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Musculus Omotransversarius in the Light of Comparative Anatomy

[With 5 Figs.]

Studies made by the authors on representatives of *Rodentia, Leporidae, Carnivora* and *Primates* led them to conclude that both *m. omotransversarius* and *m. omotransversarius dorsalis* are present in mammals with primarily formed superficial dorsal muscles. Among carnivores these two muscles are present in *Mustelidae* and beares, and among rodents in the squirrel, nutria and chinchilla. *Musculus omotransversarius dorsalis* is reduced in the dog, cat and raccoon, and also in representatives of *Muridae* and the guinea pig. This muscle is absent in the rabbit, while *m. omotransversarius* itself has undergone secondary splitting into two muscle units. The two muscles are generally present in *Primates, m. omotransversarius dorsalis* uniting with *m. levator scapulae*. In higher forms of the *Hominoidea* group *m. omotransversarius* may undergo regression, although retaining *m. omotransversarius dorsalis* as the first dens of *m. levator scapulae*.

I. INTRODUCTION

Musculus omotransversarius is distinguished in domestic mammals included in NAV and occurs, according to data given in all veterinary anatomy textbooks, in the dog, cat, pig and in ruminants, being absent only in the horse. No muscle of this name is encountered in anthropotomy and therefore its homology with human muscles remains a debatable and confused question.

In anatomical literature on rodents: G r e e n e (1955), W o o d & W h i t e (1950), P a r s o n (1894), D o b s o n (1884), M i v a r t & M u r i e (1866) *m. omotransversarius* is generally described under the name of *m. levator claviculae*. In monographs dealing with the anatomy of the rabbit K r a u s e (1884), and after him G e r h a r d t (1909), and contemporarily T e r e n t e v (1952), distinguish the so-called *m. basiohumeralis* and *m. levator scapulae maior*. C a n t i e r & V e z i n h e t (1968), like P o p e s k o (1961), in describing the muscles of the rabbit under the name of *m. omotransversarius*, only described what is termed by K r a u s e (1884) as *m. levator scapulae maior*, whereas *m. basiohumeralis*, as may be gathered from

the description, is treated by them as a component part of *m. cleidocephalicus* (termed by them »la branche trapezienne«) which would appear to be completely erroneous. O l b r o r t h (1963) distinguishes *m. omocleidotransversarius* in the chinchilla and identifies it with W o o d's & W h i t e's (1950) *m. levator claviculae*. With regard to nutria (K o c h, 1953) it can be presumed that what he terms *m. omocleidomastoideus* is *m. omotransversarius* in domestic mammals.

In literature on the *Primates m. omotransversarius* is described under various names: *M. levator claviculae, m. atlanto-scapularis* or *omo-cervicalis*. According to H i l l (1953—1970) *m. levator claviculae* occurs generally in catarrhine and platyrrhine monkeys and runs from the atlas to the acromion. M i c h a e l i s (1903) in describing muscles of the orangutan, chimpanzee and baboon distinguishes *m. omo-cervicalis* in these animals, which in the case of the chimpanzee begins on *proc. mastoideus* and in the orang-utan on the atlas, and ends on the acromial end of the clavicle, while in the baboon it runs from the atlas to *proc. acromialis*. According to H u x l e y (cited after M i c h a e l i s, 1903) a muscle behaving in a similar way may sometimes occur as a variant in man also. It may be added here that one of the more frequent variants of *m. trapezius,* mentioned in anthropotomical text-books (M a r c i n i a k, 1964; B o c h e n e k, 1953; R a u b e r- K o p s c h, 1954), consisting in the presence of an additional bundle running from the atlas to the acromial part of the clavicle, suggests its homology with *m. omotransversarius* in lower mammals. Data on occurrence of the dorsal part of this muscle in higher *Primates* are not clear. In Ž e d e n o v's opinion (1962) a characteristic muscle in *Primates* is *m. atlanto-scapularis ventralis,* from which a small muscle bundle running to the clavicle as *m. levator claviculae* may separate. In addition to the above-mentioned muscles *m. atlanto-scapularis dorsalis s.m. levator scapulae dorsalis s.m. omo-cervicalis dorsalis,* running from the atlas to the dorsal angle of the scapula, may also occur.

As shown by the review of relevant literature the data on the occurrence in *Rodentia, Leporidae* and *Primates* of a muscle homologous with *m. omotransversarius* in domestic animals are not clear. The great variety of terms used by different authors and the frequent lack of exact descriptions present very real obstacles to the use of literature on this subject, in fact it is even difficult exactly to describe this muscle in representatives of the mammals mentioned. It can only be said that it is accurately described in domestic animals, but its homology with muscles of rodents or *Primates* is still an open question. The genesis of this muscle continues to form a subject for debate. Some authors consider that it connects with the muscles of nerve XI as *m. sternocleidomastoideus* (P e r l, 1903) and *m. trapezius* (G u r l t cited after B a u m, 1936), and others as *m. serratus ventralis* (L e c h e, 1900) and *m. rhomboideus* (R i b b i n g, 1938).

The purpose of the present study is to establish which of the muscles occurring in the more important representatives of *Rodentia, Leporidae, Carnivora* and *Primates* is a homologue of *m. omotransversarius* in domestic mammals, and at the same time to present the process of its phylogenesis in the groups of mammals mentioned.

The difference of this muscle in different species, its primary or secondary connection with the foregoing muscles made it necessary to take these muscles also into consideration, of course only to the degree necessary for elucidation of the main problem.

