

Observations on the anatomy of Nycticebus tardigradus / by St. George Mivart and James Murie.

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Publication/Creation

[London] : [publisher not identified], [1865]

Persistent URL

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OBSERVATIONS

ON THE

ANATOMY OF NYCTICEBUS TARDIGRADUS.

BY

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[From the PROCEEDINGS OF THE ZOOLOGICAL SOCIETY OF LONDON,
February 28, 1865.]

ORIGINATIONS

OF THE

CAUTION OF VICTORIES TARDIUM

BY

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Published by the University of Chicago Press, Chicago, Ill., U.S.A.

THE careful and elaborate joint memoir on the genus *Stenops*, by Professors J. L. C. Schroeder Van der Kolk¹ and W. Vrolik, published as the result of reiterated observations, and as the final settlement of points previously disputed between them, might perhaps have been expected to have rendered unnecessary any further publication of anatomical facts respecting the genus therein described, excepting details of an obscure or recondite character.

Nevertheless our dissection of a specimen of *Nycticebus tardigradus*, recently received from the Society's Gardens has been the occasion of observations which we consider are worthy of special mention.

The disposition and arrangement of the muscles and tendons so differ from the description given by these authors, that we cannot consider them as merely the result of individual variation.

We are, indeed, inclined to think that, in the memoir on the genus *Stenops*, the authors have not sufficiently distinguished, or been so precise in noting, the special differences of the three forms included by them in that genus, as is desirable in such interesting animals.

In their memoir seventy muscles in all have been mentioned, but of many of these there is no more than a passing notice. We have therefore endeavoured to supplement what they have given meagrely, adding an account of other muscles not alluded to by them.

To each of the latter we have appended an asterisk, to distinguish them from those already mentioned by the authors.

Muscles of the Head and Neck.—The *digastric* we found exceedingly strong. It arises from the mastoidal region, and is inserted as usual. There is a distinct median tendon as in *Tarsius*² and *Cheirromys*, but without the "two fasciculi of muscular fibres"³ to the posterior bellies existing in the latter genus.

The muscles attached to the ventral surface of the neck are remarkable. Their great length and thickness have been mentioned by Profs. S. Van der Kolk and Vrolik, but they are spoken of only as "*muscles longs du cou (mm. longi colli).*"

It is not, however, the *longus colli* which is so very much enlarged, but the *rectus capitis anticus major*; and it attains a truly prodigious size. It arises from the front of the bodies of the vertebræ as low down as the sixth dorsal, and is inserted into the basioccipital for almost the whole length of that bone, also into the transverse processes of the axis and other cervical vertebræ (fig. 1, *R. c. a. maj.*).

Meckel⁴ is silent as to the conditions of this and the following muscles in the Primates; but he notices a similar excess of this muscle over the *longus colli* in the Beaver. In *Tarsius*⁵ this muscle is large, but does not come from the dorsal vertebræ; but in *Ateles belzebuth*, Kuhl⁶ describes it as arising from the side of the third thoracic vertebra.

¹ "Recherches d'Anatomie comparée sur le genre *Stenops* d'Illiger," in 'Bijdragen tot de Dierkunde, uitgegeven door het Koninklijk zoologisch Genootschap.' Erste Deel. Amsterdam, 1848-1854.

² Burmeister, 'Tarsius,' p. 34, t. 5. fig. 13, 14, π.

³ Owen, Trans. Zool. Soc. vol. v. p. 58.

⁴ Anat. Comp., traduit par MM. Riester et Alph. Sanson, 1830, vol. vi. p. 173.

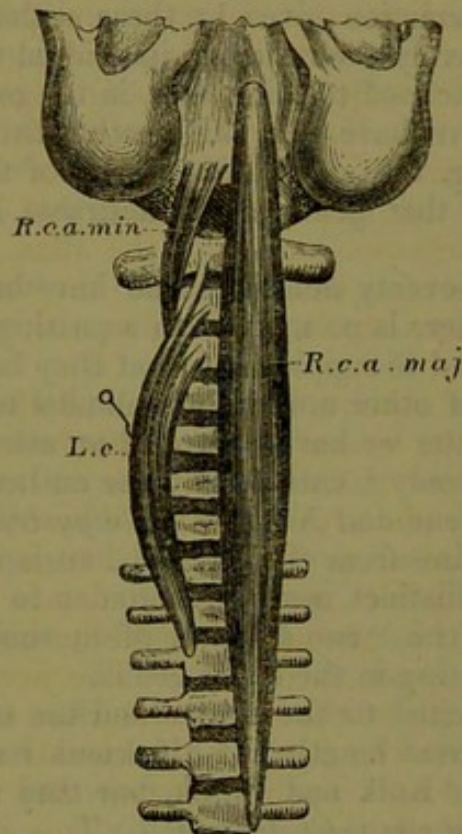
⁵ Burmeister, *op. cit.* p. 39, t. 5. fig. 14 n.

⁶ Beiträge z. Beschreibung meherer Mammalien, p. 9.

The *rectus capitis anticus minor* is pyramidal in shape, and arises from the transverse processes of both the axis and atlas, as in *Tarsius*¹. It is inserted into the exoccipital just within the mastoidal region of the periotic (fig. 1, *R. c. a. min.*).

The *longus colli* arises from the fronts of the bodies of the four anterior dorsal vertebræ, and is attached to the bodies and transverse processes of all the cervical vertebræ, three distinct tendons going to the bodies of the atlas, axis, and third cervical vertebra (fig. 1, *L. c.*).

Fig. 1.



Deep muscles in front of the neck.

