FACIAL MUSCULATURE OF SEMNOPITHECUS ENTELLUS

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Introduction

A recent perusal of Darwin's book, *The expression of the emotions in man and animals* (1890), stimulated the author's interest in the facial musculature of the primates. On looking into the available literature on facial musculature and the extensive bibliography therein cited, it became obvious that though the facial muscles of many Cercopithecidæ were already worked out in detail, the study had been confined to the Cercopithecinæ. No mention was found anywhere to the arrangement of the facial muscles in the Semnopithecinæ, nor any diagram among the hundreds given by Edgeworth (1935). Ruge's classical work has not been available here; but Polok (1908) has stated that Ruge did not study Colobus or Semnopithecus.

Another point also became clear. Though Ruge (cited by Lightoller, 1928) was unwilling to allow, probably on account of the cheek pouches, that the Cercopithecidæ belonged to the anthropoid stem, and hence regarded them as unsuitable for purposes of comparison, Paugger (cited by Lightoller, 1928) does not agree with the attitude of Ruge and Lightoller (1928) definitely says: "There seems to be no valid reason, why the appearance of buccal herniæ should prevent the facial musculature of these primates being regarded as, more or less, accurately representing that possessed by the predecessors of the higher primates". If the facial musculature of these Cercopithecidæ with a buccal pouch should have such comparative value according to Lightoller, it naturally follows that the facial musculature of those Cercopithecidæ without the buccal pouch should have an enhanced comparative value. The Semnopithecus entellus is one such, and also it has a relatively foreshortened muzzle. As the facial musculature of the Semnopithecinæ has not been described before, the present work has been undertaken.

Materials and Methods

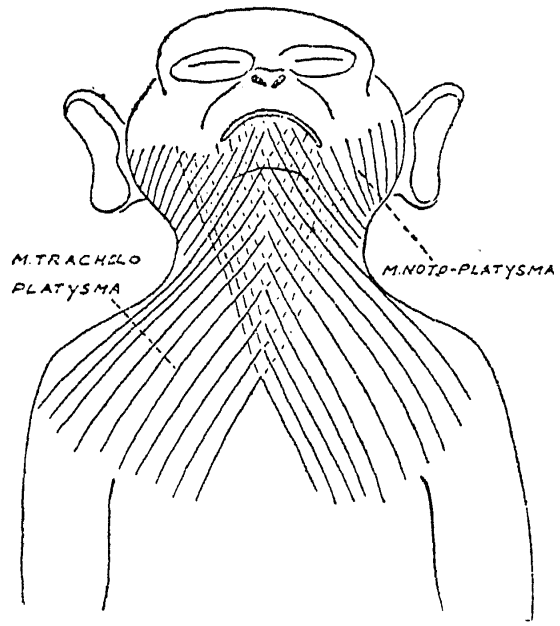
Two specimens of female laugur (*Semnopithecus entellus*), young adults, embalmed according to the usual technique followed in the Department of Anatomy, Andhra Medical College, Vizagapatam, have been dissected.

Classification and Terminology

The muscles have been classified on a regional grouping as generally followed in anatomical text-books. As regards nomenclature it was found that the terminology available in human anatomy was not sufficient and names had to be borrowed from comparative anatomy. Instead of creating a new mixture, it was considered convenient to follow a standard already set and the nomenclature used by Lightoller (1928) has been uniformly adopted.

M. Subcutaneous Colli—

M. Platysma.—(Text-figs. 1, 2, 3, 4). The subcutaneous musculature of the neck is represented only by the platysma. The sphincter colli superficialis and the sphincter colli profundus are both absent. The platysma forms an extensive and very nearly complete investment for the neck all round. There is no apparent demarcation that can be made out between