Observations were made on bodies of the following species of animals: *Tupaia glis* — 3, *Galago senegalensis* — 4, *Lori tardigradus* — 1, *Arctocebus calabarensis* — 1, *Saimiri sciureus* — 1, *Cebus apella* — 2, *Aotus trivirgatus* — 3, *Colobus badius* — 2, *Papio cynocephalus* — 4, *Macaca mulatta* — 4, *Hylobates lar* — 1, *Symphalangus syndactylus* — 2 — Primates, *Cavia porcella* — 10, *Myocastor coypus* — 8, *Sciurus vulgaris* — 4, *Chinchilla laniger* — 1, *Rattus norvegicus* — 20, *Mus musculus* — 20, *Mesocricetus auratus* — 20, *Cricetus cricetus* — 2, *Dolichotis patagonica* — 1 — Rodentia, *Oryctolagus cuniculus* — 20 — Lagomorpha, *Canis familiaris* — 20, *Felis catus* — 20. *Selenarctos thibetanus* — 3, *Martes martes, Martes foina* — 5, *Mustela lutreola* — 9, *Mustela putorius furo* — 10, *Mustela putorius* — 7, *Mustela nivalis* — 2, *Procyon lator* — 2 — Carnivora.

II. RESULTS

1. *Carnivora*

Musculus omotransversarius in the dog begins on the alae and dorsad arch of the atlas, and in the cat also at the base of the occiput, and runs in the direction of the scapula, ending on its acromion. Part of the muscle bundles furthest dorsad disappear in the fascia of the scapular region. The fact merits mention that the dorsal margin of this muscle near the terminal insertion on the scapula fuses with the cervical part of *m. trapezius* (Fig. 1).

The behaviour of the neighbouring muscles is as follows: *m. trapezius* has *pars thoracica* and *pars cervicalis*, the latter being relatively weakly developed and beginning only on the *septum nuchae*. M. *rhomboideus* has three parts, of which *pars thoracica* and *pars cervicalis* correspond to *m. rhomboideus minor* and *m. rhomboideus maior* in man, while *pars capitis*, which does not occur in man, runs to the occiput. The counterpart of *m. sternocleidomastoideus* in man is *m. sternocephalicus* and *m. cleidocephalicus*. The latter divides distinctly into *m. cleidomastoideus*, beginning on the mastoid, and *m. cleidocervicalis*, beginning on *os occipitale* and *septum nuchae*. The latter is sometimes described in the cat under the name of *m. clavotrapezius* (T a y l o r & W e b e r, 1951). *Pars cervicalis m. serratus ventralis*, corresponding to *m. levator scapulae* in *Primates*, begins on the transverse processes of the cervical

vertebrae, but starts from the third vertebra and forms a whole with *pars thoracica* of *m. serratus* corresponding to *m. serratus anterior* in man. It is remarkable that in the dog and cat *m. omotransversarius* is more closely connected morphologically only with *pars cervicalis* of *m. trapezius*, with which it fuses near *proc. acromialis scapulae*.

In the raccoon the above mentioned muscles behave similarly to those in the dog and cat, the only difference here being the far stronger development of *pars capitis* of *m. rhomboideus*.

Topographical relations in *Mustelidae* and bears (Fig. 2a), however, differ from the above. In these animals both *m. omotransversarius* and all the other muscles mentioned above occur, and in addition to them
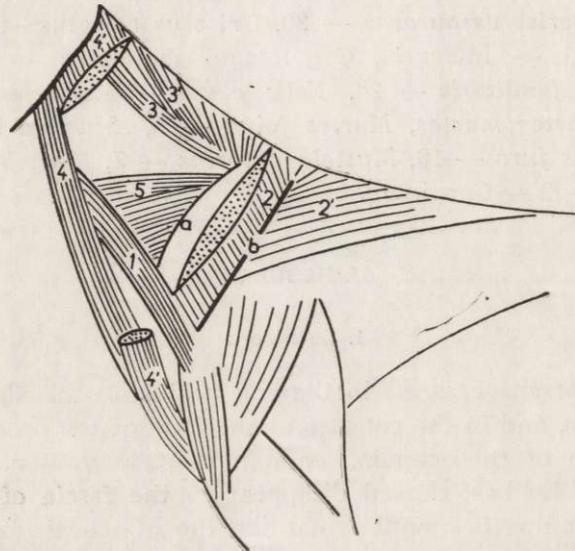

Fig. 1. Diagram of muscles in superficial layer of neck in *Canidae* and *Felidae*. 1. *m. omotransversarius*, 2 and 2' — *pars cervicalis* and *pars thoracica* of *m. trapezius*, 3 and 3' — *pars capitis* and *pars cervicalis* of *m. rhomboideus*, 4 — *m. cleidomastoideus*, 4' — *m. cleidocervicalis*, 5 — *pars cervicalis* of *m. serratus ventralis*, a — scapula.