R. c. a. maj. Rectus capitis anticus major. *R. c. a. min.* Rectus capitis anticus minor. *L. c.* Longus colli.

Muscles of the Trunk.—The two **rhomboid* muscles are represented by a single one, which is largely developed. It arises from the spinous processes, from the fifth cervical to the fifth dorsal inclusive, and is inserted into the spinal border of the scapula from its anterior end to near its posterior extremity.

The **levator anguli scapulæ* is a very strong muscle, and arises from the transverse processes of all the cervical vertebræ except the first. It is inserted as usual.

Meckel² says, "*Dans les Loris il se rend seulement à l'atlas.*" If such is the case in *Loris gracilis*, it is far from being so in *Nycticebus*.

The *levator posticus scapulæ* of Burmeister³ was absent.

¹ Burmeister, *op. cit.* p. 39, t. 5. fig. 14 o.

² Anat. Comp. vol. vi. p. 236.

³ *Op. cit.* p. 47, t. 4. fig. 1. no. 4.

The **splenius* is exceedingly large, and there is no *splenius colli*, thus confirming Meckel's¹ observations.

The **complexus* is also very strong, extending down to the spinous processes of the three first dorsal vertebræ. We did not find the division spoken of by Meckel² as existing in *Loris*.

The **cervicalis ascendens* is, as usual, continued from the sacro-lumbaris, and is inserted into the transverse processes of the two first dorsal and the last cervical vertebræ.

The **transversalis cervicis* is continued upwards from the *longissimus dorsi*, but takes fresh origin from the three first ribs. It is inserted into the outer ends of the transverse processes of the cervical vertebræ, from the seventh to the second inclusive.

Meckel³ differs from Burdach⁴ as to what goes to form the *cervicalis ascendens*. Our observations agree with the latter author.

The **levator claviculæ*, which is not noticed in the memoir on the genus *Stenops*, we find to be a long but slender muscle. It arises from the transverse process of the atlas, and is inserted into the outer end of the clavicle, and not into the acromion process. At its insertion, the fibres are in close union with those of a portion of the deltoid.

This muscle was noticed by Kuhl⁵ in *Ateles* in the year 1820, and appears to be the *levator anticus scapulæ* of Burmeister⁶; it is the *acromio-trachélien* of Cuvier⁷, the *clavio-trachélien* of Church⁸, and spoken of as an undetermined muscle by Meckel⁹.

The *omo-hyoid* has no median tendon, but is a strong muscle. It arises from the os hyoides, and is inserted into the anterior margin of the scapula at the inner end of its middle third.

Muscles of the upper Extremity.—The *pectoralis major* arises from the whole length of the sternum and the sterno-clavicular articulation. It has not the clavicular fasciculus noticed by Profs. S. Van der Kolk and Vrolik in their memoir, and which has also been found strongly marked in *Cheiromys*¹⁰. This muscle hardly seems to merit the epithet "*très-faible*" given by Meckel¹¹ to it in the *Loris*.

The *coraco-brachialis* consists of a long and a short portion. The former arises by a strong tendon from the coracoid process, and is inserted into the anterior surface and inner border of the humerus, down to the middle of the upper surface of the condyle. The latter or short portion, which is muscular at its origin, also arises from the coracoid process, just internal to the tendon of the long

¹ Anat. Comp. vol. vi. p. 141.

² *Loc. cit.* p. 146.

³ *Loc. cit.* p. 149.

⁴ "Beiträge zur vergleich. Anat. des Affen," in 'Berichte von der König. Anat. Anstalt zu Königsberg,' p. 21.

⁵ *Loc. cit.* p. 15.

⁶ Tarsius, p. 46, t. 4. figs. 1 and 3.

⁷ Leçons d'Anat. Comp. 2nd edit. 1835, vol. i. p. 371.

⁸ Nat. Hist. Review, 1861, p. 512.

⁹ *Loc. cit.* p. 236.

¹⁰ Owen, *l. c.* p. 60, pl. xxii. xxiii. fig. 1. no. 17.

¹¹ *Loc. cit.* p. 276.

portion, and is inserted into the inner side of the neck of the humerus, between the conjoined tendons of the teres minor and subscapularis and that of the teres major. It is just in front of the external head of the triceps, and has the tendon of the latissimus dorsi passing immediately before it.

S. Van der Kolk and Vrolik say nothing of the short head. With reference to the action of this muscle, it is probable that, besides mere flexion mentioned by them, the *short* slip has an influence in the rotation of the limb.

Meckel¹, in contradistinction to the *Loris* says, in "les *Makis*" it is divided, thereby implying that in the first it is single.

Kuhl², as early as 1820, noticed the division of this muscle in *Ateles*. Cuvier, in his 'Leçons'³, has also mentioned its bifurcation in Monkeys. Burdach⁴ describes a double head in the *Simiadae*; Burmeister⁵ in *Tarsius*; and Prof. Owen⁶ notices in *Cheiomys* a condition very similar to that existing in our *Nycticebus*. The shorter portion is apparently described by W. S. Church⁷ as a slip of the biceps.

The *biceps* is described in the joint memoir as having two heads, uniting obliquely below, and having a common insertion into the radius. In the earlier paper on the *Quadrumana*, by one of the authors, W. Vrolik⁸, it is described as consisting of but one portion in *Stenops*; but he does not mention which species he refers to. Meckel⁹ likewise asserts that there is but one head in *Loris*. This last is the condition it presented in our specimen, the muscle arising by a long and remarkably strong tendon from the margin of the glenoid cavity, and with its usual insertion. In both *Tarsius*¹⁰ and *Cheiomys*¹¹ there are two heads.