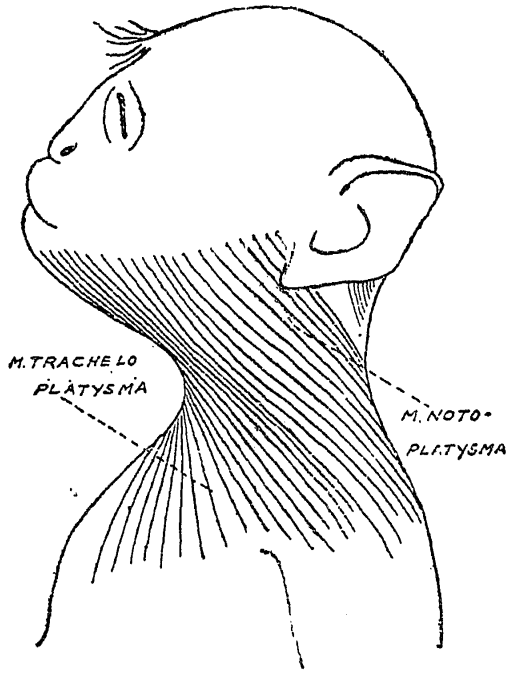


TEXT-FIG. 1. Dissection of face and neck showing m. subcutaneous colli, anterior view.

the noto-platysma and the trachelo-platysma either by difference in plane or direction of muscle fibres or by intermuscular gap between the muscles. So a conventional demarcation between the two muscles has to be made. " The tip of the acromion process will be regarded as the point where the noto-platysma and the trachelo-platysma meet " (Lightoller, 1928).

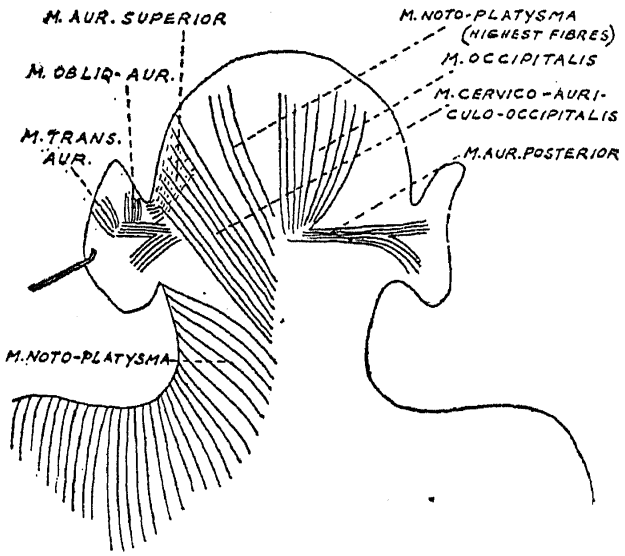
M. Noto-platysma.—(Text-figs. 1, 2, 3, 4). The muscle fibres take origin close to the mid-dorsal line of the neck and the lower part of the line of origin deviates laterally over the supraspinous region and shoulder. Their course and insertion can be conveniently described in three groups: (1) The highest muscle fibres, 3 or 4 discrete muscular fasciculi, from the

upper part of the origin, pass cephalad constituting a superficial continuation of the noto-platysma to the occipital part of the scalp. (2) The muscle fibres



TEXT-FIG. 2. Dissection of the face and neck showing m. subcutaneous colli, side view.

taking origin from the upper half of the mid-dorsal line of the neck pass upwards and laterally to be attached to the auricle and also to join the posterior part of the auricularis superior and the galea. This muscle is the Cervico-auriculo-occipitalis and though on surface view this appears to lie on the same plane as the layer constituted by the highest muscle fibres of the noto-platysma, the Cervico-auriculo-occipitalis in spreading upwards really



TEXT-FIG. 3. Dissection of neck and occipital region of scalp. On the left side the superficial strata of the scalp formed by the m. noto-platysma, and also the intrinsic muscles of the cranial side of the auricle are seen. On the right side the superficial strata have been removed.

forms a substratum to it. (3) Muscle fibres from the lower half of the mid-dorsal line of the neck and from the supraspinous region and the region of the shoulder pass upwards and forwards below the ear over the anterior part of the neck on to the face constituting the supra-angular, mandibular, modiolar and labial parts of the platysma. The supra-angular part extends on the face up to a line from the ear to below the angle of the mouth and partly overlaps the lower part of the zygomaticus. The mandibular part consists of a few fibres attached to the mandible. The modiolar part is attached to the modiolus and also the lower part of the buccinator. The labial part forms the labial tractors for the lower lip.

In addition to the groups of muscle fibres that have been described above as noto-platysma, a deeply separated off-shoot from it is said to have given rise to the auriculo-occipitalis proprius consisting of the auricularis posterior and the occipitalis (proprius). These muscles will be described subsequently.

