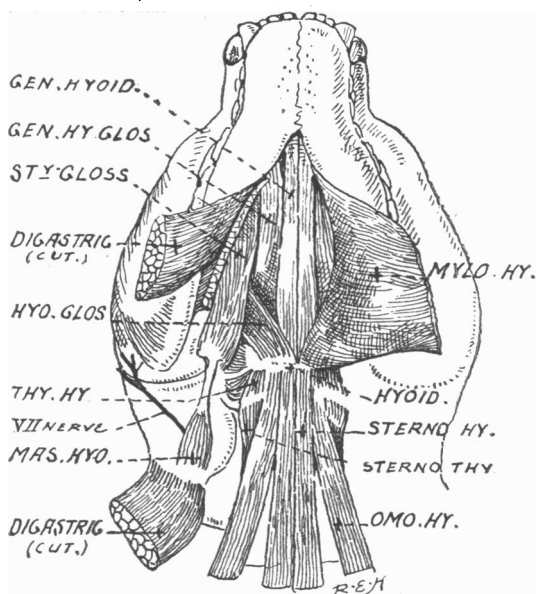


FIG. 10.—Throat muscles of Otter (*Lutra vulgaris*), showing cut digastric. (From the *Proceedings of the Zoological Society*.)

varieties of the muscle. We have already seen that some indication of a central tendon is almost always present, if carefully looked for, so that the second and third groups may easily pass into one another; while in many gibbons and semnopithecus monkeys the anterior bellies are connected by fibrous tissue across the middle line of the throat, and a little condensation of this tissue posteriorly would result in the definite sub-hyoid arch of the first variety. This arrangement I have recently seen in a spider monkey (*Ateles*). It is interesting to note that the commonest abnormalities of the digastric in man show transi-

tions from this third variety to the first or more generalised and primitive type; the anterior bellies are sometimes found meeting in the middle line; while Keith states that in a young human foetus the sub-hyoid arch may often be detected. The mento-hyoid muscle, which is found as an abnormality in man, running from the hyoid bone to the mental symphysis near the middle line, may be a remnant of the mesial part of the anterior belly of the digastric of the first variety; but about this muscle I have more to say later.

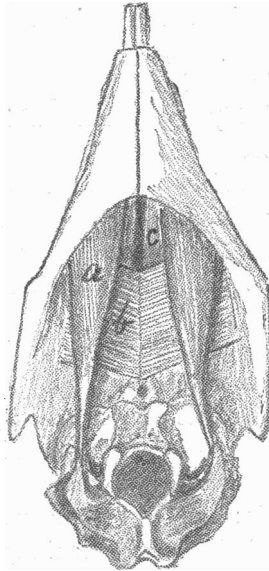


FIG. 11.—Digastric of Rabbit (*Lepus cuniculus*), showing absence of posterior belly. *a*, digastric; *b*, mylo-hyoid; *c*, genio-hyoid.

There are a few kinds of digastrics which will not fit into any of the above descriptions, and for these perhaps a fourth class should be established. They are true monogastric muscles, in which either the anterior or the posterior belly is suppressed. The lagomorphine or hare-like sub-order of rodents is a good example: here the posterior belly of the muscle is only represented by a narrow tendon (fig. 11). In many orangs it is curious that the anterior belly is wanting, and the posterior is attached to the mandible, close to its angle. In the mole (*Talpa europea*) the

posterior belly is normal, but close to the angle of the jaw the muscle narrows into a delicate tendon, which passes forward to be inserted into the body of the mandible about a third of the way back from the symphysis. I have been unable to find any other tendinous fibres or any nerve from the fifth, so I think that in this animal the anterior part of the muscle is absent.

I have not been able to think of any satisfactory explanation for one animal having one type of digastric and another a different one: it does not appear to be due to differences in the temporo-mandibular articulation. Dobson has suggested that animals which hold their food in their paws, and eat it with their heads flexed on their trunks, are the ones in which a sub-hyoid arch is found. This is a satisfactory explanation as far as rodents go, but there is probably no mammal which bends its head to take its food more than the fruit bat does, and yet this animal has an almost monogastric muscle, with no sub-hyoid arch at all. Again, why, among the primates, should the lemurs, spider monkeys, anthropoids, and man be losing their sub-hyoid arch? Probably we have not yet enough facts to try to find a satisfactory explanation.