The *flexor sublimis digitorum* is a slender and double-bellied muscle, there being a distinct tendon in its middle¹². It arises from the internal condyle and intermuscular fascia, and gives from the distal end of the lower muscular belly a very small tendon which joins the flexor profundus, as noticed by S. Van der Kolk and Vrolik. Just below this four other tendons (of about equal size, excepting that to the index, which is considerably more slender) are given off and go to the second, third, fourth, and fifth digits respectively. They bifurcate, as usual, to give passage to the tendons of the flexor profundus, except the tendon of the index, which does not split, but joins the deep tendons opposite the base of the proximal phalanx of the index (figs. 2 & 3, *F. s*).

A similar connexion exists between the superficial and deep flexors

¹ Anat. Comp. vol. vi. p. 281.

² Kuhl, *loc. cit.* p. 16.

³ Vol. i. p. 395.

⁴ *Loc. cit.* p. 25.

⁵ *Op. cit.* p. 49, t. 3. fig. 2. nos. 14 and 14 *b*.

⁶ Trans. Zool. Soc. vol. v. p. 60, pl. xxiii. fig. 1, nos. 14 and 14 *b*.

⁷ Nat. Hist. Review, 1861, p. 514.

⁸ Todd's Cyclop. Anat. and Physiol. vol. iv. p. 218.

⁹ Anat. Comp. vol. vi. p. 291.

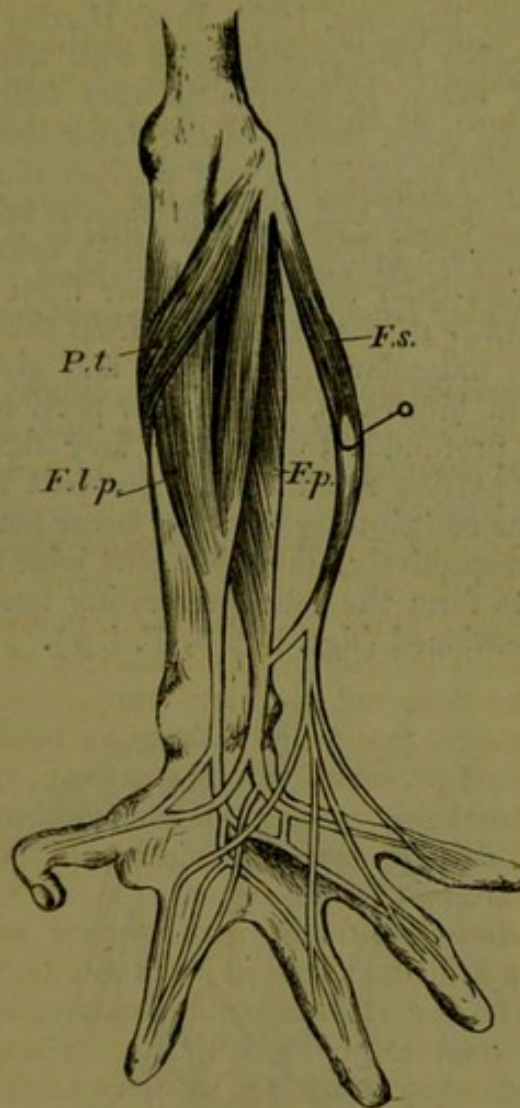
¹⁰ Burmeister, p. 51, t. 3. figs. 1, 2. no. 2 *a, b*.

¹¹ Owen, *l. c.* p. 60, pls. xxii. xxiii. fig. 1. no. 20.

¹² Previously noticed by Meckel, *loc. cit.* p. 340.

in *Cheiromys*¹ and *Tarsius*². Meckel³ also describes in *Loris* “*un faisceau charnu considérable*” as connecting these muscles.

Fig. 2.



Long flexor muscles and tendons of the hand.

P. t. Pronator teres. *F. s.* Flexor sublimis digitorum. *F. p.* Flexor profundus digitorum. *F. l. p.* Flexor longus pollicis.

The *flexor profundus digitorum* is a considerably larger muscle than the preceding. It arises from the upper two-thirds of the anterior surface of the ulna and the adjacent part of the interosseous ligament. The muscular fibres give origin to a strong tendon, which bifurcates, after being joined by the slip from the flexor sublimis, as above mentioned. One branch goes to the pollex, uniting with a tendon of the flexor longus pollicis; the other branch sends a very delicate tendon to join the deep tendon of the index, and then subdivides, one subdivision constituting the perforating division of the fifth digit, the other subdivision uniting with the perforating tendon of the fourth digit (figs. 2 & 3, *F. p.*).

¹ Owen, *l. c.* p. 63, pl. xxiii. fig. 4 *e.*

² Burmeister, p. 59, t. 3. fig. 3.

³ Anat. Comp. vol. vi. p. 341.

Profs. S. Van der Kolk and Vrolik fail altogether to distinguish the flexor profundus digitorum from the flexor longus pollicis, and omit all notice of the arrangement and distribution of the tendons except that of the pollex.

In the Hunterian Lectures, 1864, Prof. Huxley¹ described these muscles in *Nycticebus tardigradus*, and with that description our observations agree, except as regards the very delicate tendon which we found joining the index tendon of the flexor longus pollicis.

The **flexor longus pollicis* is a very distinct muscle, and as large as both the flexor sublimis and flexor profundus taken together. It consists of two separate bellies, one of which arises from the inner condyle and intermuscular septa, the other from the middle third of the anterior surface of the radius and from the interosseous ligament. These two muscular bundles join and give origin to a very large tendon, which bifurcates, the smaller portion joining the tendon of the flexor profundus to form the long flexor tendon of the pollex; the other portion again divides, one part again subdividing, its two subdivisions constituting the long flexor tendons of the index and third digits respectively, the other part joins the tendon of the flexor profundus to form the long perforating tendon of the fourth digit, as before mentioned (figs. 2 & 3, *F. l. p.*).

Fig. 3.