there is a further muscle belly not distinguished in veterinary anatomy. This muscle begins jointly with *m. omotransversarius* on the atlas, then the two muscles separate in the form of the arms of a letter V, *m. omotransversarius* running to *proc. acromialis scapulae*, while the additional muscle belly runs to the capitad angle of the scapula, ending at the base of the crest. At its scapular insertion this muscles fuses with *pars capitis m. rhomboideus*. In view of the fact that the term *m. omotransversarius* is confirmed as correct in NAV this muscle belly fully merits the term *m. omotransversarius dorsalis*. Its definition as *pars dorsalis m. omotransversarius* may lead to misunderstandings, as *m. omotrans-*

versarius itself may undergo secondary division into a ventral and dorsal part. It may also be mentioned that *m. omotransversarius* does not fuse in these animals with *m. trapezius*, but owing to the presence of
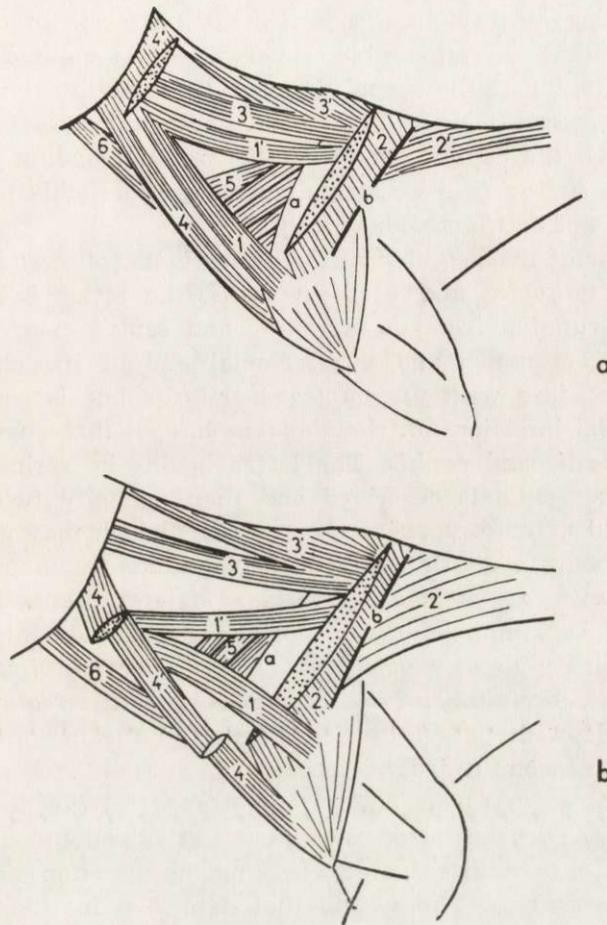

Fig. 2. Diagram of muscles in superficial layer of neck in a: *Mustelidae,* bears, squirrels and tupaia, b — nutria and chinchillas.
1 — *m. omotransversarius,* 1′ — *m. omotransversarius dorsalis,* 2 and 2′ — *pars cervicalis* and *pars thoracica* of *m. trapezius,* 3 and 3′ — *pars capitis* and *pars cervicalis* of *m. rhomboideus,* 4 and 4′ — *m. cleidocephalicus,* 5 — *pars cervicalis* of *m. serratus ventralis,* 6 — *m. sternocephalicus,* a — scapula.

m. omotransversarius dorsalis is clearly connected with *m. rhomboideus.* The behaviour of the other neighbouring muscles is similar to that found in the dog, cat and raccoon.

2. *Rodentia* and *Leporidae*

Among rodents we found both *m. omotransversarius* and *m. omo-transversarius dorsalis* present in the nutria, chinchilla and squirrel. In the nutria the two muscles begin at the basis of *os occipitale*, then separate. Running ventrad the muscle belly passes to *proc. acromialis scapulae* and, which is remarkable, covers he most capitad bundles of *m. trapezius*, running to the scapula. This belly undoubtedly corresponds to *m. omotransversarius* NAV. The second belly (not described in litera-ture) runs above the capitad angle of the scapula, ending at the base of its crest. As in the case of *Mustelidae* and bears, this muscle fuses with *pars capitis* of *m. rhomboideus* (Fig. 2b).

The behaviour of the neighbouring muscles is as follows: *M. trapezius* possesses *pars thoracica* and *pars cervicalis*, the latter being strongly developed and running from *os occipitale* and *septum nuchae* to *crista scapulae*, *proc. acromialis* and the acromial end of the clavicle. This muscle does not fuse with *m. omotransversarius* but is covered by it near the acromial insertion. *M. rhomboideus* has all three parts, *i.e. pars thoracica, cervicalis* and *capitis*. The latter begins in a similar way to that in the other animals described and then partially fuses with the above-mentioned *m. omotransversarius dorsalis* (which may give a visual impression of being a division of it) and consequently *m. rhomboideus* also connects with *m. omotransversarius*. *M. sternocephalicus* divides into two bellies beginning jointly on the clavicle, namely into *m. cleido-mastoideus*, running to *os mastoideum* and *m. cleidooccipitalis* ending on *squama ossis occipitalis*. *Pars cervicalis* of *m. serratus ventralis*, forming a whole with *pars thoracica*, begins on the cervical vertebrae starting from the second (third) vertebra.

Both *m. omotransversarius* and *m. omotransversarius dorsalis* occur in the chinchilla. They begin together on the atlas and the first of them extends to *proc. acromialis scapulae*, covering the insertion of the capitad bundles of *m. trapezius*. The second (not described in literature) fuses with *pars capitis* of *m. rhomboideus* and ends at the base of *crista sca-pulae* (Fig. 2b). *Mm. rhomboideus* and *trapezius* behave similarly to similarly to those in nutria. Both W o o d & W h i t e (1950) and O l b r o r t h (1963) distinguish yet a third part in this muscle, that is, *clavotrapezius* or *m. trapezius clavicularis*. It is, however, *m. cleidoocci-pitalis* which together with *m. cleidomastoideus* begins on the clavicle and runs to *os occipitale*, which these authors describe under this name. In rodents, irrespective of the presence of this muscle, *pars cervicalis* of *m. trapezius* has an insertion on both *os occipitale* and the clavicle.