Trachelo-platysma.—(Text-figs. 1, 2, 4). The muscle fibres take their lower attachment from the region of the shoulder in front of the acromion, from the lateral pectoral region reaching down to the anterior fold of the axilla and from the medial pectoral region as far down as the second intercostal space. There are no muscle fibres from over the body of sternum and manubrium sterni. The muscle fibres proceed upwards and medially and meeting the fibres of the opposite side constitute a strong median decussation extending from the mandible down to a point 2 cm. above jugular notch. Beyond the median decussation, the fibres of one side pass to the opposite side and continue their course interwoven with the fibres of the trachelo- and noto-platysma of the opposite side up to nearly half-way along the side of the mandible. No regularity of layeral arrangement between the decussating fibres of the right and left sides could be made out.

Evolution of the trachelo-platysma.—The trachelo-platysma was regarded by Ruge as an extension of the noto-platysma. But Lightoller (1928) considers it as a separate though sister muscle to the noto-platysma, probably developing from the same anlage. The subprimates possess only a noto-platysma. In primates the trachelo-platysma appears and gradually replaces noto-platysma which finally disappears in man. Lightoller (1928) says: " the key to the position to be occupied by the platysma of any particular primate was obtained from the point of meeting in the face of the noto- and trachelo-platysmæ, which was determined by following a muscle fasciculus from the acromion to the face ". In Semnopithecus entellus this line reaches the face close to the median line on the same side and is similar to that in Baboon and Macacus. Lightoller suggests that the gradual replacement of the noto-platysma by the trachelo-platysma may be connected with

the assumption of the upright position. He further says: " It is curious how closely, apparently this replacement of the noto-platysma by the trachelo-platysma corresponds to the evolutionary grouping of the primate ". The suggestion becomes clarified if it is amplified as follows. The points of attachment of the muscle fibres should be considered, divorced of the conventional meanings that the terms ' origin ' and ' insertion ' connote. The dynamic action of the muscle fibres in relation to the habitual position of the animal and gravity, is the important factor. In subprimates, which are habitually pronograde, the noto-platysma serves as a support for the tissues of the face and neck acting from the dorsum. In the progressively orthograde anthropoid apes, the trachelo-platysma, constitutes a supporting brace for the superficial structures of the ventral part of the neck and especially of the space below the projecting mandibular shelf, and it acts here from its facial and mandibular attachments. Thus the trachelo-platysma becomes emphasised in them, while the noto-platysma gradually disappears having lost its vital function. Among the early primates, *e.g.*, the Cereopithecidæ, where the pronograde and orthograde attitudes are both habitual to the animal, we get a marked development of both noto- and trachelo-platysmæ, with a shifting complexity of action. The progressively lateral spread of the evolving trachelo-platysma displacing the noto-platysma is probably to be accounted for by the progressive widening of the mandibular arcade.