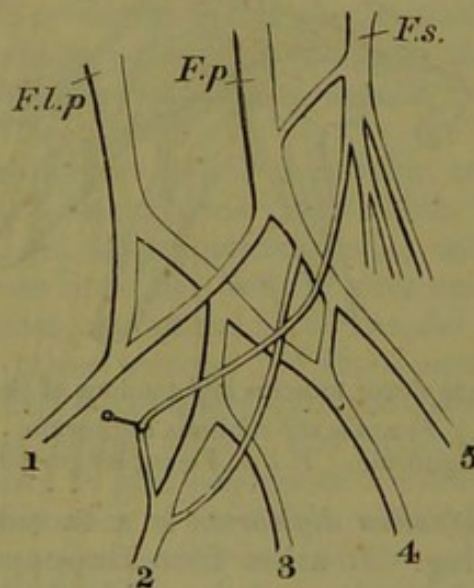


Diagram of the tendons of the palm of the hand. The numbers correspond to the digits, the letters to the same muscles as in fig. 2.

This agrees well with Professor Huxley's description already referred to. From what Meckel² says, it would appear that in *Loris* this muscle is united with the preceding, as in so many other of the Primates, including *Tarsius*³.

¹ Med. Times and Gaz. 1864, Aug. 6th, vol. ii. no. 736, p. 145.

² Anat. Comp. vol. vi. p. 341.

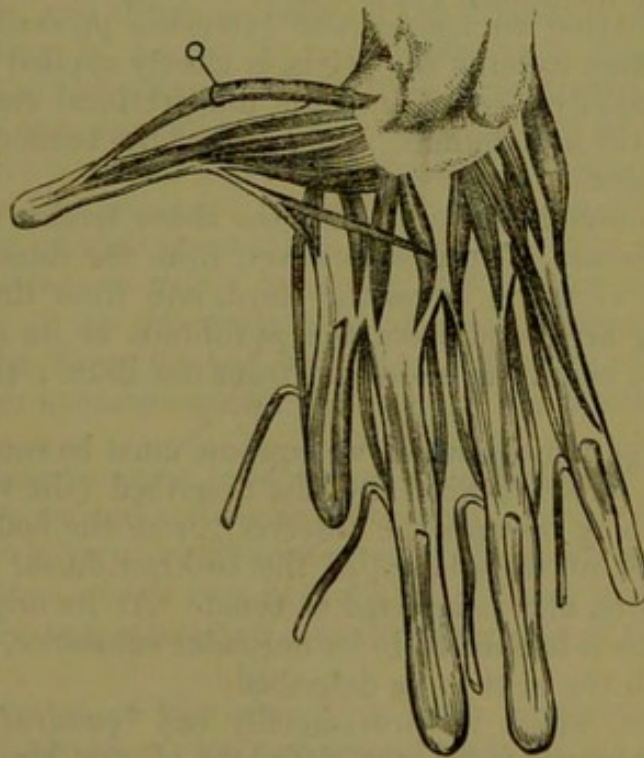
³ Burmeister, p. 60, t. 3. fig. 3, no. 34.

In *Cheiomys*¹ there is a very interesting intermediate condition. The arrangement much resembles that existing in *Nycticebus*; but the two muscles are not nearly so distinct. There is only one tendon to the pollex, and the muscular fibres arising from the middle of the ulna join the part which answers to the flexor longus pollicis.

The *extensor communis digitorum* and *extensor minimi digiti* appear to be represented by only one muscle, which arises by a diminutive tendon from the external condyle of the humerus. The muscular fibres give origin to a tendon which soon becomes divided into two; the radial one of these again subdivides into four very fine tendons, one going to the index, another (the broadest) bifurcating, its branches going to the third and fourth digits respectively; another (the third subdivision) goes to the fourth digit, and the last to the fifth digit.

The ulnar main division of the common tendon goes to the fifth digit only. This last perhaps answers to the *extensor minimi digiti*, or that portion of the *extensor communis* recorded by Professor Owen² as existing in *Cheiomys*, and sending subsidiary tendons to the fourth and fifth digits.

Fig. 4.



Enlarged view of the palmar surface of the hand, to show the small muscles of the pollex and fifth digits; also the interossei and insertions of the lumbricales.

The *extensor indicis* is a very small muscle arising from the middle of the ulna at its radial side, and from the interosseous membrane. It gives origin to two tendons, one going to the index, the

¹ Owen, Trans. Zool. Soc. vol. v. p. 63, pl. xxiii. fig. 4.

² *Loc. cit.* p. 62, pl. 23. fig. 2. no. 27a.

other to the fourth digit in the right hand, but in the left hand to the fifth and index.

This muscle, being quite single in our specimen, differs from that described by Meckel¹ as existing in *Loris*.

The *extensor ossis metacarpi-pollicis* shows no trace of subdivision in its tendon, nor any indication that it really includes (as implied in the memoir) the extensor primi internodii.

The *extensor carpi ulnaris* arises by two distinct heads, one from the posterior and lower surface of the external condyle, the other (fully half an inch broad) from the posterior surface of the ulna. These heads unite at an acute angle, and give origin to a tendon which has the usual insertion.

Muscles of the Abdomen.—As regards the *psaos* and *iliacus*, we were unable to determine satisfactorily their precise limits and subdivisions; nevertheless we are certain that neither the conditions described by S. Van der Kolk and W. Vrolik, nor those given by Meckel² as existing in *Loris*, correspond with those in our specimen. The most internal portion, far from being "*la plus forte*," is the most slender. It is undoubtedly the *psaos parvus*, and arises by fleshy fasciculi from the sides of the bodies of the second and third lumbar vertebræ, but very soon becomes entirely tendinous. Its long thin tendon, having an aponeurotic extension proceeding from the inner border, goes towards the pelvis, is closely applied to the muscle beneath, and finally inserted into the ilio-pectineal eminence immediately above the acetabulum. In *Tarsius*³ the tendon of the *psaos parvus* bifurcates.