Both *m. omotransversarius* and *omotransversarius dorsalis* occur in

the squirrel. These muscles begin on the atlas and end in the same way as in the chinchilla, the only difference being that in the squirrel *pars cervicalis* of *m. trapezius* does not extend to the clavicle and its lower edge runs parallel to *m. omotransversarius* and consequently is not covered by it (Fig. 2a). The behaviour of the other muscles is similar to that described for the above-mentioned rodents.

In representatives of Rodents of the *Muroidea* group, that is the rat, mouse and hamster, only *m. omotransversarius* is present. This muscle begins on the atlas and runs to *proc. acromialis scapulae*, covering the capitad bundles of *pars cervicalis m. trapezius* at its acromial insertion (Fig. 3). *M. trapezius* has a strongly developed *pars cervicalis* which begins on *occipitale* and *septum nuchae* and ends on *proc. acromialis*, *crista scapulae* and the acromial end of the clavicle. *M. rhomboideus* has three typical parts. *Pars capitis* is a completely separated muscle
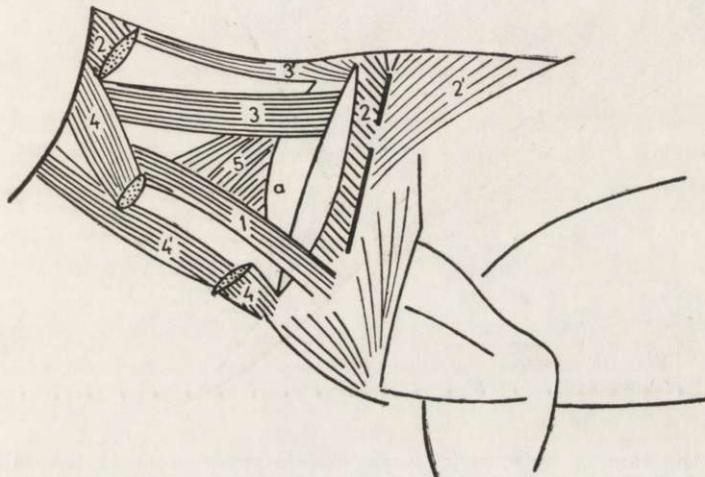

Fig. 3. Diagram of muscles in the superficial layer of neck in *Muridae*.
1 — *m. omotransversarius*, 2 and 2′ — *pars cervicalis* and *pars thoracica* of *m. trapezius*, 3 and 3′ — *pars capitis* and *pars cervicalis* of *m. rhomboideus*, 4 and 4′ — *m. cleidocephalicus*, 5 — *pars cervicalis* of *m. serratus ventralis*, a — scapula.

which runs from *squama ossis occipitalis* to the upper part of *crista scapulae*. *M. cleidocephalicus* is represented by two well-separated units, *m. cleidomastoideus*, ending on *os mastoide* and *m. cleidooccipitalis* (described as *m. clavotrapezius*) running to *squama ossis occipitalis*. *Pars cervicalis* of *m. serratus ventralis*, like that in other rodents, begins on the second (in the hamster the third) cervical vertebra.

In the guinea pig also only *m. omotransversarius* occurs which, how-ever, as distinct from the foregoing rodents, begins at the base of *os occipitale*, and ends in a typical way on *proc. acromialis*. *M. trapezius* consists of *pars thoracica* and *pars cervicalis*, the latter extending from

os occipitale and *septum nuchae* to *proc. acromialis* and *crista scapulae*.
M. rhomboideus has three typical parts which, as distinct from the
animals described above, forms one compact whole. *Pars capitis* of this
muscle, strongly developed, begins on *squama ossis occipitalis* and ends
at the base of the crest and upper angle of the scapula. *Pars cervicalis*
of *m. serratus ventralis* begins in the same way as in the hamster, but
forms a separate unit not connecting with *pars thoracica* of this muscle.
A single *m. cleidocephalicus* extends from the clavicle to *os occipitale*
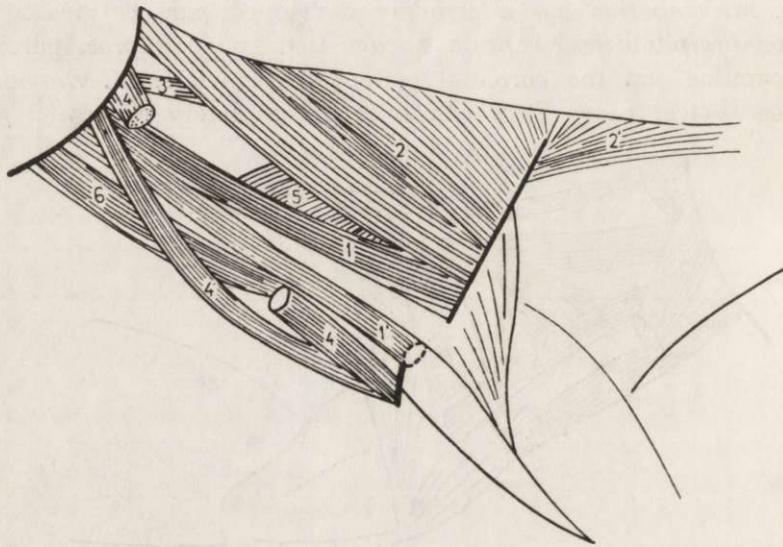and the mastoid.