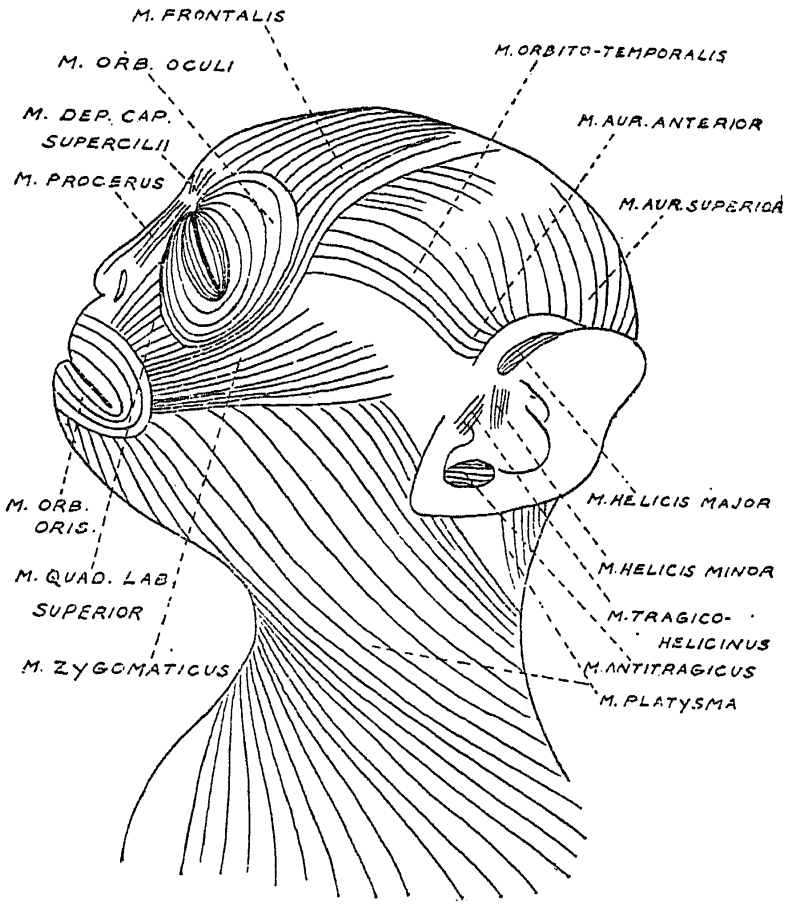
Muscles round the Mouth

M. Quadratus labii inferioris.—This muscle is absent as in Baboon and Macacus.

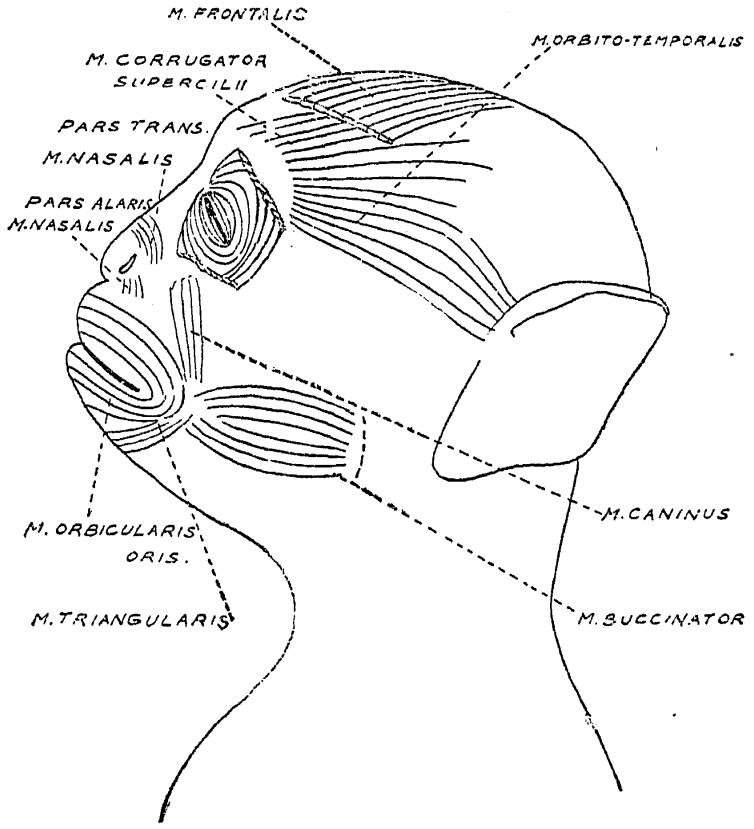
M. Quadratus labii superioris.—(Text-fig. 4). The angular head and the zygomatic head have not become differentiated from the adjacent muscles. The infraorbital head was present passing from the infraorbital margin under cover of the orbicularis oculi into the upper lip.

M. Zygomaticus.—(Text-fig. 4). This muscle takes origin from the external surface of the middle third or more of the zygomatic arch and also from the temporal fascia above. The fibres pass forwards and downwards towards the angle of the mouth to be attached to the modiolus. The upper border of the muscle is adjacent to the lateral border of pars peripheralis orbicularis oculi. The lower part of the zygomaticus covers a part of the parotid gland and is in turn overlapped by the platysma.

M. Caninus.—(Text-fig. 5). It has a linear origin from the maxilla anterior to the jugum for the canine tooth. The fibres pass laterally and caudally to their attachment into the deep part of the modiolus.



