THE MYOLOGY OF THE LIMBS OF THE UNAU, THE AÏ, THE TWO-TOED ANTEATER, AND THE PANGOLIN[1]. By PROFESSOR HUMPHRY. (Pl. I, II, III, IV.)

I WILL make a few preliminary remarks respecting the carpus, tarsus, and digits, of these animals (see Pl. I.). The first or proximal row of the carpus, in Unau, Aï, and Antr presents the usual complement and arrangement—*scaphoid, lunar, cuneiform,* and *pisiform;* the first two being articulated with the radius, the cuneiform with the ulna, and the pisiform with the cuneiform. In UNAU the ulna is short and terminates in a cone-shaped epiphysial end, which though deeper than that of the radius does not descend quite to the same level with it[2]. To make up for the deficiency, the cuneiform is of nearly cylindrical shape. In Aï, the scaphoid, lunar and cuneiform form a segment of a sphere, which revolves in a cup formed by the radius and ulna; these two descending to the same level. In both the scaphoid is continued internally into a process which projects on the inner side of the distal row, and comes into contact with the base of the representative of digit I. In ANTR the three bones are disposed as in Aï; but the scaphoid is shaped like the lunar, and the convex surface which they present to

[1] For opportunities of dissecting the Unau (*Bradypus, vel Cholœpus, didactylus*) and the Aï (*Bradypus gularis vel tridactylus*), I am indebted to the kindness of Mr Flower, of the College of Surgeons. The muscles in the Unau had unfortunately undergone decomposition to a considerable extent in the upper segments of the limbs, especially of the fore limbs, so that they could not be made out. The two-toed, or little, Anteater (*Myrmecophaga didactyla vel Cyclothurus didactylus*) is in the Cambridge Museum. All the specimens had been long preserved in spirit. Representations of the muscles of Aï and the two-toed Anteater are in Cuvier and Laurillard's Plates. A description of the anatomy of the two-toed Anteater has been given by Meckel in his *Archiv für Physiologie,* v. 1, and of the muscles of that animal as well as of the Aï in his *System der vergleichende Anatomie,* III. Meckel makes occasional mention of the muscles of Unau, and Mr Galton does the same in his article on Dasypus, *Trans. Linn. Soc.* XXVI. Dr Macalister has recently written on the myology of Bradypus tridact., *Annals and Mag. of Nat. Hist.* June, 1869.

The Pangolin (*Manis Dalmanni*), sent me by Mr Flower, arrived after I had written out the description of the others. The sternum and right scapula had been taken out, and the muscles of course were thereby a good deal mutilated. I have not met with any description of the muscles of this animal. The specimen is a male, measuring 27 inches from the tip of the nose to the end of the tail, and the tail is 11 inches. There are five clawed digits on each limb. The almost cylindrical tongue protrudes 9 inches from the mouth.

[2] The corresponding epiphysis in a young specimen of Aï is also long and conical.

the radius and ulna is less sharply curved than in Aï: the *pisiform* is very large.

The distal row in Aï and ANTR consists of two large bones—the *unciform* and *magnum*—which occupy the concavity formed by the proximal row. In UNAU the *magnum* is small; the *trapezoid* occupies its usual place, and the *trapezium* is partially ankylosed to Met. I[1]: the trapezium looks like a part of the metacarpal, and might be supposed to be an incompletely ankylosed proximal epiphysis, being on the same level with the proximal ends of the other metacarpals; but it is no uncommon thing when the pollex is absent, or nearly so, for the trapezium to extend, more or less, alongside the metacarpals, and even to resemble them in shape. This is so in Cyclothurus (Pl. I.), in the Elephant, and great Armadillo (*Priodon gigas*); and the same thing is more frequently observed in the case of its homologue, the ento-cuneiform, in the hind limb.

The metacarpals and digits in all are parallel, close together, and admit of no lateral movement; and the flexion and extension is almost confined to the ungual phalanges. In UNAU two digits only (II. & III.) are fully developed; of these Met. II. rests upon the trapezoid, and Met. III. upon the magnum extending upon the unciform. Met. I, partially ankylosed with the trapezium, terminates in a nodular end one-third from the distal end of Met. II. Met. IV. is not directly connected with the unciform, but rests upon the part of the end of Met. III. which is articulated with the unciform. It terminates in the same manner as Met. I. about one-third from the distal end of Met. III, but has an epiphysis at its distal end. There is no trace of Met. V. The first phalanges are very short and so articulated with the second and with the metacarpals, especially with the latter, as to permit very little movement, foreshadow-

[1] In a young specimen in the College of Surgeons these two are separate; in a specimen of an older animal they are quite united.

Owen, *Comp. Anat.* II. 306, considers that the scaphoid and trapezium are, in this and similar instances, united into one carpal ossicle—a scapho-trapezium—and would regard what I take to be the trapezium as the epiphysis of Met. I. In the hind limb, however, of the three- and according to Owen (p. 413) to some extent in the two-toed Sloth there is a fusion of the tarsals and metatarsals corresponding with that which I suppose to have occurred between the trapezium and the first metacarpal. Moreover, a certain amount of downward prolongation of the inner part of the scaphoid is not uncommon, and as I have said, above, the trapezium not unfrequently descends alongside Met. II.

ing the more coalesced condition in Aï. The epiphyses are separate at the distal ends of the metacarpals and at the proximal ends of the second phalanges; but no epiphyses are discernible in the first or distal phalanges.—In Aï the magnum carries Met. II. and the greater part of Met. III; and the unciform carries Met. IV. and part of Met. III. There are only two phalanges (2nd & 3rd) in each of these digits, the first being united with the metacarpal forming a 'metacarpo-phalangeal,' with which the second phalanx is so connected as to permit scarcely any movement. The elongated outgrowth at the inner side of the base of Met. II., which is the representative of digit I, rests slightly upon the process of the scaphoid abovementioned, which descends to the metacarpal level. This outgrowth is probably the representative of the distal carpal as well as the ray elements of digit I. Digit V. is represented by a process similar to that for digit I., but much smaller[1].

In ANTR digit II. has a metacarpal and three phalanges, the first and second being closely articulated. In III. the first phalanx is short[2], and for the purpose of giving strength to this large middle digit is ankylosed to the second phalanx and closely jointed with the metacarpal. In digit IV. the first phalanx is absent or fused; at least this digit consists of a metacarpal and two phalanges, which are minute, do not project the skin and are not unguiculated. Digit V. is represented only by a short metacarpal which rests upon a small facet on the ulnar side of the unciform. Met. IV. and one half of Met. III. are articulated with the unciform; and the other half of Met. III. and Met. II. with the magnum. The remainder of the carpus (trapezoid and trapezium) with the pollex are represented by a small conical bone articulated with the magnum, having its

[1] In a young specimen of Aï in the College of Surgeons these processes are separate nuclei on the sides of, but not connected with, the adjacent metacarpals; and the first phalanges are also separate though closely adapted to the metacarpals in a wavy line. I cannot distinguish epiphyses at either end of the metacarpals or of the first phalanges; but the epiphyses at the proximal ends of the second phalanges are clearly seen, and those at the proximal ends of the third phalanges are visible though less clear. In a young specimen of Unau the epiphyses at the distal ends of the metacarpals are seen as they are in the example before me.

[2] There is, apparently, a similar ankylosis of the first and second phalanges of the middle digit in the fore and hind limbs of the Megatherium, and in the middle digit in the great Antr. In the three outer digits in the six-banded Armadillo, and in the great Armadillo the first phalanges are short and closely jointed with the second.

base resting upon the scaphoid, and carrying a small supernumerary bone upon its inner side. Thus digits I. and V. have only a rudimentary existence; digit IV. has a metacarpal and two phalanges; and digits II. and III. have the usual complement; but in III. the first phalanx is ankylosed to the second.

It will be perceived that provision is in all made for concentration of force upon a hook which is formed chiefly from one—the middle—digit. This digit (to which, even in man, the others may be regarded as subsidiary) rests upon the unciform as well as the magnum, and is thus made to subtend the line of the ulna as well as of the radius. The digits on either side are, in ANTR, quite subordinate, and in AI and UNAU are, by their parallelism and close juxta-position to the middle, made to be practically one with it.

The *order of suppression* of the digits is clearly traceable. Nos. I. and V, neither of which attains in any mammal to the full carpal and ray complement (a phalanx being missing in the one and a separate carpal bone in the other) are but feebly represented in all these animals. The traces of the two are about equal in AÏ and ANTR; but in UNAU there is no trace of V, although both the carpal and metacarpal elements of I. (partially ankylosed it is true) are fairly represented. No. II. has its full carpal and ray complement in UNAU, and its proper ray complement in ANTR; whereas No. IV. is represented only by a short metacarpal in UNAU, and by a metacarpal and two phalanges in ANTR. It is seen, therefore, that the instability is greatest in I. and V, and rather greater in V. than I, is next manifest in IV, is least in II. and III, and is least of all in III. This does not altogether correspond with what is usually observed in mammals; in them digit I. is more often imperfect or absent in both limbs than any other. In the hind limb, however, of birds and the crocodile I. is present, though V. is absent or nearly so.

The order of suppression of the other digits also is somewhat variable in mammals. In UNAU and ANTR, as we have seen, II. and III. remain, No. II. being subsidiary in ANTR. In Ruminants III. and IV. are the large hoofed digits, II. and V. being mere splint bones, and I. being absent altogether. In the hind foot of the Kangaroo IV. is the large toe, V. is smaller, II. and

III, though clawed, are of extreme thinness, and I. is wanting; and in the hind foot of Megathere I. and II. are wanting. In short there appears to be no rule.