Fig. 4. Diagram of muscles in superficial layer on neck in the rabbit.
1 — *pars dorsalis* of *m. omotransversarius*, 1' — *pars ventralis* of *m. omotrans-*
versarius, 2 and 2' — *pars capitis* and *pars cervicalis* of *m. trapezius*, 3 — *pars*
capitis of *m. rhomboideus*, 4 — *m. cleidocephalicus*, 4' — *m. sternocephalicus*,
5 — *pars cervicalis* of *m. serratus ventralis*, 6 — *m. sternofacialis*.

In the Patagonian hare (*Dolichotis patagonica*) also *m. omotransver-*
sarius dorsalis is absent and only *m. omotransversarius*, which under-
goes some modifications, is retained. Beginning on the base of *os*
occipitale it fuses in the region of the scapula with the lower edge of
m. trapezius and together with part of its fibres runs to the fascia of
the arm, covering the shoulder joint. Behaviour of the neighbouring
muscles is similar to that observed in nutria.

In the rabbit, the only representative of *Leporidae* we examined, the
homologue of *m. omotransversarius* NAV is probably formed by two
muscles. They begin jointly on the base of *os occipitale*, then divide

into two branches, of which one extends to *proc. acromialis scapulae* (its caudal part termed paracromion) and the second to the rudimentary clavicle fusing with the well developed *pars clavicularis* of *m. deltoideus* (Fig. 4). The first of these muscles is described in literature as *m. levator scapulae magnus* or *m. omotransversarius*, the second as *m. basiohumeralis*. It would appear that in the rabbit *m. omotransversarius*, as the result of the characteristic development of *proc. acromialis scapulae* and the partial regression of the clavicle, divided into two bellies, one of which entered into close contact with *pars clavicularis* of *m. deltoideus*. *M. trapezius* begins in a way typical of the majority of rodents and runs to *proc. acromialis* and *crista scapulae*. *M. rhomboideus* consists of *pars thoracica* and *pars cervicalis* forming one whole. *Pars cervicalis* of *m. serratus ventralis* reaches only as far as the third cervical vertebra, as in the case of the guinea pig. *M. sternocleidomastoideus* consists of a single *m. cleidocephalicus* and *sternocephalicus*.

In addition to the above mentioned muscles in the rabbit there is an additional muscle, termed *m. levator anguli scapulae* (K r a u s e, 1884, *et al.*) or *m. levator scapulae* (C a n t i e r & V e z i n h e t, 1968). This muscle runs from *squama ossis occipitalis* to the caudad angle of the scapula and most probably forms a weakly developed but separate *pars capitis* of *m. rhomboideus*.

3. Primates

In the majority of cases both *m. omotransversarius* and *m. omotransversarius dorsalis* are present in *Primates*. Cases in which one of them is absent are encountered only in representatives of *Pongidae* and in some *Lemuroidea* (*Prosimiae*).

In *Tupaia glis*, the most primitive representative of the last group, the two muscles are present, beginning on the atlas and behaving in a similar way to that in primitive rodents, *e.g. squirrels*. *M. omotransversarius* runs to *proc. acromialis scapulae*, does not cover *m. trapezius* but is situated parallel to it (Fig. 2a). *M. omotransversarius dorsalis*, on the other hand, fuses with *pars capitis* of *m. rhomboideus* and ends at the base of *crista scapulae*. As in the case of rodents, it gives the visual impression of an additional part of *m. rhomboideus*. *M. trapezius* does not reach the clavicle but ends on *proc. acromialis*. *M. cleidocephalicus* has two typical parts: *m. cleidomastoideus* and *m. cleidooccipitalis*. *M. rhomboideus* has all three parts, and *m. levator scapulae* does not begin until the second cervical vertebra and forms one whole with *m. serratus anterior* (*pars thoracica* of the *m. serratus ventralis*). In othe representatives of *Lemuroidea*, such as *Galago senegalensis*,

Lori tardigradus and the *Anguantibo, m. omotransversarius* is present, and runs from the atlas to *proc. acromialis scapulae*, covering *m. trapezius* with its acral insertion. In the galago there is most certainly no *m. omotransversarius dorsalis,* and *m. levator scapulae,* as in other lower mammals, does not reach the atlas. The same applies to the lori, but there is some doubt as to the existence of *m. omotransversarius dorsalis* in the anguantibo, in which *m. levator scapulae,* as distinct from that in the previously mentioned representatives of *Lemuroidea,* reaches the atlas. This might suggest that the first dens of this muscle (as in the case of monkeys) is here the homologue of *m. omotransversarius dorsalis.* While, however, in monkeys the first dens of *m. levator scapulae* is undoubtedly the connected *m. omotransversarius dorsalis,* in the case of the anguantibo this cannot be stated with complete certainty as it is completely anastomosed with the other dentes of *m. levator scapulae* and ends together with them only on the costal surface of the scapula. *M. rhomboideus* is modified in the lori and anguantibo, unlike the tupaia, and in the former does not possess *pars capitis* typical of the tupaia and lower mammals, this part being present in extremely rudimentary form in the galago only. *M. trapezius* in the galago, lori and anguantibo runs to the clavicle and is covered by *m. omotransversarius.*