TEXT-FIG. 4. Dissection of face and neck showing the superficial musculature of the face and forehead, and also the intrinsic muscles of the lateral aspect of the auricle.



TEXT-FIG. 5. Dissection to expose the deeper muscles of the face and forehead.

M. Triangularis.—(Text-fig. 5). In its complete form when seen in man the triangularis is said to have a deeply situated caput longum and a superficial fan-shaped part subdivided into three rays, *viz.*, caput latum, caput transversum and caput buccale. In Semnopithecus entellus the superficial part is not present. The deep part, the caput longum, is present and is attached to a tubercle on the middle of the outer-aspect of the mandible below the first premolar tooth. It forms a distinct rounded bundle passing obliquely cephaled and laterally into the deep part of the modiolus. Fibres of the caninus and triangularis intimately meet here. Muscle fibres of the labial part of the platysma partly overlap and partly pass deep to the triangularis.

Ruge considered the triangularis as a caudal extension of the fibres of the caninus. Huber (1933) also takes the same view. But Lightoller (1928) considers triangularis as an off-shoot of the trachelo-platysma. The picture of caninus and triangularis in Semnopithecus as seen in Text-fig. 5 is comparable with that seen in the figure of the human embryo given by Futamura reproduced as fig. 378 in Keibal and Mall, *Manual of Embryology* (1910). Futamura regarded the m. triangularis as associated with the m. caninus. It is possible that the caput longum of the m. triangularis originates from the same rudiment as the m. caninus and that the superficial heads are derivatives of the platysma.

M. Risorius.—It is absent.

M. Buccinator.—(Text-fig. 5). The buccinator takes its usual origin from the posterior portion of the alveolar margin of the maxilla and mandible and from the pterygomandibular ligament. In the Macacus, a gap in the continuity of the mandibular attachment about the premolar region is described (Huber, 1933; Lightoller, 1928). But in the Semnopithecus entellus there is no such gap. The fibres of the buccinator proceed forwards to their attachment to the modiolus and some continue into the orbicularis oris.

M. Orbicularis Oris.—(Text-figs. 4, 5). It consists of the usual orbicular fibres getting reinforcement from the incisivi superioris and inferioris and at each modiolus from the buccinator. The orbicular fibres get crosswoven in different planes with the labial tractors.

M. Incisivi Superior and Inferior.—The muscle fibres take origin from the incisive region of the upper and lower jaw close to the mucous membrane of the mouth and the muscle fibres pass laterally uniting with the deeper fibres of the orbicularis oris.

M. Mentalis.—It takes origin from an expanded area on the juga of the lateral incisor and canine teeth of the lower jaw and fibres pass forwards and

upwards through the portio-decussata of the platysma to get attached into the deep aspect of the skin near the median line.

Muscles of the Nose

M. Procerus.—(Text-fig. 4). The muscle is cranially continuous with the frontalis. The muscle fibres pass down on the nose between the orbicularis oculi muscles on either side and overlap inferiorly the pars transversus m. nasalis. The lateral margin of the procerus spreads beyond the nose and gets attached into the upper lip by the side of the quadratus labii superioris.

Pars Transversa M. Nasalis.—(Text-fig. 5). This muscle was absent in the Orangs, Baboon and Macacus dissected by Lightoller (1928). It is, however, present in Semnopithecus entellus in which it forms a transverse muscular band about 3 mm. wide taking origin from the side of the bony piriform aperture medial to the caninus, and passing over the side of the nose to meet the muscle of the opposite side on the dorsum of the nose. The fibres are muscular throughout.

Pars Alaris Proprius M. Nasalis.—(Text-fig. 5). The muscle consists of short fibres passing between the lower part of the piriform aperture and the rudimentary ala of the nose.

Muscles round the Eye

Pars Palpebralis M. Orbicularis Oculi.—(Text-fig. 4). It consists, as usual, of the delicate muscle fibres on the superficial part of the eye-lids.

Pars Orbitalis M. Orbicularis Oculi.—(Text-fig. 4). It consists of the orbicular fibres situated outside the palpebral part and taking attachment from the medial palpebral ligament and the adjacent part of the frontal process of the maxilla. Superiorly the fibres unite with the fibres of the frontalis. At the orbitonasal angle some of the fibres of the orbital part of the orbicularis oculi become differentiated into the depressor çapitis (supercilii).