The large muscular mass beneath the above tendon appears to represent the *iliacus*. It arises, however, from the sides of the bodies of the lumbar vertebræ below the third, and from the front of the sacrum (being separated from the pyriformis at its origin by the sacral plexus), but it has no origin from the ilium; the insertion is normal.

Another large muscle, which we suppose must be considered as the *psaos magnus*, arises behind the last described (the ventral surface of the body being towards the observer), from the bodies and transverse processes, at their bases, of the two last dorsal and six upper lumbar vertebræ, and is inserted as usual. At its origin it has numerous tendons interspersed in its muscular substance, and is closely connected with the next to be described.

This muscle, which we provisionally call **quadratus lumborum*, arises from the two transverse processes of the lumbar vertebræ, from about the fourth downwards, and is inserted into the crest of the ilium immediately above what appeared to be the *scansorius*. Above it is so closely connected with the *psaos magnus* that the correct determination of their limits requires further examination.

The superficial abdominal muscles present nothing worthy of remark, excepting the *rectus*. This is continued forward as a narrow band on each side of the sternum, parallel with and about one-fifth

¹ Anat. Comp. vol. vi. p. 324.

² *Loc. cit.* p. 374.

³ Burmeister, p. 67, t. 4. fig. 2. no. 1.

of an inch distant from it, as far as the first rib, into which it is inserted.

Muscles of the lower Extremity.—The *gluteus minimus*, the entogluteus of Owen¹, is a very small fan-shaped muscle, arising from the junction of the ilium and ischium, behind the acetabulum, and is inserted into the trochanter.

This appears to be the muscle described by W. S. Church² as the gemellus superior; but in our *Nycticebus* there is a distinct gemellus superior between the gluteus minimus and the tendon of the obturator internus.

The *pyriformis* is very largely developed. It arises from the anterior (abdominal) surface of the sacrum, and is inserted into the great trochanter. The sciatic nerve passes out beneath its inferior border.

The authors of the joint memoir, though they mention by name, give no description of this muscle; neither does Professor Owen in his monograph so often quoted. Meckel also says nothing of its existence in *Loris*. Burmeister³ gives a long description of apparently the same muscle in *Tarsius*, and remarks that it must have a powerful action in rotating the thigh outwards.

The *gracilis* has indeed a very extensive origin; but it nevertheless is quite single, and shows no trace of the division described by Meckel⁴ as existing in *Loris*. It is inserted by a distinct but short tendon into the inner border of the tibia, beneath the sartorius.

The **pectineus* arises from the anterior surface of the pubis, and is inserted into the inner side of the femur. Professor Vrolik, in his article on the *Quadrumana*⁵, denies the existence of a pectineus in *Stenops*; but Meckel asserts that in *Loris* it is very strong.

The *biceps femoris* arises by a long and narrow tendon from the posterior end of the tuberosity of the ischium, beneath the semitendinosus. The fibres expand distally in a fan-like manner, and are inserted by an aponeurosis into the head of the fibula and the fascia of the leg.

The *semimembranosus* arises from the ischium at its junction with the pubis, immediately beneath the origin of the semitendinosus, with which it is very closely connected. Passing downwards, it ends in a long tendon, which goes beneath the internal lateral ligament of the knee-joint, and is inserted into the inner side of the tuberosity of the tibia.

The description of this muscle in *Loris*, as given in the French translation of Meckel, is too ambiguously worded for us to be able to decide whether it agrees with our observation.

The *tibialis anticus* is a very large and powerful muscle, and arises from fully the upper half of the anterior surface of the tibia, and has its usual insertion (figs. 5 & 6, *T. a*). There is no trace

¹ *Cheiromys*, p. 66.

² *Nat. Hist. Review*, Jan. 1862, p. 87.

³ *Op. cit.* p. 69, t. 3. fig. 4, and t. 4. fig. 5, no. 7.

⁴ *Loc. cit.* p. 397.

⁵ *Cyclop. Anat. and Physiol.* vol. iv. p. 218.

whatever of any division of the tendon of this muscle, *à fortiori* not of its muscular part.

The *extensor longus digitorum* is a very slender muscle, the smallest of the leg-extensors and flexors of the lower limb; yet it has a double origin, as also in *Cheiromys*¹. The smaller head arises by a thin muscular bundle from the outer side of the tuberosity of the tibia, with also a small pencil of fibres coming from the inner side of the head of the fibula; the larger origin consists of a rhomboidal, flat, muscular fasciculus attached to the inner side of the middle third of the fibula. The muscle gives a tendon which splits into four subdivisions, sending one to each of the four outer digits, that to the index being the smallest.

The *extensor longus hallucis* is of about equal magnitude with the preceding, but quite distinct from it. It arises from more than the upper half of the external margin of the tibia. Its tendon is inserted into the proximal end of the last phalanx of the hallux (fig. 6, *E. l. h*).

In *Loris*, according to Meckel², this muscle seems to be confounded with the extensor longus digitorum.

The *peroneus longus* is remarkable for its great extent, covering about one-half of the anterior surface of the leg; but there is nothing unusual in its origin or insertion (fig. 6, *P. l*).

The **peroneus quinti digiti* is very distinctly developed, the muscular fibre being of considerable length. It arises between the *peroneus longus* and *peroneus brevis*, completely hidden by them, and is inserted by an extremely delicate tendon into the proximal end of the second phalanx of the fifth digit (fig. 6, *P. q. d*). This muscle, we believe, was first described under the above name by Professor Huxley³, in his Hunterian Lectures for 1864; but it has been noticed by Meckel⁴ among the extensors of the digits.