As regards the *manner* of suppression of the digits, it would seem to take place in two ways, either longitudinally, when certain elements are abortive or two or more become blended into one during growth by fusion or ankylosis of the osseous nuclei, or, laterally, when there is in some instances a blending of one or more elements of the digit with those of an adjacent digit. An example of the first (the longitudinal) mode is afforded by the ordinary condition of digit I, in which there is a suppression of a phalanx; and an example of the second (the lateral) mode is afforded by the ordinary condition of digit V, a carpal element of which is connate with a carpal element of IV. forming the unciform bone. Both of the modes are often seen together. Thus in Aï the carpal and ray elements of I. and V. are blended, longitudinally, into short stumps which again are blended, laterally, with the adjacent metacarpals. Moreover the separate phalanges in each of the remaining digits are reduced to two, of which one (the second) is scarcely separate from the first, while this (the first) is quite ankylosed to the metacarpal. In UNAU, where V. is quite wanting, the phalangeal ray elements of I. and IV. are absent, never having been produced, or having faded during development, or, possibly, being blended, longitudinally, into what presents itself as a short metacarpal; and this in I. is partially blended with the carpal element, and in V. rests upon IV, as if preparatory to a lateral union with it, similar to that which has taken place in Aï. In digits II. and III. the first phalanges are short and closely united to the metacarpals, which may be regarded as an approach to the fusion with them that has taken place in Aï. In ANTR there is a tendency to fusion of the first and second phalanges, which appears to have occurred in digits III. and IV. The ray elements of V. are reduced to a short metacarpal; and in I. the ray and carpal elements are all reduced to a single rudiment, which is blended with the carpal element of II: at least there is only one bone to represent all these parts[1].

[1] In Armadilloes and some others the tendency to imperfect cleavage or to subsequent union (judging from the closer adaptation and the appearances in

On the inner side of this small bone in ANTR is an ossicle corresponding evidently with the supernumerary sickle-like ossicle of the carpus in the Mole, many Rodents and others. It may probably be referred to the same category as the pisiform bone, being, like it, rather an appendage for the purpose of muscular attachment and not being, like the true carpal bones, in the line between the bones of the forearm and those of the digital rays. The downwardly projecting part of the scaphoid in UNAU and Aï seems to represent the separate ossicle and to serve the same purpose.

In *Manis* the *scaphoid* and *semilunar* are united into a scapho-lunar bone. The other carpal and ray elements present the ordinary mammalian number. The first phalanges are short and closely articulated with the second in digits III. and IV. and especially in III, foreshadowing the union of the two which has occurred in Antr. The terminal phalanges are long and bifid.

HIND-LIMB.

The *astragalus* in all is large and presents anteriorly a cup which receives a conical projection of the scaphoid. This serves to facilitate that rotation of the distal part of the foot upon the astragalus which permits the inturning of the sole so marked in the Sloths, at the same time that it is a security against displacement of the bones. In Aï and UNAU it presents a still more remarkable cup, above and externally, which receives a conical projection of the lower end of the fibula and which assists in the rotation just mentioned at the same time that it affords an effectual provision against displacement of the tarsus outwards under the powerful pull of the tibialis anticus, such a provision being especially needed in the inturned position of the foot[1]. The deep collar covered by cartilage which sur-

Priodon, Dasypus and Megatherium) appears to be between the first and second phalanges rather than between the first phalanx and the metacarpal; and I think as a general rule the variability of the ray elements above or below the ordinary number is caused by suppression or multiplication of the first and second phalanges. That is to say, the metacarpals and the terminal or clawed phalanges retain their individuality; and the variations in number take place between them; that this however is not without exception is shewn by the example of Aï where the metacarpal and first phalangeal shafts have grown together.

[1] In Megatherium the same result is attained by a ball-like projection of the inner part of the articular surface of the astragalus fitted to a cup in the lower end of the tibia.

rounds, or forms the edge of, this cup is thick at the inner part where it is received into the concavity formed by the tibia and the inner side of the conical process of the fibula. In UNAU this acetabular cup is situated more on the outer aspect of the bone; and the inner edge is thicker than in AÏ, whereas the outer edge is incomplete or interrupted, and the interval is occupied by a strong ligament—the posterior peroneo-tarsal—which extends to the bottom of the socket, and which, externally, is connected with the outer and hinder aspect of the lower end of the fibula. The similarity of the disposition of this ligament to that of the ligamentum teres of the hip-joint is very striking[1]. It is however covered by synovial membrane in a part only of its circumference. In AÏ the ligament is much weaker and passes to the exterior of the outer edge of the acetabular cup which is complete though lower than the rest of the circumference. Indeed it presents a slight notch here[2]. The other bones of the tarsus present no very remarkable peculiarities.

In UNAU the scaphoid is small and is covered on its inner side by the elongated ento-cuneiform which presents a concave surface for the tendon of the tibialis anticus. The ento-cuneiform extends, like its homologue in the carpus, below the level of the other cuneiforms. The metatarsals have their distal epiphyses; and there is a slight unevenness near the proximal ends suggestive of lines of union of epiphyses. [See paper by Prof. Allen Thomson, on the ossification of the metacarpal and metatarsal bones in this *Journal*, III. 131.] Digits II. III. and IV. are long and clawed, whereas I. and V. are represented only by their metatarsals which are two-

[1] It may be remarked that the ligamentum teres is absent in UNAU and AÏ, and the spherical head of the femur has accordingly no dimple. There is however the usual space devoid of cartilage at the bottom of the acetabulum, and this is large in Unau. In ANTR the ligamentum teres is present. In MANIS the ligament is absent: there is a slight unevenness at the part of the head of the femur where the dimple usually is; and there is the space devoid of cartilage at the bottom of the acetabulum, but it is small.

[2] In monkeys, in which the foot is also inturned, elongated, and adapted for clinging as in the sloth, there is a similar, though less marked, concavity on the outer surface of the astragalus adapted to a slightly convex surface of the fibula, and the post. peroneo-tarsal ligament is very strong, in the Proboscis Monkey at least, is inserted more forward than in man, more in the bottom of the concavity of the astragalus just mentioned, and does not approach the groove for the flexor digitorum fibularis. Indeed this Monkey presents an arrangement intermediate between that of Man and that of the Unau.

thirds of the length of the other metatarsals. Met. I. has an epiphysis at its proximal end. Met. V. does not rest upon the cuboid but upon the outer part of Met. IV. and has a small epiphysis upon its distal end. The first phalanges are short and closely articulated both with the metatarsals and with the second phalanges. Neither in them nor in the distal phalanges are any epiphyses visible, but the epiphyses at the proximal ends of the second phalanges are separate from the shafts.

In Aï the os calcis is very long. The scaphoid, three cuneiform bones and three inner metatarsals are united into one bone; and the same is the case in an articulated specimen in the Cambridge museum with regard to the cuboid and two outer metatarsals (IV. and V.). Mets. I. and V. are processes from II. and IV. as in the fore-limb[1]. The first phalanges are connate with the metatarsals. The dotted lines in the drawing represent unevennesses which indicate the lines of union of the phalanges with the metatarsals (Pl. I.).

In ANTR the ento-cuneiform is broad and flat overlapping the meso-cuneiform. It carries metatarsal I. at the extremity of which is a single rather long phalanx concealed by the skin and not furnished with a claw. On the inner side of the ento-cuneiform, articulated with it and slightly with the anterior and inner edge of the scaphoid[2], is a long, broad, flat, supernumerary bone which projects into the sole, reminding us of the hallux in some of the quadrumana and supporting the inner side of the broad thick cutaneous pad which serves as an opponent to the four digits. Its summit and that of os calcis are nearly on a level; and the two are connected by tendinous tissue which, as well as the two bones, assist to carry the pad. It corresponds with the supernumerary bone on the inner side of the carpus and may be referred to the same category with it. The first and second phalanges are closely articulated in all the four outer digits, exhibiting the same tendency to union as their counterparts in the fore-limb.

[1] In a specimen in the College of Surgeons the scaphoid, cuboid, three cuneiforms, and all the metatarsals are united, forming one bone. In a young specimen in the same museum these are all separate, and the rudimentary metatarsals of I. and V. are also separate as in the fore-limb.

[2] In the drawing it is detached a little from the scaphoid to shew the extent of the entocuneiform.

In MANIS the tarsal and the ray bones accord in number and general characters with those usual in mammals. As in the fore-limb the first and second phalanges are closely articulated together and the terminal phalanges are bifid.

MUSCLES OF THE FORE-LIMB.

Pectoralis Major in the ANT-EATER consists of two strata, a superficial stratum arising from the sternal end of the clavicle and the surface of the sternum, and a deeper stratum arising from the edge of the sternum and the adjacent parts of the costal cartilages. The fibres of these strata have different directions. Those of the superficial stratum are directed *back*wards and outwards towards the lower part of the pectoral crest of the humerus; whereas those of the deeper stratum, crossing the preceding obliquely, are directed *for*wards and outwards towards the upper part of the pectoral crest. The two are united behind by the superficial fibres curling into the deeper; so that when the superficial layer is reflected to the axillary edge of the muscle the two strata form one sheet. The deeper stratum is, near the sternum, continuous with the pectoralis minor.