*The Ventral Group of Neck Muscles.*—In this group are included the muscles which in man act as depressors of the hyoid bone, the sterno-hyoid, sterno-thyroid, omo-hyoid, and thyro-hyoid, as well as the continuation of these forward into the tongue. The group is usually regarded by anatomists as the prolongation forward of the rectus ventralis; and as the tongue develops in the floor of the mouth, some of this longitudinal layer becomes continued into it. The first thing that attracts attention in the abdominal part of the layer is the presence of tendinous intersections (*lineæ transversæ*), recalling the original myocommata and myotomes. In the cervical portion these inscriptions are seen in the central tendon of the omo-hyoid of man, and often in the sterno-hyoid and thyro-hyoid. The nerve-supply of the group is interesting. In man the tongue muscles are supplied by the hypoglossal and the depressors of the hyoid bone by the *ansa hypoglossi*. The hypoglossal nerve in some fish and amphibians is a spinal nerve which, higher up in the scale, becomes included in the cranium. It supplies myotomes behind those supplied by the seventh and ninth; and when these myotomes are prolonged into the tongue,

they carry their original nerve with them, consequently the tongue muscles are supplied by the hypoglossal; and in dissecting the submental region of the *Ornithorhynchus*, for example, we find the most superficial muscle supplied by the seventh nerve, because it is part of the facial panniculus, and is derived from the hyoid visceral arch; deep to this come the anterior belly of the digastric and the mylo-hyoid supplied by the fifth nerve, because they are muscles of the mandibular visceral arch; and deep to these, again, the tongue muscles supplied by the hypoglossal nerve (fig. 7).

Taking the question of the tendinous intersections, occasionally present in the sterno-hyoid and -thyroid of man, we find that they are constant in many mammals, but are more frequently found in the sterno-thyroid than in the sterno-hyoid. In a dog which I lately dissected, the sterno-hyoid and -thyroid were completely fused from their sternal origin as far as a tendinous intersection which was situated about a third of the way up the neck; after this they were separate. In a three-toed sloth (*Bradypus tridactylus*) the two muscles were fused as far forward as the cricoid cartilage, after which the sterno-hyoid was delaminated from the ventral and mesial part of the muscle as a slender slip to the hyoid bone. These specimens are interesting, because they bear out Testut's evidence, showing that the sterno-hyoid and -thyroid are mere delaminations of one muscular sheet. Tendinous intersections are found in many carnivora besides the dog,—in kangaroos, lemurs, and, according to Keith, in all cynomorphous monkeys; they are also common in the anthropomorpha. According to Chauveau, the tendinous intersection or myocomma is seen in its best development in the horse: here it is so large that the muscle is described as digastric, and the arrangement recalls that of my dog, in that the sterno-hyoid and -thyroid are only separable on the cephalic side of the intersection.

We have already noticed that the ventral layer of throat muscles is prolonged forward into the tongue on the dorsal side of the mylo-hyoid sheet: it is in many mammals prolonged forward ventral to this sheet as well. This has been noticed by Testut in the pangolin, armadillo, and anteater, and by Humphry in the hippopotamus, while Young found in three koalas some fibres of the omo-hyoid passing to the mandibular symphysis



ventral to the mylo-hyoid, while others passed deep to form the lingualis muscle. Windle found the sterno-hyoid continued forward ventral to the mylo-hyoid in the Australian rat (*Hydromys*); and I have recorded it in the coypu rat (*Myopotamus*) and the strand mole (*Bathyergus*). In the latter animal the muscle is continued forward as far as the symphysis menti. This arrangement never seems to occur in the primates, unless the mento-hyoid muscle already referred to may be regarded as the remains of a forward extension of the sterno- and omo-hyoid toward the symphysis. I do not know that the nerve supply of the mento-hyoid has ever been recorded; but if it comes from the fifth, the muscle is probably a dismemberment of the anterior

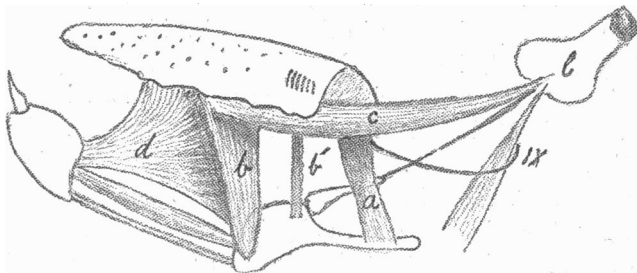


FIG. 12.—Tongue muscles of Macaque Monkey. *a*, hyoglossus; *b*, *b'*, basiglossus; *c*, stylo-glossus; *d*, genio-hyoglossus; *l*, tympanic bone; IX, glosso-pharyngeal nerve.

belly of the digastric; if from the hypoglossal, it is a remnant of the sterno-hyoid prolongation.