Burdach⁵ has also described it under the name *peroneus tertius*; and W. S. Church⁶ likewise refers to it under the same designation. But this muscle can scarcely be the homologue of the *peroneus tertius* of Man, inasmuch as it arises not on the tibial side of the *peroneus brevis*, but on the fibular side. Moreover Professor Huxley remarks, it is sometimes represented in Man by a slip from the tendon of the *peroneus brevis*.

The *gastrocnemius*.—It is difficult to understand how Professors S. Van der Kolk and W. Vrolik can have asserted that "*les jumeaux et le muscle soléaire sont très-forts*," unless they have mistaken one head of the flexor longus digitorum for part of the gastrocnemius. It is the more probable that they have done so, as they have described the semimembranosus as "*embrassant les jumeaux*," whereas it is the flexor communis longus which this muscle directly embraces. So far from being "*très-fort*," the gastrocnemius is exceedingly

¹ Owen, *l. c.* p. 68, pl. 25. figs. 1, 3. no. 35.

² Anat. Comp. vol. vi. p. 499.

³ Med. Times and Gaz., 9th July, 1864, p. 40.

⁴ Anat. Comp. vol. vi. pp. 438 and 440.

⁵ *Loc. cit.* pp. 46-55.

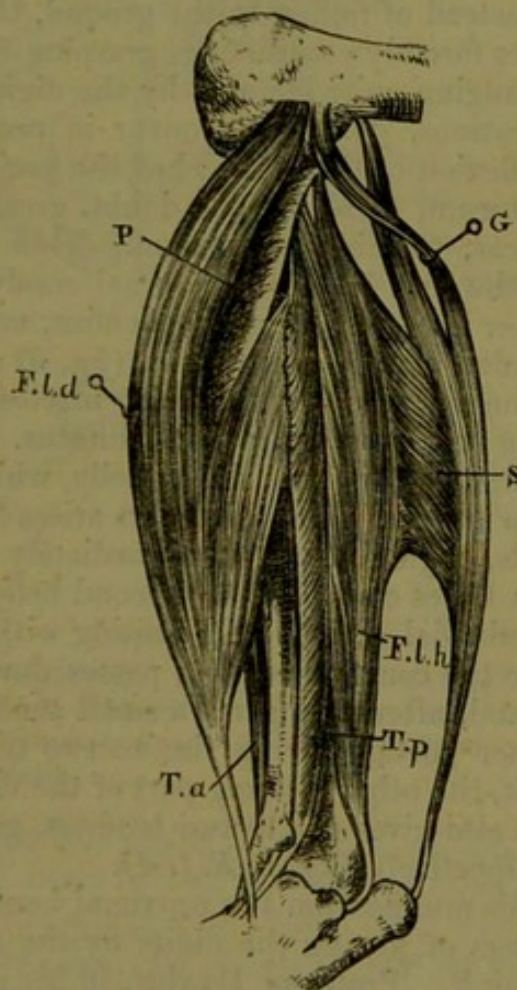
⁶ Nat. Hist. Review, Jan. 1862, p. 92.

weak and slender. It arises by the usual two heads, the inner one being very much higher than the outer one. It has the ordinary insertion by the tendo Achillis, which is moderately developed, the gastrocnemius being muscular almost its entire length (fig. 5, *G*).

The *soleus* appears to be represented by a flat rhomboidal band of muscular fibre without any tendon. It arises from the posterior margin of the head of the fibula and the inner border of the flexor longus hallucis for about half its length, then joins the outer border of the gastrocnemius for above half an inch (fig. 5, *S*). In *Loris*, according to Meckel¹, it arises from almost the whole of the fibula.

We were unable to find any trace of a *plantaris* muscle.

Fig. 5.



Hind limb between knee and ankle.

P. Popliteus. *G.* Gastrocnemius. *S.* Soleus. *F. l. d.* Flexor longus digitorum. *F. l. h.* Flexor longus hallucis. *T. a.* Tibialis anticus. *T. p.* Tibialis posticus.

The **popliteus* is rather well developed. It arises from the posterior surface of the tibia as far inwards as the internal lateral ligament (fig. 5, *P*). It is inserted by a very strong tendon (containing a large sesamoid bone), which passes behind, rather than beneath, the external lateral ligament, into the depression outside the outer condyle. In *Tarsius*, according to Burmeister², this muscle is in-

¹ Anat. Comp. vol. vi. p. 421.

² *Op. cit.* p. 75, t. 4. fig. 5. no. 23.

serted into the sesamoid bone of the outer head of the gastrocnemius.

The *flexor longus digitorum* presents perhaps the most interesting peculiarities of any of the muscles of this animal. These peculiarities are passed over in silence by Professors Van der Kolk and Vrolik, which makes it the more probable that part of this muscle has been confounded by them with the gastrocnemius.

The spontaneous flexion of the digits of this creature is very remarkable; and, as has been noticed by Professor Huxley¹ in his account of the nearly allied form, *Arctocebus*, it requires considerable effort to extend the toes, which when left to themselves become again bent.

We observed, in suspending the dead specimen by the feet from our fingers, that instead of falling to the ground, the body remained suspended, the toes forcibly contracting, grasping firmly the fingers, the animal thus hanging quite securely by the digits of its feet.