In Aï the pectoralis major has been detached from the sternum, so that I cannot determine its origin. It is inserted into the pectoral crest.

In MANIS it has evidently been attached along the whole length of the sternum and to part of the linea alba. Its fibres converge to the pectoral crest of the humerus, those from below crossing beneath the others to the middle of the crest; but the chief part of the tendon of the muscle is inserted very low down below the middle of the humerus.

Pectoralis minor (Aï), from 2nd, 3rd, 4th, 5th, and 6th costal cartilages close to the sternum. The fibres converge to a tendon which is quite distinct from that of the pectoralis major and is inserted, above it, into the outer tubercle of the humerus[1]: (ANTR), from the three anterior sternal ribs[2], to the

[1] I find this muscle to be, as represented by Cuvier and Laurillard, quite distinct. Meckel and Macalister do not admit its presence.

[2] The first sternal rib is represented by a lateral process of the manubrium sterni.

upper part of the outer tubercle of the humerus. I could not discover any traces of it in MANIS; but it may have been present as the parts were a good deal mutilated.

Subclavius (Aï), a thin muscle arising, tendinous, from the large 1st rib near the sternum. It becomes muscular and expands as it passes outwards and is inserted slightly into the under surface of the rudimentary clavicle[1], but chiefly into the inner edge of the coracoid process. In ANTR it is not separate from the pect. min.[2]

These muscles, *pect. major* and *minor* and *subclavius* belong, apparently, to one group which may be called the 'pectoral' or 'brachio-sternal' group and which presents different degrees of segmentation or separation into layers and sectors in different animals. The blending of the subclavius with the pect. minor and the close connection of the combined muscle with the deeper stratum of the pect. major in ANTR are worthy of note with reference to this, as is the attachment of the subclavius to the coracoid (the frequent point of insertion of the pect. minor) in Aï. The varying degree of segmentation or separation of these muscles in different animals or in different specimens of the same animal affords some explanation of the discrepancies in the description of them by different anatomists[3].

[1] The gradations of the clavicle in the four animals are curious. In MANIS it is absent. In Aï it is a mere scale attached to the inner edge of the coracoid which is large and projects forwards to a level with the acromion. A long ligament, the remnant of the structures of which its proximal part was originally composed, connects its inner end with the sternum. In the young state the cartilage of the acromion is continued to the coracoid and the clavicle, but subsequently retires leaving the clavicle upon the coracoid. (Parker, *On the Shoulder-girdle*, p. 200.) In UNAU the clavicle is articulated externally with the acromion which remains continuous with the coracoid, and is much longer; still it does not quite reach the sternum, a strong ligament (the degenerated 'omosternum' of Parker, *l. c.* p. 200) connecting it with the sternum. In ANTR the clavicle reaches the sternum, and is connected with it by a tough fibrous substance, which passes behind the edge of the manubrium, and which contains an ossicle (the 'omosternum' of Parker, *l. c.* p. 203) like that found in the Rat and some other Rodents.

[2] Meckel makes no mention of the muscle in this animal, and it is not represented by Cuvier. It appears to be absent in the other Anteaters and the Armadilloes, but is present in Orycteropus. I find no trace of it in MANIS.

[3] In both Aï and ANTR a strap-like muscle arises from the hinder edge of the broad first rib behind, and extending outside of, the insertion of the scalenus, runs backwards across the ribs, and is inserted into the 7th and 8th ribs, external to their cartilages, between the obliq. ext. and the serratus magnus. Meckel (*Arch.* v. 41 b.) describes it in Antr as the pect. minor; but there seems no sufficient reason for this. It has not the direction or disposition of that muscle, and it co-exists with a distinct pect. min. in Aï. It seems rather to correspond with an extension of the scalenus backwards, which is not uncommon. It is called *rectus thoracicus lateralis* by Macalister in his description of Aï; but it can scarcely be a detached slip of the rectus abdominis which lies deeper.

The *scaleni* are represented in ANTR by fibres descending from the four lower cervical transverse processes to the first rib behind the subclavian vessels.

Brachio-lateralis: under this name I propose to include a muscle or series of muscles which has been described by different writers in different animals as *pectoralis quartus, latissimus dorsi secundus, abdomino-humeralis, brachio-abdominalis, costo-humeral*[1], and the disposition of which is very much implied by the various names which have been given to it. It is, above, attached to the humerus, usually to the pectoral crest or the great tubercle, beneath and in more or less close connection with the pectoral muscles, but sometimes to the ridge on the inner side of the bicipital groove, in front of and more or less closely connected with the latissimus dorsi. It passes backwards through the axillary opening between the pectoralis and the lat. dorsi and radiates upon the side of the trunk, passing over the external oblique, and extending, it may be as in Orycteropus and Phoca[2], over the buttocks, thighs and knees, and frequently extending upon the back and covering the latissimus dorsi. In some animals or in some parts (Pteropus[3], Rat, Mole, &c.), it is subcutaneous and closely connected with the skin, forming part of the pannicle, and might be called 'brachio-cutaneous'. In other animals, or in other parts, it is attached to the ribs and might be called 'brachio-costalis'.

In Aï a muscle arises from the hinder surface of the 9th cervical transverse process, and is inserted into the anterior edge of the first rib, and resembles an interosseous; and a thin muscle passes from the extremity of the 8th transverse process, behind the subclavian vessels, to the 2nd rib.

The transverse processes of the 9th cervical vetebræ in Aï are large, truncated and projecting, and correspond with the hinder parts of the transverse processes above them; those of the 8th vertebra are shorter and present both the anterior and the posterior parts usually appertaining to a cervical transverse process with the foramen transmitting the vertebral artery. There are no floating rib-appendages to either the 8th or 9th cervical vertebra in this specimen, though such are present in the articulated skeleton in the Cambridge Museum, and are commonly found in this animal.

A muscle, which may be regarded as a continuation forwards of the obliquus externus abdominis (it is so described by Meckel), arises from the hinder half of the sternum beneath the pectorals, spreads out, the direction of its fibres being chiefly forwards and outwards, and is inserted into the five foremost ribs indigitating with the serratus; and the hindmost fibres are continued into the serratus. It may be called *sterno-costalis superficialis.*

Beneath the last-mentioned and the external oblique is the broad fore part of the rectus abdominis passing forwards, with slight inclination of its fibres outwards, and inserted into the several ribs as high as the first.

Beneath this again is the muscle described by Meckel (*Arch.* v. 41 c), arising from the four anterior bones of the sternum with its fibres directed backwards and outwards and inserted into the ribs from the 2nd to the 6th.

[1] See Macalister in *Ann. and Mag. of Nat. History*, July, 1869.

[2] Vol. II. of this Journal, p. 294.

[3] In Pteropus (Vol. III. of this Journal) it is attached above to the coracoid process, and I have, consequently, called it 'coraco-cutaneous'.

It is to avoid the exclusive significance of either of these names that I venture to give the name 'brachio-lateralis'. In some, as in Manis (see below), its fibres are closely, inseparably, blended with those of the external oblique. At its humeral end it often appears like a segmentation from the pectoralis major or latissimus dorsi, and in its abdominal part it has frequently been confounded with one or other of these muscles. This is the more likely to occur, because the abdominal fibres both of the pectoralis major and of the latissimus dorsi usually ascend on the axillary side of the respective muscles, therefore close to the fibres of the brachio-lateralis. Moreover, its costal and its superficial lateral part is often closely connected with and likely to be confounded with the hinder part of the latissimus dorsi; and crossing, as it sometimes does, from an origin with the latissimus dorsi to an insertion with the pectoralis major, it may unite the two muscles and form the 'Achselbogen' of German anatomists. Indeed, it not unfrequently is difficult or impossible of separation from one or other of the adjacent muscles—the pectoralis major, latissimus dorsi, obliquus externus abdominis, and the pannicle—and it forms more or less of a bond of union between them.

Speaking generally I would say the muscular series which radiates, funnel-like, from near the pectoral crest of the humerus is divisible into four great sectors, a 'brachio-sternal' (the pectorales), a 'brachio-lateral,' a 'brachio-lumbar' (the latissimus dorsi), and a 'brachio-cervical' (the deltoid and trapezius or delto-trapezius).

In Aï the *brachio-lateral* is attached, above, to the upper part of the pectoral crest, between the pectoralis major and minor, passes backwards beneath the pectoralis major, appearing as a deeper stratum of it, and expands upon the abdomen on the rectus and obliquus externus. Towards the hinder part of the abdomen it contracts and is continued upon the front and outer side of the thigh, being lost in the fascia about the knee. It has a close connection with the 7th rib on its way; but most of its fibres are continued over the rib. I cannot trace its fibres directly into the skin in any part of its course. In ANTR also it looks like a division of the pectoralis major, being attached above by a thin tendon to the upper part of the pectoral crest. Behind, it radiates over the abdomen, some of its deeper fibres

being attached to the 8th and 9th ribs just behind the rectus thoracicus lateralis, while its superficial fibres become united with the pannicle spreading over the latissimus dorsi, the obliquus externus abdominis, and the outer part of the thigh nearly to the knee. It here becomes connected with the fascia of the thigh; and some of its fibres may be traced with the fascia to the femur between the vastus externus and the glutæus maximus, constituting a 'femoro-cutaneous', like that in Pteropus; except that in Pteropus (Vol. III. p. 300) the muscle, in consequence probably of the different rotation of the limb, is connected with the tibial side of the femur.