In the representatives of the *Ceboidea* and also *Cercopithecoidea* groups both *m. omotransversarius* and *m. omotransversarius dorsalis* are present (Fig. 5), the first of them beginning on the atlas and running to *proc. acromialis scapulae* and, as must be emphasised, is covered by *m. trapezius.* In the *Aotus trivirgatus (Ceboidea)* this muscle also runs to *proc. acromialis* with the difference, however, that it covers the capitad fascia of *m. rhomboideus,* as in the case of the majority of rodents. The counterpart of *m. omotransversarius dorsalis* in lower mammals is here undoubtedly the first dens of *m. levator scapulae.* This muscle begins together with *m. omotransversarius* on the atlas and runs to the upper angle of the scapula. It must be recalled here that in rodents, carnivores and the tupaia *m. levator scapulae* did not begin until the second or third cervical vertebra. Therefore in monkeys the first dens of *m. levator scapulae* running from the atlas most probably constitutes *m. omotransversarius dorsalis,* as is also shown by its joint start with *m. omotransversarius.* As a result of the weak development of *m. rhomboideus* it has here lost its original connection with it.

Among representatives of the group *Hylobatinae,* both muscles were found to be present in *Hylobates lar. M. omotransversarius* began in this case on the atlas and ended on the acromial end of the clavicle (on the site of *articulatio acromioclavicularis*) under the strongly developed *m. trapezius. M. omotransversarius dorsalis* begins together with it and

here forms the first dens of *m. levator scapulae*. In the gibbon *m. rhom-boideus* has no *pars capitis* at all, and *m. levator scapulae* completely loses connection with *m. serratus anterior* and consists of four dentes running from the first four upper cervical vertebrae to the upper angle of the scapula. The first dens of this muscle is undoubtedly the homologue of *m. omotransversarius dorsalis* in lower mammals. The following details bear out the correctness of this opinion: this dens begins jointly with *m. omotransversarius* and ends slightly differently from the other dentes on the upper angle of the scapula from the lateral side.
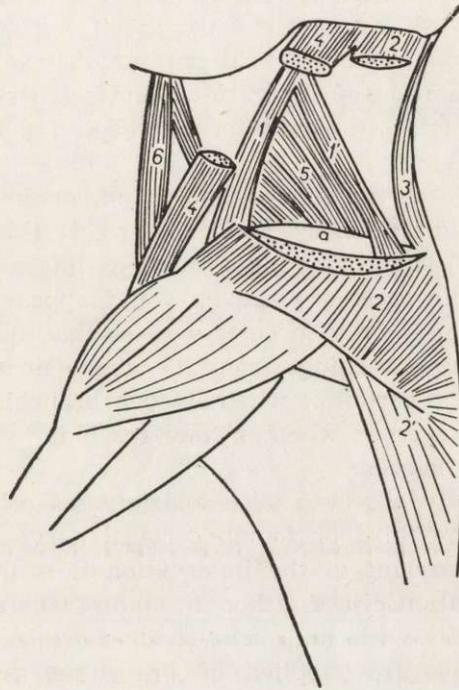

Fig. 5. Diagram of muscles in superficial layer of neck in *Primates*.
1 — *m. omotransversarius*, 1' — *m. omotransversarius dorsalis*, 2 and 2' — *pars capitis* and *pars cervicalis* of *m. trapezius*, 3 — *m. rhomboideus*, 4 — *m. cleido-cephalicus*, 5 — *m. levator scapulae*, 6 — *m. sternocephalicus*, a — scapula.

In the *Symphalangus syndactylus* examined there was no *m. omotrans-versarius*, but *m. omotransversarius dorsalis* was present, of course in such cases joined to an even greater degree with *m. levator scapulae* and giving the impression of being its first and strongest dens.

In conclusion reference must be made to the question of the innervation of the two *mm. omotransversarii dorsales*, which, although taken into consideration during observations, has not been dealt with so far,

since in our particular studies application of the most frequently used criterion of the homology of muscles on the basis of innervation does not provide a definite and unequivocal answer. It can be stated on the basis of the observations we made that *m. omotransversarius*, and also *m. omotransversarius dorsalis*, are innervated exclusively (or almost exclusively) by the cervical nerves, that is, by the same elements which serve *m. rhomboideus* and *pars cervicalis* of *m. serratus ventralis*.

In view of the fact that data in literature on homology of nomenclature of the nerve branches innervating these muscles are very contradictory, we have limited ourselves in this study to using only the general term »cervical nerves« without exactly specifying them. It would be beyond the scope of our studies to carry out observations providing an unequivocal interpretation of the various cervical nerves in the animals examined, and in fact this would form a basis for further studies on this question.

The studies made on the innervation of *m. omotransversarius* show that data contained in studies by E l l e n b e r g e r (1943), B a u m (1936) and N i c k e l (1954) suggesting innervation of this muscles in domestic animals solely by the accessory nerve, would appear to be completely erroneous. At most it is only in certain cases that this nerve might be reached by very fine branchings from the above mentioned nerve, and in addition there is no certainty whether such branchings originate from the nucleus of the nerve or whether they reach it by means of anastomoses with cervical nerves.