Pars Peripheralis M. Orbicularis Oculi.—(M. Malaris of Henle). (Text-fig. 4.) The medial head of this muscle cannot be differentiated from the adjacent fibres of the procerus and the orbital part of the orbicularis oculi. The lateral head consists of the peripheral muscle fibres of the infero-lateral part of the orbicularis oculi. Craniad, these fibres curve laterally and upwards along the lateral margin of the orbit and then turn upwards and medially. Here they part company from the other orbicular fibres and proceed upwards on the lateral part of the forehead joining the external part of the muscular stratum constituted by the frontalis. Caudad, on the other

hand, some of these fibres pass into the region of the upper lip between the quadratus labii superioris and Zygomaticus.

M. Depressor Capitis (Supercilii).—(Text-fig. 4). At the orbito-nasal angle and above the medial palpebral ligament, some muscle fibres are found passing upwards and medially into the fibro-fatty tissue of the medial part of the eye-brow margin and glabella. These muscle fibres are caudally united with the orbital part of the orbicularis oculi.

M. Corrugator (Supercilii).—This muscle is situated deep to the orbicularis oculi and frontalis. It takes origin from the glabella and the medial part of the superciliary arch and passes upwards and outwards to become continuous laterally with the orbito-temporalis.

Muscles of the Scalp

M. Epicranius.—(Text-figs. 3, 4). The muscle epicranius consists of the fibro-muscular sheet over the scalp. Anteriorly on the frontal region it shows two muscular strata, *viz.*, a superficial layer, m. frontalis and a deeper layer made up of m. Corrugator supercilii and m. orbito-temporalis. Over the vertex it consists of a single stratum of aponeurotic galea. Posteriorly on the occipital region it consists of three muscular strata, *viz.*, a superficial layer formed by the occipital extension of the notoplatysma, an intermediate layer, the m. Cervico-auriculo-occipitalis and a deeper layer, the m. auriculo-occipitalis (proprius), which is made up of the auricularis posterior and the occipitalis. The individual muscular components are described hereunder.

M. Frontalis.—(Text-fig. 4). The medial fibres of the frontalis muscles of the two sides unite in the middle line and continue downwards as the procerus. The frontalis terminates below deep to the orbicularis oculi in the region of the eye-brow. Laterally the frontalis receives some muscular fibres from the lateral part of the pars peripheralis of the orbicularis oculi. Towards the vertex frontalis ends in an aponeurosis which unites with the deeper stratum to form the galea aponeurotica.

M. Orbito-temporalis —(Text-figs. 4, 5). The deeper muscular stratum on the frontal region consists of the corrugator supercilii medially and in continuation with it laterally, the m. orbito-temporalis. This muscle takes origin from the lateral part of the superciliary arch and external angular process of the frontal bone. The more external fibres of this muscle as they course upwards and laterally have a progressively increasing side deviation so that the most lateral fibres pass in a gentle arc in an approximately horizontal direction over the temporal fascia to the region of the ear, there to become united with the anterior auricular muscle and the anterior part of

the superior auricular muscle. This deep muscular stratum formed by the combined corrugator supercilii and orbito-temporalis muscles ends in an aponeurosis blending with the galea.

Occipital extension of the M. Noto-platysma.—(Text-fig. 3). The highest fibres of the noto-platysma consist of 3 or 4 discrete muscle fibres taking origin from the side of the upper part of the ligamentum nuchæ and proceeding upwards. These have been described as group (1), in the description of the noto-platysma. The individual muscle fibres are too far apart to form a muscular layer. But with the intervening fascia they constitute the superficial stratum of the occipital region of the scalp.

M. Cervico-auriculo-occipitalis.—(Text-fig. 3). It constitutes the intermediate stratum in the occipital region of the scalp. It consists of muscle fibres of the noto-platysma taking origin along the upper part of the ligamentum nuchæ and these fibres were indicated as group (2), in the description of the noto-platysma. They form a muscular ribbon which passes upwards and laterally. The outer fibres get attached to the upper part of the root of the auricle and the other fibres blend over the posterior part of the m. auricularis superior.