In MANIS it has very extensive relations. Above, it is connected with the inner bicipital ridge and the inner tubercle of the humerus by a flat tendon, internal to and distinct from the latissimus dorsi. As it passes backwards the greater number of its fibres are separated from the latissimus dorsi by the brachial nerves and vessels; some however pass behind these with the lat. d. They take a course superficial to the lat. d., are not attached to the ribs and come into connection with the fibres of the external oblique and the pannicle, and are inextricably interlaced with both. At the hinder part of the abdomen the fibres again become separate from the external oblique; at least, muscular fibres are continued over the outer side of the thigh and knee and are lost upon the fascia. The fibres of this conjoined brachio-lateral and external oblique are closely connected with the scale-covered cutis, but do not terminate in it, except to some extent over the buttock, where the fibres of the muscle run into the cutis. Also towards the fore part of the abdomen a superficial plane separates from the deeper stratum, as it runs forwards, and is lost in the skin over the back of the axilla and the hinder part of the scapula. This may perhaps rather be regarded as the pannicle separating itself from the brachio-lateral and the external oblique.

Omohyoid is absent in ANTR; and I find no trace of it in the others.

Sterno-mastoid, in ANTR, arises by a narrow tendon from the upper edge of the sternum close to the articulation with the clavicle and is inserted into the mastoid part of the temporal bone behind the ear.

Cleido-occipital, in ANTR, running parallel with and close to, but distinct from, the preceding, arises from the anterior edge and upper surface, slightly from the hinder surface, of the inner third of the clavicle, spreads and becomes thinner as it ascends and is inserted into the whole of the ridge of the occipital bone and the occipital crest; and some of its fibres meet those of the opposite muscle beneath the crest. It thus shuts off the trapezius from the occipital bone, occupying the part from which that muscle usually arises and quite filling up the upper part of the interval between it and the sterno-mastoid[1]. In the other three animals this muscle, if it existed, and the sterno-mastoid had been cut away or were decomposed.

Trapezius (Aï), cervical fibres delicate, scarcely traceable to the skull. It is inserted into the rudimentary clavicle, the coracoid, coraco-acromial ligament, acromion and spine of scapula. The hindmost fibres are continued into those of the deltoid. In ANTR it arises from the eight anterior dorsal spines and from the ligamentum nuchæ and, through it only, from the skull. It is inserted into the spine of the scapula, the acromion and the outer third of the clavicle; above, its fibres are in contact with those of the cleido-occipital; but, below, the two muscles are separated by a considerable interval.

In MANIS the trapezius is large. It arises from the occipito-mastoid ridge, as far forwards as the ear, from a fascia uniting it with the opposite muscle in the neck and from the upper dorsal spines. It is partially inserted into the spine of the scapula; but the greater number of its fibres, forming a thick mass, pass over the scapular spine and the shoulder-joint and are inserted into the prominent pectoral crest; and a thick bundle of its foremost fibres is continued from the pectoral crest on to the inner condyle, and is inserted into it and into a tendinous band extending from the pectoral crest to the inner condyle. This band and the muscle bridge over a space through which passes the biceps muscle. Behind this space

[1] Meckel describes the 'Kopfnicker' as consisting of three parts, one corresponding with the sterno-mastoid and the other two with the cleido-occipital of my description. In my specimen the clavicular part is not divisible into two, though there is some crossing of the fibres, those arising foremost and innermost crossing superficial to the others and being inserted hindmost.

is the bone forming the anterior wall of the supra condyloid foramen through which passes the medium nerve.

This extension of the trapezius below the shoulder is no doubt the representative of the fore and larger part of the deltoid, the two muscles being continuous as is often the case where the clavicle is absent. I say continuous; but I should observe that there is to be seen in places a faint transverse tendinous inscription where the muscle passes over the shoulder.

Occipito-scapular[1] (Pl. IV. fig. 1 *o.s.*) is large in MANIS, arising tendinous, immediately beneath the trapezius, from the occipital ridge and from the ligamentum nuchæ all along the neck. It passes over the supra-spinatus muscle and is inserted into the upper edge of the spine of the scapula in nearly its whole length. Situated between the trapezius and the splenius the direction of its fibres is more in the axis of the trunk than it is in either of those muscles; but its general disposition indicates it to be a segmentation from the trapezius. A thin slip detaches itself from the hinder part and, passing along the base of the scapula, is inserted into it opposite the divergence of the spine.

This corresponds with the ordinary insertion of the lesser rhomboid; and if my view of the nature of the muscle is correct, brings the rhomboids (the lesser or anterior rhomboid at least, which not unfrequently extends to the occiput) into the relation with the trapezius of being segmentations or derivatives with it from one common and continuous muscular plane. The same plane is continued forwards to the ear; and variable portions are segmented from it, in front, constituting the sterno-mastoid, the cleido-mastoid, or, as in Antr, the cleido-occipital. In the last instance the segmentation has taken place further back than usual at the expense of the trapezius.

Masto-scapular (*m. s.*) in MANIS is a strap-like muscle attached to the fore part of the mastoid portion of the temporal bone, just beneath the ear, behind and external to the rectus capitis anticus major. (The sterno-mastoid has been removed so close to the skull that I cannot be sure of the relations to it.) Passing backwards it reaches the same plane with the occipito-scapular, lies in front of it and is inserted

[1] The muscle was described under this name as a variety in man by Mr Wood, *Proc. R. S.* May, 1867. Galton found it enormously developed in Dasypus sexcinctus, *Trans. Linn. Soc.* XXVI. 525.

in front of it into the spine of the scapula. Its foremost fibres run in front of the spine, beneath the trapezius, upon the fascia covering the infra spinatus.

This probably corresponds with the muscle which I have in preceding papers called cervico-humeral. I do not find it in Aï or ANTR. Like the occipito-scapular it is probably a segment of the trapezius.

Serratus magnus is in two portions passing to the two angles of the scapula as in Pteropus (Vol. III. p. 302). The anterior arises from the 1st and 2nd ribs in Aï.—In ANTR the anterior portion arises from the upper edge of the first rib, immediately behind the insertion of the scalenus. It expands and is inserted chiefly on the inner surface of the anterior angle of the scapula internal to the levator scapulæ. Its foremost fibres are quite separate from the levator. Its middle fibres are at their insertion blended with that muscle; and its hindmost fibres extend along the inner side of the base of scapula to the hinder angle where they come into contact with those of the hinder portion. This hinder portion arises from the first rib behind the preceding (separated from it by the scalenus) and from eight ribs behind the first; its fibres converge to and are inserted into the under surface of the posterior angle of the scapula. In MANIS it is too mutilated to admit of description.

Levator scapulæ in Aï arises from the transverse processes of the 8th and 9th cervical vertebræ as well as from the 6th and 7th. In ANTR it arises from the transverse cervical processes below the 1st and from anterior surface of the atlas. It is inserted into the upper part of the base of the scapula behind the serratus and distinct from it in both[1]. In ANTR the part which arises from the atlas does not become quite blended with the rest and is inserted more upon the outer surface of the upper angle of the scapula.

In MANIS it arises from the transverse processes of all the cervical vertebræ below the 2nd, and is inserted into the anterior edge of the scapula. It is apparently continuous with the

[1] Macalister did not find it distinct from the serratus in Aï, and describes the serratus as undivided.

serratus magnus and is quite separate from the occipito-scapular and the masto-scapular.

Rhomboideus, in ANTR, is one broad muscle extending from the 4th cervical spine to the 5th dorsal spine, where it comes into contact with the upper edge of the latissimus dorsi, but is distinct from it. It is inserted into the lower three-fourths of the base of the scapula, the fibres of the hinder part of the levator scapulæ passing internal to it. In MANIS it is also large, arising from three or four dorsal vertebræ and is attached to the base of the scapula behind the spine. A superficial stratum extending further back, lying between it and the latissimus dorsi, so that it is difficult to tell to which it really belongs, arises from three or four dorsal spines and is inserted on the outer surface of the hinder angle of the scapula.

More or less blending of the hinder or larger rhomboid with the fore part of the latissimus dorsi is not uncommon, and indicates a segmental relation between this rhomboid and the latissimus similar to that which I have hinted at between the occipito-scapular, the anterior rhomboid and the trapezius; and it is probable that all these muscles—occipito- and masto-scapular, rhomboideus major and minor, trapezius and latissimus dorsi—with the teres major (see teres major in Antr) are segments of one muscular plane.

Supra-spinatus and Infra-spinatus, present nothing peculiar.

Teres Minor presents nothing peculiar in Aï. In ANTR and MANIS it is pushed from its usual position on the scapula by the large teres major in the one and by the large triceps in the other, and has acquired an attachment to the spine of the scapula. In ANTR it arises from the middle of the scapular spine between the deltoid and the teres major, quite separate from both, in closer connection with the teres than with the deltoid and slightly overlapped by it. It is inserted into the outer supra condyloid ridge of the humerus just behind the hinder part of the deltoid and the supinator longus. In MANIS it arises from the anterior extremity of the scapular spine (the spine is in this animal short, the acromion part of it being as in Aï suppressed) in front of the triceps, and is inserted into a ridge on the outer side of the humerus beneath the great tubercle and the infra-spinatus.

It might be taken for part of the deltoid but is quite separate from it, and there is no other representative of the teres minor. Meckel makes no mention of it in Antr.