We not infrequently observed such anastomoses originating from the ventral branch of the third or fourth cervical nerve during the course of our studies. On account of the innervation it is therefore necessary to rule out close relationship of either *m. omotransversarius*, or *m. omotransversarius dorsalis* with *m. sterno-cleido-mastoideus* and *m. trapezius*, as these muscles are supplied by branchings from the accessory nerve. It can only be added that while some bundles of *m. omotransversarius* receive nerve fibres from the accessory nerve, this fact can only provide evidence that during onto- and phylogenesis this muscle assimilated a small number of myomeres from the nucleus of muscles of the terminal branchiate arches. Also we are unable to give a definite interpretation, on the basis of innervation only, as to the closer relationship of the muscles examined with *m. rhomboideus* or *m. serratus ventralis*, since the latter two muscles are also innervated by branchings of the cervical nerves. It is only the topography of the muscle bellies referred to (in this case of course the chief criterion of homology) and the behaviour of their insertions, and also consideration of the presence of numerous transitional forms between the two extreme forms of these

muscles in different species which can provide evidence, in our opinion, of the correctness of R i b b i n g' s view (1938) on the genetic connection of *m. omotransversarius* with *m. rhomboideus*.

III. DISCUSSION

The studies made of *m. omotransversarius* show that it occurs commonly in *Carnivora, Rodentia,* the rabbit and the majority of *Primates.* In mammals characterized by more primitive formation of the musculature of this region *m. omotransversarius* is accompanied by an additional belly defined by us as *m. omotransversarius dorsalis.*

M. omotransversarius is considered by different authors as a splitting of *m. trapezius* or *m. sternocleidomastoideus* which, however, in the light of our studies, must be considered as erroneous. This muscle exhibits closer genetic connection with *m. rhomboideus,* which is evident in the more primitive mammals possessing *m. omotransversarius dorsalis* connecting *m. omotransversarius* with *m. rhomboideus.* It would appear necessary to emphasise here that it is difficult in any case to consider *m. omotransversarius* as the product of the splitting of one of such muscles, since they only made their appearance in this form in mammals and, what is more important, simultaneously with *m. omotransversarius.*

It is therefore possible to speak only of genetic connection with one of the above-mentioned muscles (this connection in fact applies to earlier stages of development) and the most probable would appear to be connection with *m. rhomboideus.* Both *mm. omotransversarii* occur in primitive carnivores, rodents and *Primates,* and also marsupials, and consequently must by now have reached the stage of their common ancestors, at least the stage of *Panthotheria.* At the same time it would appear very likely that it was at this stage that *m. rhomboideus* possessed three parts: *pars thoracica, pars cervicalis* and the strongly developed *pars capitis.* *M. serratus ventralis* (*pars cervicalis*) did not reach the first cervical vertebra and formed one whole with *pars thoracica* of this muscle. *M. cleidocephalicus* had two parts: *m. cleidooccipitalis* and *m. cleidomastoideus.* All these characters (together with the presence of both *mm. omotransversarii*) occur in primitive rodents, carnivores and *Primates.* Deviations from the above pattern are of an undoubtedly secondary character and one of them is reduction of *m. omotransversarius dorsalis.*

In the rabbit, in our opinion, the originally single-form *m. omotransversarius* underwent secondary division into two separate muscle, while *m. omotransversarius dorsalis* underwent regresion. This point of view

is at variance with that of L e c h e (*l.c.*), according to whom the so-
-called *m. levator scapulae maior* forms the dorsal part of *m. omoclei-
dotransversarius* (which would correspond to our *m. omotransversarius
dorsalis*) and *m. basiohumeralis* is the ventral part of this muscle (which
would correspond to *m. omotransversarius*). This view must, however,
be considered erroneous, as the terminal insertion of the so-called *m.
levator scapulae maior* completely coincides with te insertion of the
typical *m. omotransversarius* and not with *m. omotransversarius dor-
salis*. Consequently *m. basiohumeralis*, situated more ventrad, should be
considered as the secondary split of the originally united *m. omotrans-
versarius*, which may be the result of specific modification of the shape
of *proc. acromialis*. In summing up the foregoing the conclusion must
be reached that in the rabbit it is permissible, and even essential, to
speak of *pars dorsalis* and *pars ventralis* of *m. omotransversarius* and
of the reduction of *m. omotransversarius dorsalis*. Although the specific
muscle running from *squama ossis occipitalis* to the caudad angle of the
scapula, which can be suspected of homology with *m. omotransversarius
dorsalis*, still occurs in this animal, it is more probable that it constitutes
a specifically modified and separate (as in some rodents), *pars capitis* of
m. rhomboideus. It would also appear that it is impossible in the case
of the rabbit to speak of the fully formed *m. brachiocephalicus* as is the
case in ungulates and carnivores, since in the rabbit the clavicle is still
relatively well preserved and although it has lost direct connection with
the scapula and sternum, it is nevertheless relatively large and connected
with them by ligaments. *Pars clavicularis* of *m. deltoideus* here connects
more closely with *m. basiohumeralis*, or (in our opinion) *pars ventralis* of
m. omotransversarius, while *m. cleidocephalicus* has an insertion on the
retained osseous part of the clavicle. If, however, this whole muscle
complex is treated as the nucleus of *m. brachiocephalicus*, then it should
be emphasised that it is composed of: *pars clavicularis* of *m. deltoideus*,
m. cleidocephalicus and *pars ventralis* of *m. omotransversarius*.