M. Auriculo-occipitalis Proprius.—(Text-fig. 3). The third or deepest stratum of the occipital region consists of the auricularis posterior and the occipitalis. The auricularis posterior is described with the extrinsic muscles of the ear. *The occipitalis* takes origin from the medial part of the highest muchal line and passes upwards deep to the two other strata. Where the muscle fibres of the occipitalis become aponeurotic the two superficial strata join it to form a composite galea.

The epicranial musculature of the Semnopithecus therefore presents its primitive components better than the Baboon and the Macacus.

Extrinsic Muscles of the Auricula

M. Auricularis Posterior.—(Text-fig. 3). It consists of a well marked muscular bundle taking origin from the highest muchal line close to the origin of the occipitalis and passing to the posterior part of the concha to be inserted in two well defined bands. The upper band is practically continuous with the muscle transversus auriculi.

M. Auricularis Superior and Anterior.—(Text-figs. 3, 4). These muscles together form a common muscular fan in front of and above the auricle. The anterior muscle fibres become blended with the orbito-temporalis. The posterior part of the auricularis superior becomes united with cervico-auriculo-occipitalis.

The Intrinsic Muscles of the Auricle

M. Transversus Auriculæ.—(Text-fig. 3). It appears to be a continuation of the auricularis posterior; it is directed upwards and backwards on the cranial aspect of the pinna.

M. Obliquus Auriculæ.—(Text-fig. 3). It takes origin from under cover of the upper border of the auricularis posterior and passes upwards.

M. Helicis Minor.—(Text-fig. 4). This small muscle lies on the crus helicis as in man.

M. Helicis Major.—(Text-fig. 4). It is situated on the anterior margin of the helix and is attached to spina helicis.

M. Antitragicus.—(Text-fig. 4). It lies on the antitragus.

M. Trago-helicinus.—(Text-fig. 4). It represents the tragicus but has extended its attachment to bridge over the gap between helix and tragus.

Summary and Conclusion

Two specimens of Semnopithecus entellus have been dissected. The subcutaneous colli consists of well developed noto- and trachelo-platysmæ and forms a nearly complete investment for the neck. The only gaps in this muscular investment are a small triangular interval above the manubrium for a distance of 2 cm. and another smaller triangular gap behind the ear between the fibres of the noto-platysma that go ventral and dorsal to it. The highest fibres of the noto-platysma spread over the occipital region of the scalp in primitive fashion. The quadratus labii inferioris is absent. The quadratus labii superioris lacks differentiated angular and zygomatic heads. Zygomaticus, caninus, the caput longum of the triangularis, the incisivi, and mentalis are present. The risorius is absent. The orbicularis oris and buccinator present the usual features. The procerus overflows from the nose on to the upper lip and is adjacent to orbicularis oculi and infra-orbital head of the quadratus labii superioris. Pars transversa and pars alaris m. nasalis are seen. The depressor supercilii is intimately connected to the medial part of pars orbitalis m. orbicularis oculi. The peripheral part of orbicularis oculi associates itself with the frontalis above and the tractors of the upper lip below. The epicranius shows two muscular strata in front and three muscular strata posteriorly uniting to form the galea over the vertex. The two anterior layers are the frontalis superficially and the combined corrugator supercilii plus orbito-temporalis deeply. Over the occipital region the three layers of the epicranius are, firstly, the highest fibres of the noto-platysma, secondly, the muscle cervico-auriculo-occipitalis, and thirdly, the layer composed of the occipitalis and the auricularis posterior. Over the auricle,

the derivation of the transversus auricularis from the m. auricularis posterior is clearly indicated in the continuity of their fibres. Other extrinsic and intrinsic muscles of the ear are also described.

After a study of the facial musculature of the Baboon and the Macacus, Lightoller (1928) finds that the cercopithecidæ are lavishly endowed with facial muscles and that no support was found for the statement that their facial musculature was altered by their possessing buccal herniæ. His conclusion is that: "They probably would be a much better standard for the facial musculature of the primates than the Lemuroidea." The present investigation has shown that this conclusion is applicable, with even more appropriateness, to that subfamily of the cercopithecidæ without the buccal pouch, of which Semnopithecus entellus is the type.

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