Subscapularis arises in Aï from the under surface of the scapula including the bony margin and the ligament of the supra-coracoid foramen and is easily divisible into three portions[1]. It lies external to the capsule of the shoulder-joint in Aï, but forms part of the wall of the joint in ANTR.

In MANIS it arises from all the internal surface of the scapula not occupied by the teres major, and passes, distinct from the capsule of the joint, to the inner tubercle. A lower portion of it, separated from the teres major by the circumflex nerve, is somewhat distinct from the rest, but not sufficiently to deserve a name.

Latissimus dorsi arises as usual in Aï, and from the dorsal (behind the 4th) and the lumbar spines, and from the hinder ribs (6th to 11th, inclusive), in ANTR. The several fibres cross, like those of the pectoral; the fibres which arise hindmost passing forwards, beneath i.e. on the axillary side of the others, to the highest part of the inner bicipital ridge of the humerus, (this is well seen in Aï where the tendon of insertion is broad and stops at this ridge); and those which arise foremost pass lowest in the arm. Some of the last in ANTR descend (constituting the *dorso-epitrochlien*) on the inner side of the arm and forearm to the wrist, being connected with the pannicle and inner condyle in their course; and in Aï some of the fibres, suddenly changing their course, descend along the inner side of the humerus and are inserted just above the inner condyle[2]. There is no attachment to the scapula. The tendon of insertion into the humerus is narrow in ANTR and passes beneath the biceps to the inner side of the pectoral crest, where it is attached close beneath the fibres of the pectoral.

In MANIS the *latissimus dorsi* arises from the hinder dorsal and the lumbar vertebræ and the ribs as far forwards as the 5th, beneath the trapezius in front, and the pannicle and brachio-

[1] The hindmost of these I conclude is the *subscapulo-humeral* described by Macalister as arising close to the glenoid cavity and inserted below the lesser humeral tuberosity.

[2] This portion is represented by Cuvier. It is said by Mr Galton (*l. c.* p. 532) to be present in Unau.

lateral muscle behind. Its costal part and the inner stratum of its lumbar fibres pass forwards—the former almost straight and the latter more obliquely—to the inner bicipital ridge of the humerus, the outermost of them becoming tendinous at some distance from the humerus. The outermost of the lumbar fibres diverge from those of the inner stratum which are ascending to the humerus and pass, on the inner side of the triceps, to the olecranon; and the foremost, or dorsal, fibres pass over the hinder angle of the scapula, without being connected with it, and run down on the inner side of the triceps and the olecranon to be continued into the portion of the flexor sublimis digitorum which passes to the large middle digit. They have no connection with the inner condyle.

These foremost fibres on their way down to the elbow and the forearm cross, nearly at a right angle, the hinder fibres which are passing forwards to the humerus. They cross external to them where they are tendinous and acquire a close connection with their tendons. Indeed they receive an accession of muscular fibres from those tendons on their way over them. So that some of the fibres passing to the forearm actually arise, at right angles or nearly so, from the tendon of insertion of the hinder portion of the muscle, and through them might be said to arise from the humerus.

The disposition of the fibres of the latissimus dorsi thus traced explains what has often puzzled me, viz. that this muscle as it passes to the humerus, not unfrequently (rat, rabbit, and others) sends from its tendon, and at right angles, what may be regarded as a second muscle, upon the inner side of the arm (it is included under the name 'dorso-epitrochlien'). It is sometimes tendinous at its origin from the lat. d., and becomes muscular as it descends the arm. Now, this muscle is clearly a representative of the anterior fibres of the lat. d. which in Manis cross the hinder fibres at right angles and derive accessory bundles from them. In Aï I have described this derivation from the lat. d. as being formed by a sudden change in the direction of its fibres.

Teres major, in Aï, is large and disposed much as in Man. In ANTR it is a very large muscle arising from the inferior costa and the greater part of the spine and part of the outer surface of the scapula; it nearly covers the infraspinatus and almost surrounds the scapular origin of the

triceps. It is inserted along the inner side of the humerus between the tubercle and the condyle. Its lower fibres are nearly parallel with those of the triceps, but pass internal to them without blending with them. A strap-like portion however passes from the angle of the scapula, with the latissimus dorsi, and is inserted, partly, into the inner side of the olecranon and, partly, along the inner side of the forearm. It may be questioned whether this appertains to the teres or to the lat. d., being closely connected with the one in its origin and with the other in its insertion. Meckel describes it as part of the teres. At any rate it acts as an extensor of the forearm. In MANIS the teres major is of moderate size, arises from the inferior costa and part of the inner surface of the scapula, internal to the triceps, and is inserted as usual into the inner bicipital ridge external to, but in close connection with, the latissimus dorsi.

Deltoid (Aï) arises from the parts into which the trapezius is inserted (see description of biceps). In ANTR the clavicular part occupies a large share of the clavicle, is separate from the scapular part, and is inserted into the pectoral crest above and in front of the origin of the supinator muscle. The scapular portion is small arising only from the acromial or fore part of the spine of the scapula and is inserted into the supra-condyloid ridge below and behind the supinator. In MANIS it does not exist at all as a distinct muscle, that which usually constitutes its fore-part being a continuation of the trapezius, and that which usually constitutes its hinder part being continued into the supinator longus.

Coraco-brachialis in Aï is a slender muscle passing from the root of the coracoid process to the inner side of the humerus, above the middle, in front of the latissimus dorsi[1]: in ANTR and MANIS I can find no trace of it[2]; and there is no distinct coracoid projection of the scapula in either.

Biceps in Aï consists of three portions. 1. 'Coracoid' portion arises, tendinous, from the foremost part of the coracoid in front of, superficial to, the deltoid, and in close con-

[1] It is said by Mr Galton to resemble this in Unau. *Trans. of Linnæan Society*, xxvi. 535.

[2] Meckel makes no mention of this muscle in his description of the Antr, and Cuvier does not represent it.

nection with it, so as to appear part of it (it is described as part of the deltoid by Meckel). It forms a long thin muscular belly which at the lower part of the arm becomes tendinous and is connected with the humeral portion, but terminates in the fascia on the ulnar side of the forearm[1]. 2. 'Glenoid' portion, from the root of the coracoid process, in front of the glenoid cavity, by a long thin tendon which passes through the shoulder-joint. It becomes muscular in the lower part of the arm and is inserted with the brachialis anticus into the ridge on the anterior and outer aspect of the ulna. It is quite separate from the other portions in its whole length. 3. 'Humeral' portion, the largest of the three, arises tendinous from the fore part of the humerus beneath the pectoralis tendon. It has a broad tendinous origin from the outer bicipital ridge and a narrow tendinous origin from the inner bicipital ridge. It therefore covers to some extent the tendon of the glenoid portion passing along the groove between the two ridges. It is inserted into the tubercle of the radius. In ANTR it consists above of one portion only which arises from the upper edge of the glenoid cavity: in the middle of the arm its muscular belly divides into two nearly equal parts, of these one terminates in a tendon which is inserted into the tubercle of the radius, and the other continues muscular joining the brachialis anticus and is inserted into the fore part of the ulna[2].

In MANIS it is a simple muscle and not large. It arises from the outer surface of the foremost part of the glenoid cup by a broad tendon which lies external to the capsule of the shoulder-joint. It soon becomes muscular in its anterior aspect; and its cylindrical muscular belly runs down to the fibrous band into which the trapezius is inserted. It here becomes tendinous and is continued under the band, internal to the brachialis anticus, and is inserted into the inner side of the anterior surface of the ulna, having no connection with the radius.

[1] This portion is represented by Cuvier, but Macalister found no trace of it in the specimen dissected by him. It appears in my specimen to be the usual coracoid origin of the biceps; and its close relation to the deltoid is caused by the attachment of that muscle to the coracoid, which again is to be associated with the retirement of the acromion and the consequent connection of the rudimentary clavicle with the coracoid (p. 26).

[2] The same in Dasypus sexcinctus except that it is joined by some fibres of the coraco-brachialis, which muscle is present and consists of a long and a short portion. (Galton, *loc. cit.* p. 536.)

Brachialis anticus in Aï arises from the anterior and outer aspect of the humerus, beneath the deltoid, joins the glenoid part of the biceps, being placed on the radial side of it, and is inserted into the ulna a little above and radial of it. In ANTR it passes from beneath the deltoid ridge of the humerus to the ulna joining the ulnar part of the biceps.

In MANIS it is large in comparison with the biceps, arises from the anterior and outer surface of the humerus beneath and external to the pectoral crest, and is inserted into the anterior and inner surface of the ulna, lying on the radial side of the biceps and so separating it from the radius.

The disposition of the biceps in these animals derives interest from its variety. In MANIS it is single in its whole length. In the ANTR it presents a less simple form; for though single above it bifurcates below to the radius and ulna. In Aï it consists of three parts which are separate, or nearly separate, in the whole length: the 'coracoid' and 'humeral' parts correspond with that which is usually attached to the coracoid only, and the 'glenoid' part furnishes an exception to the general rule by being inserted into the ulna only. The brachialis anticus is steady in its adherence to the ulna and to the part of the biceps which is attached to the ulna. It will be remarked that in Manis neither muscle is attached to the radius.