The *Hyo-glossus* muscle in man often consists of three parts. The main and most constant of these rises from the great cornu of the hyoid bone, and forms a continuation of the thyro-hyoid muscle towards the tongue. Nearer the mid-ventral line another set of fibres is sometimes found which rises from the lesser cornu of the hyoid, and is spoken of as the chondro-glossus; while less frequently a third bundle, called the triticeo-glossus, appears. This is situated more dorsally, and rises from the tip of the great cornu, or from the cartilago triticea in the lateral thyro-hyoid ligament. As far as I know, a separate chondro- or triticeo-glossus has not been recorded in the lower mammals, but I think that either the lemur or macaque monkey will give a clue to the meaning of the former muscle. In these animals the *hyo-glossus*

is sharply divided into two portions, the more ventral of which rises from the body of the hyoid bone, and perhaps slightly from the lesser cornu, while the more dorsal comes from the greater cornu (fig. 12). In the black ape (*Cynopithecus niger*) I found the ventral part of the muscle, which I believe corresponds to the chondro-glossus, still rising from the body of the hyoid, but overlapping the dorsal part above, as it does in man (fig. 13). In man the body of the hyoid is not as large as it is in the lower primates; and the chondro-glossus, when it is present, has to rise

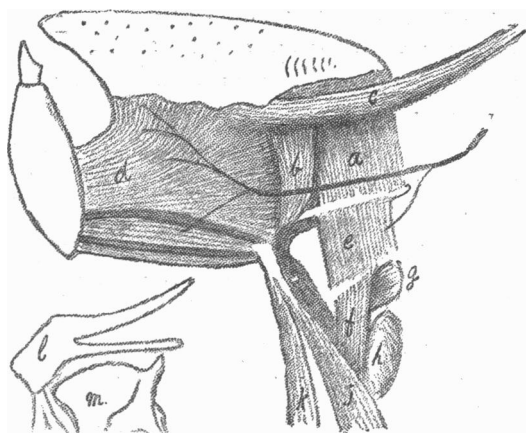


FIG. 13. — Tongue muscles of Black Ape (*Cynopithecus*). *a*, hyo-glossus; *b*, basi-glossus; *c*, stylo-glossus; *d*, genio-hyo-glossus; *e*, thyro-hyoid; *f*, sterno-thyroid; *g*, crico-thyroid; *h*, thyroid gland; *j*, omo-hyoid; *k*, sterno-hyoid; *l*, hyoid bone; *m*, thyroid cartilage.

from the lesser cornu, so that what in the monkeys is a basi-glossus becomes in man a chondro-glossus.

The *Omo-hyoid*, as has been pointed out by Gegenbaur, is probably the lateral part of a large muscular sheet, of which the sterno-hyoid and -thyroid are the mesial portions. I have observed one or two points which support this theory. Among the porcupines the omo-hyoid is well developed in the climbing forms (*Sphingurus* and *Erethizon*), but in the ground forms (*Hystrix* and *Atherura*) it is usually absent. In one specimen of the ordinary porcupine (*Hystrix cristata*) I found the anterior (cephalic) portion of the muscle present as a very delicate layer, which, when it reached the deep surface of the sterno-mastoid,

gradually shaded off into the cervical fascia, instead of being continued on to the scapula. This, to my mind, is an evidence that the cervical fascia, or at all events that layer which passes deep to the sterno-mastoid, is the remains of a large fibro-muscular sheet, the mesial portion of which always contains muscular fibres as the sterno-hyoid and -thyroid, while the lateral part may or may not be muscular. Another evidence of the close relationship between the omo- and sterno-hyoid is the arrangement in *Bathyergus*, where the omo-hyoid is continued forward with the sterno-hyoid to the mandibular symphysis. Connecting-bands of muscle between the sterno-hyoid and omo-hyoid are recorded frequently in man: they also occur, according to Keith, in many monkeys, and I have seen one in a lemur.