Discussion of the behaviour in *Primates* of the muscles in question
merits particular attention. In the most primitive representative of this
group (tupaia) there are two *mm. omotransversarii*. In some *Lemuroidae*
there is no *m. omotransversarius dorsalis*, while *m. omotransversarius*
is retained. In all of the monkeys examined from the *Ceboidea* and
Cercopithecoidea groups these two muscles are present, as they are in
primitive mammals. A certain modification, however, occurs here con-
sisting in *m. omotransversarius dorsalis*, which begins jointly with *m.
omotransversarius*, separating in its terminal insertion from *m. rhom-
boideus* and consequently giving the impression of the first dens of *m.
levator scapulae*. In anthropoid apes such as, for instance, in the gibbon

examined, *m. omotransversarius* and *m. omotransversarius dorsalis* may occur, the latter being united to an even greater degree in *m. levator scapulae*, since *pars capitis m. rhomboideus* is completely absent in the gibbon. The first dens running together with *m. omotransversarius* from the atlas ends on the upper angle of the scapula (from the lateral side). The foregoing shows that this dens, only slightly transformed and attached to *levator scapulae*, constitutes *m. omotransversarius dorsalis*. In certain cases, among representatives of *Hylabatinae*, there is no *m. omotransversarius*, as in the case of the *Symphalangus syndactylus* examined, but *m. omotransversarius dorsalis* is always present here, of course united to an even greater degree with *m. levator scapulae*.

Generally speaking it may be said that tendencies to reduction of *m. omotransversarius* can be traced in many representatives of *Pongidae*, since as can be gathered from descriptions in literature (Ž e d e n o v, 1962), this muscle exhibits considerable individual variation. This tendency has become a typical phenomenon in man and *m. omotransversarius* appears here only as a variant (H u x l e y cited after M i c h a e l i s 1903). It must be mentioned that a process of this kind, consisting in reduction of *m. omotransversarius* while retaining *m. omotransversarius dorsalis*, is a phenomenon which is at least rare in mamals. The reverse process is far more frequently found, *i.e.* reduction of *m. omotransversarius dorsalis* while retaining *m. omotransversarius*.

When the results of our studies are compared with data in literature on other domestic mammals, that is, domestic ungulates, the conclusion may be reached that in ruminants *m. omotransversarius dorsalis* has undergone regression, while *m. omotransversarius* is retained. Descriptions of these muscles in pigs give rise to doubt, since the data given by E l l e n b e r g e r (1943) and N i c k e l (1954) for this animal show that *pars cervicalis m. serratus ventralis* begins from the first cervical vertebra and ends not only on the serrated surface of the scapula, but also on its capitad angle from the lateral side. Such descriptions suggest that in pigs the first dens of this muscle, running from the atlas, may in fact constitute *m. omotransversarius dorsalis*. In addition data in literature show that *m. omotransversarius* is present in pigs.

In conclusion yet another detail, connected with the phylogenesis of another muscle, namely *m. trapezius*, should be taken into consideration. As already mentioned *m. omotransversarius* may occupy three different positions in relation to the latter muscle. It may thus be situated parallel to the lower edge of *m. trapezius*, may cover its capitad bundles, or conversely may be covered by it in its terminal part. When considering which of the three above-mentioned kinds of behaviour of *m. omotransversarius* in relation to *m. trapezius* is the original one, it is not difficult

to reach the conclusion that only the first possibility can be considered, as the last two cancel each other out. It would follow from this that originally *m. trapezius* did not reach the clavicle in mammals, since the parallel situation of the two muscles is possible only in this particular case. Confirmation of the correctness of this opinion can be provided by the fact that in the squirrel or tupaia, which possess a well developed clavicle, *m. trapezius* does not reach it. Extension of the insertion of *m. trapezius* to the clavicle, encountered in many rodents, marsupials and *Primates,* is probably of a secondary character. In such cases the bundles of *m. trapezius,* in acquiring new field for insertion, extend to the clavicle under or over the previously existing *m. omotransversarius* which reaches *proc. accromialis.*

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MIĘSIEŃ BARKOWO-POPRZECZNY W ŚWIETLE
ANATOMII PORÓWNAWCZEJ

Streszczenie

Na podstawie badań przeprowadzonych na gryzoniach, zajęczakach, mięsożernych i naczelnych autorzy dochodzą do wniosku, iż typowy *m. omotransversarius* występuje powszechnie u gryzoni i mięsożernych. U niektórych przedstawicieli obu tych grup ssaków pojawia się jeszcze dodatkowe pasmo mięśniowe (nie wyróżniane w NAV) określone przez nas jako *m. omotransversarius dorsalis*. Mięsień ten biegnąc od kręgu szczytowego do szyjnego kąta łopatki zlewa się w swym końcowym odcinku z *m. rhomboideus*. W antropotomii nie wyróżnia się mięśnia o nazwie *omotransversarius*. U naczelny homologiem tego mięśnia jest *m. atlanto-scapularis ventralis*, występujący u małp niższych i biegnący od kręgu szczytowego do wyrostka barkowego łopatki, a u form wyższych — do obojczyka. U małp obecny jest również *m. omotransversarius dorsalis*, czyli *atlanto-scapularis dorsalis*, który łącząc się z *m. levator scapulae* przekształca się tym samym w jego

pierwszy, najsilniejszy ząb. U królika homologiem *m. omotransversarius* są dwa mięśnie tzw. *m. basiohumeralis* i *m. levator scapulae maior*. Przeprowadzone badania skłaniają autorów do wyrażenia poglądu iż *m. omotransversarius* nawiązuje łączność genetyczną nie z *m. trapezius*, czy *sterno-cleido-mastoideus*, lecz z *m. rhomboideus*. Unerwienie obu mięśni barkowo-poprzecznych głównie odgałęzieniami nerwów szyjnych a nie nerwem dodatkowym zdaje się potwierdzać słuszność wyrażonego wyżej poglądu.