Various modifications, doubtless, concur in producing this very strong and ready flexion of the digits; but the peculiar origin of the *flexor longus digitorum*, there is little doubt, greatly contributes, if not mainly conduces, to this phenomenon. This muscle has three distinct origins—the first from the internal condyle of the femur as high as the inner head of the gastrocnemius, and from the inner surface of the tendon of that inner head (fig. 5); the second part arises from the inner border of the tibia, in close union with the aponeurosis of the sartorius and semitendinosus. The fibres from these two origins unite to form one fleshy belly, which constitutes the greater part of the muscle. The third part arises from the posterior surface of the tibia, beginning above immediately below the popliteus (fig. 5). Its fibres constitute the second belly of the muscle—an elongated rhomboidal mass which, uniting with the larger belly immediately above the common tendon, passes down behind the internal malleolus, and, after giving off a small tendon to the hallux, bifurcates, the inner portion giving rise to two tendons, one going to the middle digit, the other forming part of the deep index-tendon. The outer portion also gives rise to two tendons, going to the fourth and fifth digits respectively (fig. 6, *F. l. d.*).

The origin of this muscle from the proximal bone of the limb (the femur) has the effect of flexing the digits by the mere extension of the leg on the thigh. Professor Huxley, in his present Hunterian Course of Lectures, dwelt upon the passive mode of suspension of *Pteropus* by its hinder extremities, and also noticed in the same the origin of the *flexor longus digitorum* from the femur. This similar condition must, doubtless, have a similar effect, and greatly contribute in *Pteropus*, as in *Nycticebus*, to the effortless suspension of the body.

Meckel² describes the muscle under the name of the "*plantaire grêle*," and says it arises in the ordinary way from the internal condyle of the femur; but the plantaris, as far as we know, arises constantly and exclusively from the *fibular* side. This fact tells against

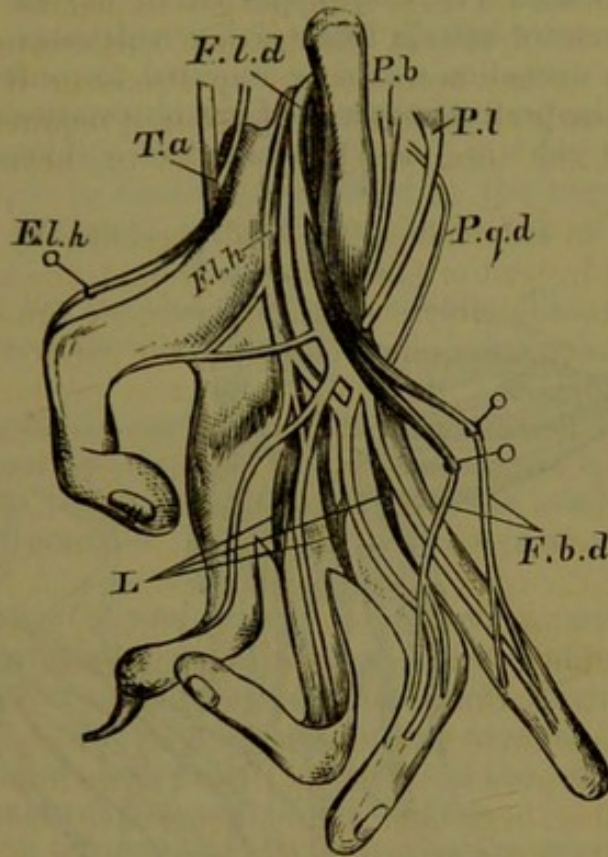
¹ Proc. Zool. Soc. 1864, p. 319.

² Anat. Comp. vol. vi. p. 456.

the possibility of the plantaris in any way contributing to form this so largely developed flexor longus digitorum.

An interesting similarity with reference to the distribution of the tendons exists in *Cheiromys*¹, except that there is no tendon given off to the hallux.

Fig. 6.



Flexor tendons of the foot.

F. l. d. Flexor longus digitorum. *F. l. h.* Flexor longus hallucis. *F. b. d.* Flexor brevis digitorum. *L.* Lumbricales. *P. b.* Peroneus brevis. *P. l.* Peroneus longus. *P. q. d.* Peroneus quinti digiti. *T. a.* Tibialis anticus. *E. l. h.* Extensor longus hallucis.

The *flexor longus hallucis* is a powerful muscle, but smaller than the preceding. It arises by two heads—one from the posterior surface of the fibula, the other, a very small fasciculus, from the tendon of the popliteus (fig. 5). Its strong tendon gives off a slip to the hallux, joining that going to the same digit from the flexor longus. It then bifurcates, one part joining that branch of the flexor longus which goes to the index and middle digits, and forms its share of each of their tendons; the other joins a tendon of the flexor longus, and forms with it the perforating tendon of the fourth digit (fig. 6, *F. l. h.*).

A very similar arrangement exists in *Cheiromys*²; only this muscle exclusively furnishes the hallux-tendon.

The *flexor brevis digitorum* is very narrow; it arises from the plantar surface of the tendon of the flexor longus, and ends in two

¹ Owen, *loc. cit.* p. 67, pl. 25. fig. 2. no. 32.