The omo-hyoid, in the mammalia, appears and disappears with great freedom, and yet it is a good muscle for classificatory purposes, because it is fairly constant in animals nearly allied. It is present in monotremes and marsupials, in most ungulates, but not in *Procavia* (*Hyrax*), in all the myomorphine and sciuro-morphine rodents, sometimes in the hystricomorphine, but never in the lagomorphine; it is also present in the cetaceans and in carnivores belonging to the families of the ursidæ and mustelidæ, in most insectivora, in the cheiroptera, and in all the primates.<sup>1</sup> It is apparently absent in the edentates, though this order requires to have its myology worked up and collated, in many rodents as stated above, in most of the carnivora, with the exception of the two families named, and it is also absent in the families of the talpidæ, chrysochloridæ, and solenodontidæ of the insectivora. The study of this muscle in the mammalian series will give one a very good idea of how often the presence or absence of a muscle depends, not on the habits of its possessor, but on the position of that possessor in the animal scale. The ordinary digging mole (*Talpa*) has no omo-hyoid, neither has the aquatic desman (*Myogale*), which is closely related to it. On the other hand, the burrowing strand mole (*Bathyergus*), the arboreal dormouse (*Myoxus*), the aquatic vole (*Microtus*), and the leaping gerbille all possess omo-hyoids, because they are all myomorphine rodents. The presence or absence of an omo-hyoid

<sup>1</sup> I have lately found it wanting in the spider monkey (*Ateles*), but this may be an abnormality.

seems to be quite independent of the degree of development of the clavicle, since it is present in the non-claviculate ungulates, in potamogale, the only insectivore which has no clavicle, as well as in the cheiroptera and primates in which the clavicle is well developed.

The central tendon of the omo-hyoid is a structure which has given rise to a good deal of discussion. In by far the greater number of the lower mammals the muscle is riband-like and runs back from the hyoid to the anterior border of the scapula without forming a definite angle, the mesial border of the omo-hyoid lying close to the lateral border of the sterno-hyoid and -thyroid; it is only in the cheiroptera and primates that a constant fibrous intersection is present. Macalister has pointed out that in the ordinary insectivorous bats (*vesperilionidæ*) the muscle is slender and biventral, in the fruit bats (*pteropodidæ*) it has a very short central tendon, while in the vampires (*phyllostomatidæ*) the muscle is large and the intersection a mere streak. In the lemurs an intersection may or may not be present. Keith found it in the slow lemur, Mivart and Murie came across it once in nine specimens recorded, and I have seen it once in three lemurs which I have dissected.

Among the monkeys and apes there is a great deal of variability. The intersection is rare in the cynomorphous monkeys, while in the anthropomorpha it is much commoner, and in the chimpanzee is always present. Taking into account the late appearance of this intersection in the mammalian series, we are not surprised to find several recorded cases of human omo-hyoids in which it is entirely absent. The long intermediate tendon, which is so characteristic of man and many bats, must be due, I think, to the dorsal position of the scapulæ and the increased breadth of the shoulders. These tend to draw the more caudal part of the muscle away from its original line: the fibrous intersection would be more closely continuous with the surrounding fascia than the fleshy part, consequently that would be the point at which the bend in the muscle would occur. After the bend had been established there would be intermittent traction on the portion of fascia lying between the intersection and the proximal end of the clavicle, which would lead to its thickening, and eventually one would expect a pulley-like strap to be formed, as

is the case with the muscles in front of the ankle. This strap, by its pressure, would tend to convert the muscle adjacent to the