Triceps presents nothing peculiar in Aï. In ANTR it is very small, the origin of its scapular part being confined to the immediate vicinity of the glenoid cavity and of the humeral parts to the lower half of the humerus. In MANIS its scapular portion is very large. It arises not only from the whole length of the inferior costa of the scapula; but a thick outer stratum is prolonged over the supra-spinatus and is attached along the entire length of the spine of the scapula beneath the supinator longus. It arises also from the back of the humerus being prolonged, externally, to the outer tubercle; but the internal humeral portion (that beneath and internal to the radial nerve) is small. It is inserted into the olecranon: the part which arises from the spine of the scapula being inserted on the outer or radial side of the olecranon, that from the inferior costa of the scapula and the back of the humerus into the upper surface of the process, while the latissimus dorsi is attached to the inner side.

Anconeus internus[1] is distinct in Aï and ANTR and large in MANIS. It is nearly square, passes transversely across from the back of the inner condyle, over the ulnar nerve, to the inner side of the olecranon. In ANTR it is confined to the upper part of the condyle; but in MANIS it covers the lower as well as the upper part of the back of the condyle.

Anconeus externus distinct in Aï. In ANTR it extends down nearly the whole length of the outer surface of the ulna between the extensor carpi ulnaris, on its outer side, and the flex digitorum and flex carpi ulnaris which arise from the ulna on its inner side; and the three muscles may be said to form an almost continuous sheet in these animals. In MANIS it is large, but simply passes from the upper surface of the back of the outer condyle to the outer surface of the olecranon.

The disposition of the muscles on the surface of the palmar aspect of the forearm in UNAU and ANTR is remarkable. In each the supinator longus and the flexor carpi ulnaris consist of a superficial and a deep portion; and the superficial portions of the two muscles meet in the middle and are forcible reminders of the gastrocnemius. The deeper portion of the fl. c. u. evidently corresponds with the soleus.

Supinator longus in these, as in most animals, is a flexor of the forearm. In UNAU and Aï it consists of two parts, of which one arises, flat and muscular, high up from the outer side of the humerus and expands upon the fascia of the palmar aspect of the forearm, extending to the wrist. The other and deeper part arises from the humerus, beneath the preceding, and is inserted into the outer border of the radius a little above the carpus, thus resembling the sup. l. of man. In ANTR the disposition is much the same, the superficial part arising from the humerus between the insertions of the clavicular and scapular portions of the deltoid and being inserted into the palmar fascia and the supernumerary bone on the inner side of the carpus. The deeper portion arises lower down, and is inserted into the radius just above the carpus.[2]

[1] This muscle, which is merely a part separated from the inner origin of the triceps, is by no means uncommon. It is called *Epitrochleo-anconeus* by Prof. Gruber, *Mém. de l'Acad. des Sc. St Pétersbourg*, 7th Sec. tome x. No. 5, and *Bulletin de l'Acad.* Mélanges biologiques, VI. 464.

[2] The supinator longus appears to be absent in Dasypus sexcintus, Galton,

In MANIS it is single, arises, broad and musculo-tendinous, from the whole of the lower edge of the spine of the scapula (having that is the usual origin of a part of the deltoid), passes over the humerus and elbow and descends along the outer side of the forearm in the usual course of the sup. l. and is inserted into the outer edge of the radius just above the wrist. (Pl. IV. fig. 1, *Sup. l.*)

Although the sup. l. usually arises from the humerus near the insertion of the deltoid, and in Antr arises between the insertions of the two portions of the deltoid, yet the fusion of the two muscles, as presented in Manis, is very rare. I do not know any other instance of it. It is of great interest, and may throw some light upon the serial homology of the muscle respecting which there is much difficulty. It seems to indicate a relation of this kind to the sartorius. Yet, as I have stated above, the disposition of the superficial part of the muscle in the other three animals is suggestive of homology with the inner (tibial) head of the gastrocnemius.

Supinator brevis large in all. In ANTR it descends nearly to the lower end of the radius. In MANIS also it is inserted along nearly the whole length of the anterior edge of the radius; and it contains a rather large sesamoid bone in its tendon of origin. This sesamoid has a concave under edge applied upon a facet on the outer surface of the capitulum of the radius and a smaller concave upper surface which is applied upon the edge of the outer condyle of the humerus. The tendon of origin of the superjacent extensor digitorum is quite free from it.[1]

Pronator teres is large and descends low in all. In UNAU and Aï its origin is from a little above the int. cond. of the humerus on the same plane with the fl. c. u. and the fl. c. r. In ANTR its origin extends very little above the int. cond., and is covered by the superficial part of the fl. c. u. In all, its insertion extends nearly to the lower end of the radius opposite the insertion of the deeper portion of the sup. l. In MANIS it is large, arises from the inner condyle, above and in front of the flexor digitorum, and is inserted into the inner surface

l. c. p. 540; and I do not find it in Cuvier's representation of the Tatou. It is well developed in Tamandua and Orycteropus.

[1] Owen, *Comp. Anat.* II. 409, mentions an articular sesamoid developed on the outer side of the capsule uniting the radius with the humerus. Mr Macalister found a sesamoid bone in the tendon of the supinator brevis of a woman. *Jour. Anat.* III. 108.

of the anterior edge of the lower half of the radius, extending close to the wrist.

Pronator quadratus in UNAU and Aï is much as usual, though in both small in proportion to the length of the forearm, but not so small in Aï as Meckel describes. The attachment to the radius is broader than that to the ulna; so that the fibres radiate somewhat from the ulna to the radius. In ANTR it covers nearly the whole interosseous space, the upper fibres being nearly transverse, the lower descending more obliquely from the ulna to the radius. The lowest part of all is, to some extent, separate from the rest, forming a pyramidal muscle with a muscular base attached to the ulna, and a tendinous apex attached to the margin of the radius just above the interval between the scaphoid and lunar bones[1]. In MANIS there is no trace of it.

Flexor carpi ulnaris in UNAU is in two parts; one arising from the inner condyle of the humerus and expanding upon the fascia on the inner side of the forearm, where it meets and joins the sup. l. and is inserted into the margin of the ulna, the pisiform bone and the palmar fascia. The deeper part arises from the inner edge of the ulna between the flex. dig. and the ext. c. u., from the inner side of the olecranon, and by a thin aponeurosis from the internal condyle, and is inserted into the pisiform bone beneath the preceding. The ulnar nerve lies between the two. In ANTR the disposition is similar, except that the segment of the superficial portion passing to the palm, and attached to the pisiform bone the pad and the flexor sheath, is more separate from that passing to the pisiform bone only, and bears, therefore, closer resemblance to a palmaris longus; and the deeper portion arises from the lower part of the ulna only, being separated from the superficial part by the flexor dig., and is inserted beneath it into the pisiform bone. In Aï the distinction between the ulnar and the humeral parts is not greater than in man. The tendon passes over the proximal part of the pisiform which is smooth and is inserted into the distal part and into metacarpals IV. and V.

[1] In the Scinc (*Cyclodus nigroluteus*) I find a portion which resembles this separate portion passing over the wrist joint and inserted into the lunar part of the scapho-lunar bone. Meckel does not mention the muscle in Antr.

In MANIS the muscle is quite dwarfed by the inordinate development of the flexors of the digits. It lies beneath and between the portions of flex. dig. s. to digits IV. and V., and arises in company with them from the olecranon and the surface of the flex. dig. p. It is very small and short, and is inserted into Met. IV. The pisiform bone which is small appears merely as a sesamoid developed in it.

This in Manis corresponds with what I have described in the others as the ulnar or deeper portion of the muscle. The more superficial part would seem to be absorbed by the flex. dig. s.

Flexor carpi radialis passes from the inner condyle in all. In UNAU it is inserted into the projecting process of the scaphoid which forms the inner edge of the carpus. (The palmaris l. is inserted into the corresponding process in Aï.) In Aï it is inserted into the root of the rudimentary Met. I. This gives it greater purchase than if it had been inserted into Met. II. In ANTR it is inserted into the base of Met. II. In MANIS it passes over the projecting inner edge of the scapho-lunar bone along the bases of Met. I, II. having some fibres attached to these, and is inserted into the palmar surface of the base of Met. III. This extension of the tendon across to the middle of the palm resembles that so usual of the peroneus longus, in an opposite direction, across the sole.

The *Palmaris longus* and *Flexores digitorum* are involved and related in peculiar and instructive varieties. In UNAU a muscle, representing chiefly the *palm. l.* and partly the *flex. dig. sublimis*, arises from the int. cond. of the humerus, between fl. c. r., and u. It terminates in a tendon which divides into two; and these are lost in the flexor sheaths of the two digits. A much smaller muscle is detached from the surface of the fl. dig. and gives off two delicate tendons which join the under surface of the two tendons just mentioned over the metacarpo-phalangeal joints. This is a partial representative of the *flexor dig. sublimis.* The *Fl. dig. prof.* is large, arises from the internal condyle and from the under surface of the combined tendons of fl. c. r. and u. and palm. l., also from the surface of the radius and ulna, and gives rise to the two flexor tendons which pass to the terminal phalanges of the two digits.—In Aï

the *Palmaris l.* arises from the int. condyle in company with the pronator teres, fl. c. r. and fl. c. u., being situated between pr. t. and fl. c. r., and is inserted into the process of the scaphoid that descends towards Met. I. It meets and is closely connected with the superficial part of the sup. l. in the middle of the forearm, and in its insertion resembles that of sup. l. in Antr[1]. The *flexor digitorum* arises from the internal condyle beneath the other muscles (pr. t., palm. l., fl. c. r. and u.) and from the radius and ulna. The part arising from the radius is large, and the two tendons to digits II. and III. are derived chiefly from it. The tendon to digit IV. is derived from the ulnar part of the muscle. Of the humeral part some of the muscular fibres blend with those of the ulnar part and so terminate in the tendon to digit IV.: the remaining and larger portion of it gives rise to two tendons which lie upon and subsequently join the two tendons to digits II. and III. This humeral part is, therefore, evidently the representative of the *flexor dig. subl.*— In ANTR the *Palmaris longus* is not distinctly segmented from the flexor carpi ulnaris. The *Flexor digitorum sublimis* consists of two parts; one arising from the internal condyle separate from the fl. d. pr. and passing to digit II.; and another also arising from the int. cond., but closely connected with fl. d. pr. so as to appear to be derived from it. The latter is the smaller and passes to digit III. Both are partly blended with the flexor sheaths and partly related to the flexor tendons after the usual manner of the fl. d. s. The *Flexor digitorum profundus* is very large, arising from the int. cond., the radius and the ulna. It extends to the back of the ulna between the two parts of the fl. c. u. and has extensive origin from both sides of the olecranon. It gives rise to two tendons of very unequal size, the smaller to digit II. and the larger to digit III.