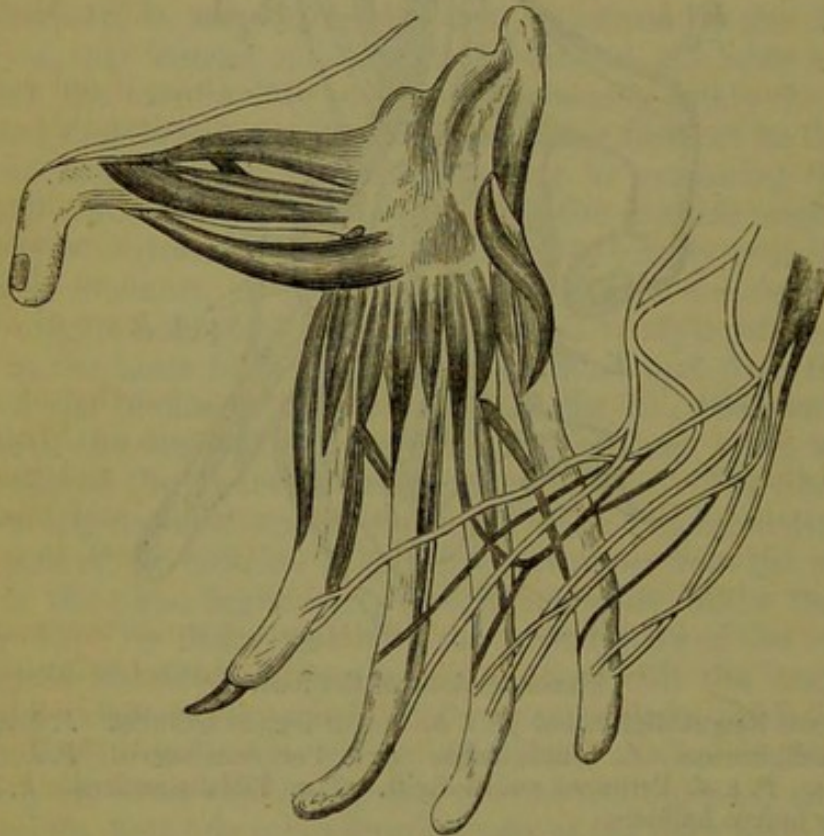
² *Ibid.* no. 31.

fleshy bellies, each giving off two slender and perforated tendons which go to the fourth and fifth digits respectively (fig. 6, *F. b. d*).

We did not observe an *accessorius*.

The small muscles of both hand and foot, which belong to the first and fifth digits respectively, we found to exist as mentioned by our authors: and with regard to the interossei of the hand and foot, these are represented (as they appeared to us) in the woodcuts (figs. 4 & 7); but we refrain from giving a detailed description of them, as a fresh dissection would be required to confirm and satisfy ourselves as to the perfect accuracy of our observations upon them.

Fig. 7.



Enlarged view of the plantar surface of the foot, to show the small muscles of the hallux and fifth digits, the interossei, and the lumbricales attached to the flexor tendons.

On carefully comparing the brain of our specimen with the description of Professors Van der Kolk and Vrolik, and likewise with the careful and minute account given by Mr. W. H. Flower¹, of the brain of *Nycticebus javanicus*, we found it to agree completely with the statements of the latter author, except that the posterior parts of the Sylvian fissures converged instead of being parallel.

A slight difference existed in form and dimensions; but these, doubtless, were due to its having been previously preserved in alcohol.

The viscera agree with Professors Van der Kolk and W. Vrolik's account of them. It may be worth while at the same time to men-

¹ Trans. Zool. Soc. vol. v. p. 103.

tion that the liver, which, according to our authors, offers "*de grandes différences individuelles*," in our specimen showed a very interesting uniformity in the number and relative dimensions of its lobes.

It corresponded with the conditions represented and described by Professor Huxley¹ as existing in the allied form of *Arctocebus*.

The liver in *Loris* does not seem to be very different, according to Buffon² and Martin³. In *Cheiromys*⁴ there is also a singular resemblance to *Nycticebus tardigradus* in the form and divisions of this organ.

This extends even to the direction of the fundus of the gall-bladder, which, according to Professor Peters⁵, in a paper read at Berlin in April 1864, is in *Cheiromys* directed in the normal manner, instead of the abnormal manner peculiar to the other Madagascar *Lemuroidea*.

The cæcum has the elongated prolongation (like, if not really and essentially, a vermiform appendix) which is figured and described in the memoir.

The comparatively small zoological importance of this character is, however, shown by the fact that in *Cheiromys* a condition exists very similar to that presented by *Nycticebus*, while in the closely allied genus *Arctocebus*⁶ and in *Loris*⁷ there is no trace of any such prolongation.

The generative organs present no difference, worthy of remark, from the description already given in the memoir on *Stenops*, the uterus being bicorned, and the clitoris very large and perforated by the urethra. The kidneys, suprarenal capsules, and bladder are similar to those of *Arctocebus*⁸, except that the ureters do not enter so low down towards the neck of the bladder.

If we sum up the results of our investigation upon the anatomy of *Nycticebus tardigradus*, we are led to note the interesting peculiarities offered by the muscles of the limbs,—on the one hand, the reappearance and, as it were, exaggeration of that anthropoid muscle, the flexor longus pollicis; on the other hand, its resemblance, by the interlacements of its tendons with those of the flexor profundus, to the conditions always offered by the foot in Primates—a resemblance which has already been noticed by Professor Huxley in his Hunterian Lectures for 1864.

We are also struck with the almost atrophied gastrocnemius, but concomitantly augmented flexor longus communis, which last, inverting the analogy of the flexor longus pollicis, resembles a hand-flexor in its origin from the proximal bone of the limb.

Likewise are we impressed with the very large size of the rectus

¹ Proc. Zool. Soc. 1864, p. 330, fig. 9.

² Hist. Nat. tome xiii. p. 216.

³ Proc. Zool. Soc. 1833, p. 23.

⁴ Owen, *loc. cit.* p. 73.

⁵ See Notice in Nat. Hist. Review, Jan. 1865, p. 149.

⁶ Huxley, Proc. Zool. Soc. 1864, p. 329, fig. 9.

⁷ Buffon, Hist. Nat. vol. xiii. pl. 31. fig. 2.

⁸ Huxley, Proc. Zool. Soc. 1864, p. 332, fig. 11.

anticus major, and the generally extensive development of the muscles of the ventral surface of the spine.

All these peculiarities of muscular structure must be considered in connexion with the singular movements which this animal is capable of making, and which it habitually employs in its arboreal manner of life. We allude especially to its Sloth-like mode of progression, and its great power of slowly and easily raising up the head and anterior part of the body while hanging suspended by its posterior extremities alone.