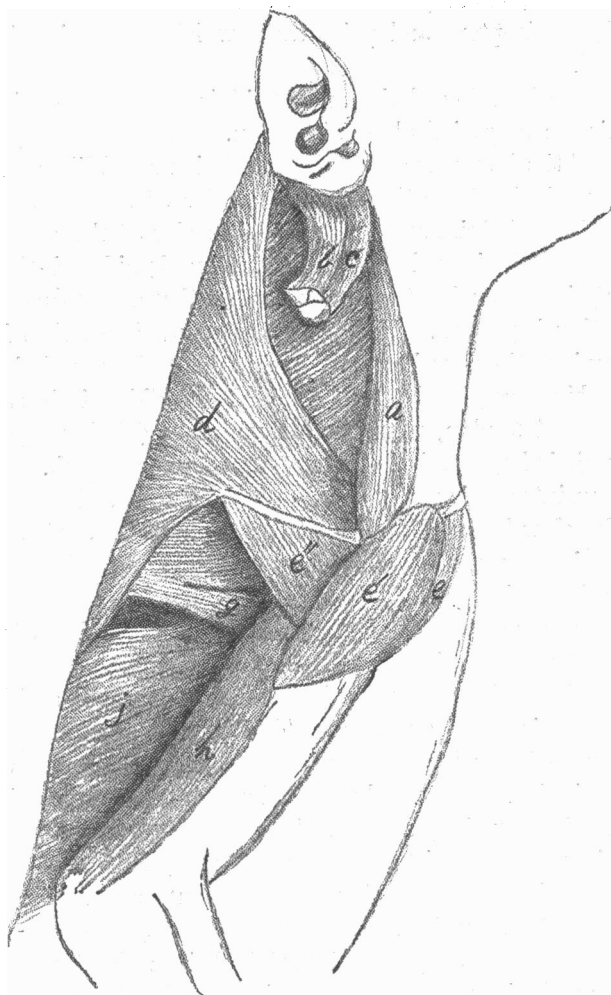


FIG. 14.—Shoulder muscles of Lemur. *a*, omo-trachelian; *b*, cleido-mastoid; *c*, sterno-mastoid; *d*, trapezius; *e.e'.e''*, three parts of deltoid; *g*, teres major; *h*, triceps; *j*, latissimus dorsi.

intersection into fibrous tissue. This, of course, is a theoretical explanation of the formation of the central tendon of the omo-hyoid, the only fact at my disposal being that a central tendon

only occurs in animals with set-back scapulæ and broad shoulders. If the theory prove tenable in the light of fresh facts, it will harmonise existing views; for some regard the central tendon of the omo-hyoid as a myocomma between two myotomes, others as fibrous tissue produced by pressure. If the tendon were produced by pressure between the sterno-mastoid and scalenes, we should expect those muscles also to show some signs of it in the development of fibrous tissue where they are in contact with the omo-hyoid tendon.

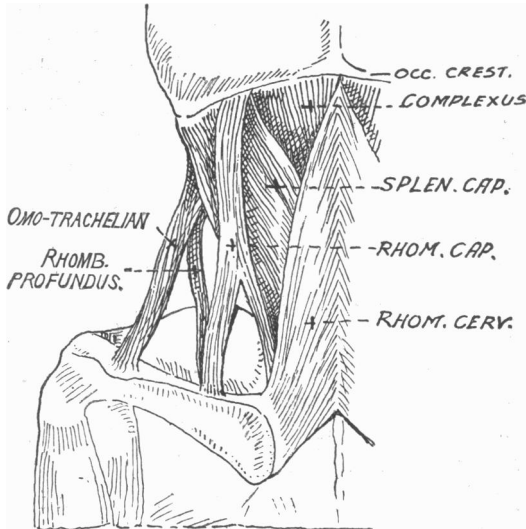


FIG. 15. Neck muscles of African Pole Cat (*Ictonyx*). (From the *Proceedings of the Zoological Society*.)

*Omo-trachelian* (*Levator claviculæ*).—This is a very constant muscle in mammals (fig. 14), but it only occurs as an abnormality in man. The most usual origin is from the transverse process of the atlas, but in certain animals (*e.g.*, hystricomorphine rodents) it rises from the basi-occipital bone dorsal to the attachment of the scalenus ventralis, which in these animals comes from here also. Its insertion into the acromion or, when it is present, the metacromion process is very constant, the only two exceptions with which I am familiar being the anthropoid apes and the bats. In these the muscle is inserted into the outer end of the clavicle, and I have little doubt that the change is due to the great

broadening and setting back of the shoulders in these animals. When the omo-trachelian occurs in man it has the same origin and insertion as in the anthropoids, rising from the atlas and sometimes the axis, and being inserted into the outer end of the clavicle. At its insertion the muscle is on the same plane as the trapezius, and, I think, should be regarded as part of the same sheet, which had to seek a deeper origin than the rest. It is always supplied by the 2nd, 3rd, or 4th cervical nerves. Its absence in man suggests that in the erect position it is no longer needed; possibly its chief function in the lower mammals is to fix the scapula for the long head of the triceps to act from in quadrupedal locomotion. This seems the more probable, in that the long head of the triceps is proportionately much smaller in man than in most other mammals.

*Rhomboideus profundus*.—This is another muscle which has often been described as a second or dorsal part of the omo-trachelian (fig. 15). It runs from the transverse process of the atlas to the vertebral end of the spine of the scapula, and is never, as far as I know, found as a distinct abnormality in man, but is possibly fused with the levator anguli scapulæ. Windle and I found it very constantly as a distinct muscle in the mustelidæ or weasel family of the carnivora, while in the other families it was either absent or blended with the levator anguli scapulæ or rhomboids. From its relations, we thought it must be a deep portion of the rhomboid plane. I mention it here as an evidence of the value of muscles for classificatory purposes.

(To be continued.)