In each instance that which represents the flexor dig. subl. is imperfectly segmented from the fl. dig. pr., and the degrees and varieties of segmentation are noteworthy. Moreover in UNAU it is only imperfectly segmented from the palmaris. In ANTR the palmaris is imperfectly segmented from the fl. c. u.; and in Aï the disposition of the palmaris is peculiar, for it has no connection with the fascia or flexor sheaths of the palm.

[1] Prof. Macalister found it inserted into the palmar fascia and the pisiform and unciform bones. It is quite to be expected that varieties of this muscle would occur in animals of the same species.

In MANIS there is no *Palmaris longus*. The *Flexor digitorum sublimis* (Pl. III. fig. 2) is disposed in a remarkable and unusual manner, and consists of five separate portions, i.e. one for each digit including the pollex. The division for the pollex is quite superficial, and arises, muscular, from the fascia at the lower part of the forearm. It soon bifurcates and its divisions, passing on the sides of the long flexor tendon, are inserted into the sides of the first phalanx. The division to digit II. arises, in conjunction with the deep flexor, from the inner condyle of the humerus, separates from the deep flexor in the middle of the forearm and, after being closely connected with the flexor sheath, passes internal to it, splits and is inserted into the sides of the second phalanx. The division to digit III. derives its origin partly from the continuation of the latissimus dorsi (see description of that muscle) and partly from the inner condyle of the humerus. The divisions to digits IV. and V. arise together and in company with the fl. c. u. from the olecranon and the surface of the deep flexor. They separate from it and from one another and from the flexor carpi ulnaris as they descend to the wrist. The tendon to digit IV. is disposed in the same manner as those to digits II. and III.; but the tendon to digit V. passes external to the flexor sheath, on the ulnar side, and is inserted into the ulnar side of the second phalanx.

The muscle in this instance, therefore, is connected with the internal condyle, the olecranon, the deep flexor, the flexor carpi ulnaris, and contains the palmaris longus. I cannot recall any other instance in which the pollex has so complete a representative of the superficial flexor muscle. This digit has in addition a flexor longus and a flexor brevis.

The passage of the flexor sublimis to the ulnar side only of digit V. is unusual; when the tendon to this digit is, as is not unfrequently the case, single it commonly is inserted on the radial side[1].

The *Flexor digitorum profundus* in MANIS is of great size and has much the same relations as in Antr. It arises from the inner condyle of the humerus and the entire palmar surfaces of the radius and ulna and from the back part and both sides of the olecranon. It contains a large sesamoid as it passes over the wrist, which plays upon a convex cartilaginous

[1] See note of the same peculiarity in fl. br. dig. in hind limb.

surface of the scapho-lunar bone. It gives off a tendon to each digit.

Lumbricales. In UNAU one passes from the radial side of each deep flexor tendon to the radial side of each digit. They send slips to the sides of the phalanges, but the larger parts are connected with the extensor tendons. I do not find them in Aï or ANTR[1]. In MANIS they are four, passing from the sesamoid mass, between the tendons, to the radial sides of the second phalanges of the four outer digits. They are inserted into the phalanges and do not therefore reach the extensor tendons.

Extensor carpi radialis (UNAU and Aï) is one strong muscle arising from the outer condyle. Over the wrist its tendon divides into two. Of these one, small, is inserted into the middle of the back of Met. II. near the proximal end; the other and larger is inserted into the corresponding part of Met. III. In ANTR it is described by Meckel to be disposed in the same way; but in my specimen the tendon does not divide but passes between the two metacarpals, and is inserted into the radial side of Met. III. just below its upper end. In *Manis* it arises broad from the outer condyle and the ridge ascending from it and is, in consequence of the peculiar origin of the supinator longus, the uppermost muscle arising from that ridge. It terminates in one strong tendon which is inserted into the distal end of Met. III., some of the fibres passing on to the proximal end of the first phalanx.

This muscle not unfrequently presents one or other of the dispositions described in these animals. When there is one tendon only it is inserted into Met. III., and when there are two tendons or two muscles, the larger of the two is inserted into Met. III., showing this to be the primary or more important insertion, that into Met. II. being secondary or subsidiary.

Extensor carpi ulnaris (UNAU) from the outer condyle and the side of the olecranon and ulna, gives rise to two tendons of which the one, derived chiefly from the condyloid part, is inserted into the back of the proximal end of the first phalanx of digit III.; the other is inserted into the ulnar edge of the base

[1] Cuvier does not represent them, nor does Meckel mention them, and Prof. Macalister notes their absence in Aï. Yet they are present in the hind limb in Antr.

of Met. IV. In Aï there are two muscles, one arising tendinous from the outer condyle and inserted into the back of the distal part of Met. IV: the other has a slight tendinous connection with the condyle, but arises chiefly from the outer side of the ulna, keeps close to that bone, and is inserted into the ulnar side of the base of Met. V. In ANTR there are two distinct muscles arising from the outer condyle: one of these which has also a slight attachment to the ulna is inserted into the rudimentary Met. V., sending a delicate slip to Met. IV.; the other and larger is inserted into the ulnar side of Met. III. In MANIS it consists also of two muscles. Of these the smaller and more external arises from the outer condyle, the olecranon and the edge of the ulna, passes over the groove in the outer surface of the lower edge of the ulna on to the outer and palmar surface of the wrist and is inserted into the palmar surface of MET. V. The inner and larger muscle arises from the outer condyle between the preceding and the extensor digitorum and divides a little above the wrist into two broad tendons; the outer and smaller of these is inserted into the outer side of Met. V., and the inner is continued along the outer side of digit IV. to the terminal phalanx.

The divisions of this muscle in the four animals show an interesting similarity to the usual divisions of the peronei in the hind limb with which it is no doubt homologous. The outer part of it (the extensor carpi ulnaris proper) corresponds with the peroneus longus. It passes in Manis on to the palmar aspect of Met. V., which corresponds with the partial insertion of the per. l. into the plantar aspect of Met. V. The next portion, inserted into the outer side of the base of Met. V., probably corresponds with the peroneus brevis; and the inner or third portion corresponds with the peroneus tertius. This will be seen to tally closely with the arrangement of the parts in the hind limb. There is a good deal of variety in the muscles in both limbs in different animals, especially in the peroneus brevis and tertius, though the peroneus longus is remarkably constant in its partial or entire insertion into the innermost metatarsal[1]. In the fore-limb the three muscles are, in several animals, blended into one—the extensor carpi ulnaris. In others there are two—the extensor carpi ulnaris, constituting the homologue of the peroneus brevis and longus, and the extensor minimi digiti, which may pass to two or more digits, constituting the homologue of the peroneus tertius. All these, together with the extensor digitorum, belong to what I describe as the 'superficial layer.' (See pages 48 and 69 to 73.)

[1] See exception to this in Aï (p. 75).

Extensor digitorum (UNAU) from the outer condyle to the terminal phalanges of digits II. and III. In Aï it is small, and passes to the terminal phalanges of II, III, and IV. In ANTR it arises from the outer condyle and slightly from the ulna, being situated rather deeply. It passes as a single tendon through a tendinous loop close to the carpus and runs to the ungual phalanx of digit III, not stopping, as Meckel describes it to do, at the first joint.

In MANIS it arises from the outer condyle of the humerus and the upper third of the ulna. As it descends it divides into two large portions (Pl. IV. figs. 1 and 2) of which the tendons pass to the terminal phalanges of digits III. and IV, and two smaller portions: of these one (3) from between the two large portions passes along the ulnar side of digit III. to the terminal phalanx, and the other (4) from the ulnar or lowest part of the muscle, sends a tendon to the terminal phalanx of digit V, and a small tendon which crosses to beneath the large tendon to digit IV, and runs under that tendon to the terminal phalanx. They are all thrown into relief by fibro-cartilaginous sesamoid bodies upon the metacarpo-phalangeal and phalangeal joints of the digits.

I conceive that the larger portions of the muscle in Manis are representatives of the 'superficial layer' (*i. e.* of the extensor digitorum), the smaller portions are, together with the ext. poll. pr. the representatives of the 'deep layer' (including the extensor brevis) of the three other animals.

Extensor brevis digitorum is well developed in all three animals and corresponds closely with the extensor brevis digitorum pedis. In UNAU it arises from the back of Mets. II. and III. embracing the tendons of ext. c. r, and also from the back of the carpus beneath the tendon of ext. dig. It has two tendons of which the inner or radial, uniting with the palmar interosseus from between Mets. II. and III, joins the ulnar side of the tendon of ext. dig. to digit II, and so reaches the terminal phalanx of this digit. The other is lost upon the dorsal surface of the proximal end of the second phalanx of digit III. In Aï it arises also from the back of the carpus and metacarpus. The muscular fibres are continued over the first phalanges; and the three tendons arising from them constitute the chief part of,

[While this sheet is passing through the press I take the opportunity of referring to a paper by Mr Galton in the *Annals and Magazine of Natural History* for Oct. 1869, on the TWO-TOED ANTEATER, just received from the Author.]

rather than the accessories to, the extensor tendons. Each is joined by an interosseus on either side. In ANTR it consists of two portions. Of these one arises from the lower end of the ulna, passes over Met. II, and extends to the ungual phalanx constituting the only extensor of digit II. The other and larger part arises tendinous from the carpus close to the loop for the tendon of extensor dig., and applies itself to the under part, and both sides of the extensor tendon to digit III. In MANIS (see ext. dig.) the arrangement is different.

This muscle, which is well developed in the first three animals[1], represents very clearly the extensor brevis digitorum pedis, and is a reappearance of a disposition not uncommon in amphibious reptiles. The portion passing to digit II. in Antr represents the extensor indicis. It reminds us of a corresponding portion in the hind limb of Manis (p. 69).

Extensor pollicis primus (UNAU) from the hinder surface of the ulna, in nearly its whole length, to the inner edge of the trapezium, (Aï) from the ulna, in a somewhat more limited range, to the hinder surface of the base of the rudimentary pollex, i.e. to the trapezium. In the ANTR it arises, which is very unusual, from the outer condyle, and from it only, by a broad thin tendon between the fl. c. r. and the fl. digit., and extending up beneath the latter. It passes, as usual, over the fl. c. r., and is inserted into the bone rudimentary of trapezium and others.

In MANIS it arises from the upper half of the ulna, beneath the origin of the extensor digitorum, crosses over the lower end of the radius and is inserted into the inner edge of the trapezium. On the wrist it sends a thin slip to the inner side of the extensor surface of digit I, which reaches the terminal phalanx.

I think that the muscles on the dorsal or extensor surface of the forearm may, like those of the corresponding surface of the leg, be divided into two planes, a superficial, nearly vertical, constituting what is usually described as the extensor digitorum with the extensor carpi ulnaris and the extensor minimi digiti, and a deeper plane crossing obliquely from the ulnar to the radial side, and consisting of the muscle which from human anatomy is called extensor ossis metacarpi pollicis (better called 'ext. poll. primus' or, better still, 'rotator carpi'), the other extensors of the pollex and the extensor indicis. In the fore-limb, owing probably to the greater variety of

[1] It is described by Meckel in Aï and Antr.

movement and the consequent greater specialization of the part, the arrangement is less clear, and the division of the planes is less complete than in the hind limb; and the segments of the deeper layer are often, some of them at least, absent though the rotator carpi is very constant (see p. 69 et seq.).

Extensor indicis (UNAU and Aï) from the middle of the ulna, external to the preceding, to the base and upper surface of the stunted first phalanx of dig. II. In ANTR see p. 48.

The representative of this muscle in MANIS (ext. i.) arises from the lower half of the ulna, crosses beneath and in the same channel with the extensor digitorum, and divides into tendons which pass to the radial side of digit III, to the middle of digit II. and to the ulnar side of digit I, all reaching the terminal phalanges.

Interossei (UNAU): one between rudimentary Met. I. and Met. II. passes to the radial side of the extensor tendon of digit II: one between rudimentary Met. IV. and Met. III. to the ulnar side of the extensor tendon of digit III; this takes origin also from the unciform and pisiform bones: one between Mets. II. and III, on the palmar aspect, which passes to the ulnar side of the extensor tendon of digit II; and one on the dorsal aspect to the radial side of the extensor tendon of digit III. There are thus four interossei, one on each side of each extensor tendon. There is also an adductor of digit II. passing from the pisiform bone to the ulnar side of the first phalanx.

It is interesting to observe that even here the interossei follow the general plan. There is only one digit that can be adducted to the line drawn through digit III, and the muscle (or muscles) which effects this movement is situated palmad of those which act as abductors from the same line.

There is also a second set of interossei '*phalangeal interossei*' two in number quite separate from the preceding, arising from the apposed sides of the two second phalanges and joining the apposed sides of the two extensor tendons near their insertion into the ungual phalanges.

These phalangeal interossei have relation to the close approximation and lateral immobility of the phalanges which in this respect closely resemble ordinary metacarpals.

In Aï the arrangement is much the same as in UNAU, there being an interosseous on the radial side of Met. II. and one on the ulnar side of Met. IV; two in each of the metacarpo-phalangeal interspaces between digits II. and III, and III. and IV. These are chiefly situated on the back, but extend also into the palmar part of the space between the metacarpals. They pass to the apposed sides of the respective digits. Their origins extend to the phalanges. Indeed they may be said to be phalangeal rather than metacarpal interossei. The three sets of muscles—flexor brevis, metacarpal and phalangeal interossei—are less distinguishable from one another than in Unau, the metacarpal parts being more blended with the phalangeal parts on the one hand and with the extensor brevis on the other.

In ANTR the interossei lie on either side of digit III. Several small muscles connected with the pisiform bone are described by Meckel, *Archiv*, v. 47.

In MANIS the small muscles on the palmar surface are as follows. *Abductor pollicis* arises from the sheath of the flexor carpi radialis, over the scapho-lunar bone, and is inserted into the radial side of the first phalanx. *Flexor brevis pollicis* arises, in close contact with the preceding, from the sheath of fl. c. r. and is inserted into the radial side of the sesamoid bone over the metacarpo-phalangeal joint. It represents therefore the inner part of the flexor brevis; and there is no outer part present. Four adductors towards digit III. arise and radiate from the middle of the scapho-lunar bone and are inserted into the ulnar sides of the sesamoid bodies and first phalanges of digit I. (this is *adductor pollicis*) and digit II, and the radial sides of the sesamoid bodies and first phalanges of digits IV. and V. (these are the palmar *interossei*). Their connection with the sesamoid bodies is very slight. None of them pass beyond the phalanges. The origin of the adductor of digit II. is continued from the scapho-lunar bone along Met. IV, and is derived partly from the first phalanx of digit IV. It, therefore, crosses over Met. III; that is to say, it has an origin similar to that commonly given to the adductor pollicis. The part nearest the phalanges is somewhat separate from the remainder, and constitutes a *transversus* muscle.

The *abductor* and *flexor brevis minimi digiti* are very small,

especially the latter. This (the fl. br.) arises from the metacarpal, and is inserted into the sesamoid body and the base of the phalanx. The *abductor* arises from the back and outer part of the unciform and the base of the metacarpal, and is inserted into the side of the first phalanx.

The *dorsal interossei* are on both sides of the three middle digits, and all pass to the sesamoid substances on the terminal joints and to the terminal phalanges close to, but not directly connected with, the extensor tendons. The first, arising from Mets. I. and II, passes to the radial side of digit II. In the interspace between Mets. II. and III. there are two interossei—one large arising from both metacarpals and passing to the radial side of digit III. and one small arising, beneath the other, from Met. II. and passing to the ulnar side of digit II. In the interspace between Mets. III. and IV. there are two interossei of nearly equal size arising from the respective metacarpals and passing to the respective digits. In the interval between Mets. IV. and V. there is only one muscle arising from both metacarpals and passing to the first phalanx only of digit IV. and to the sesamoid body on the palmar aspect of its metacarpo-phalangeal joint.

HIND-LIMB.

Psoas parvus and *magnus* and *Iliacus* present nothing peculiar except that the insertion of the two latter extends to a considerable distance down the femur, especially in ANTR; and in this animal the iliacus extends a little on to the outer surface of the spine of the ilium encroaching somewhat upon the territory of the glutæus medius with which it is there closely connected. In MANIS the *iliacus*, which is quite confined to the inner surface of the ilium, is inserted more than half-way down the femur, the *psoas magnus* presents nothing peculiar, and the *psoas parvus* is a powerful muscle.

Glutæus Magnus (Aï) arises, as usual, from the back of the iliac crest and from the sacral and caudal spines, and is inserted into the femur below the outer trochanter and also into the fascia, its fibres meeting those of the pannicle. Its hindmost fibres are in close contact with those of the semitend. and add.

m. In ANTR it arises from the crest of the ilium, the sacral spines and two of the caudal transverse processes, the fibres from the latter emerging from beneath the caudal muscles, and is inserted into the lower half[1] of the outer side of the femur close to the vast. ext. In MANIS it is a very broad muscle arising, in front, from the short thick anterior crest of the ilium and by the lumbar fascia from the hindmost one or two lumbar vertebræ. It is here, by its anterior edge, in contact with the external oblique and, by its inner surface, applied upon the internal oblique. It arises also by fascia covering the caudal muscles from the sacral spines and one or two anterior caudal vertebræ. It covers the whole of the outer aspect of the buttock and thigh and is divisible into three portions. Of these the foremost (Pl. IV. fig. Gl. 1), representing probably the sartorius and tensor vaginæ femoris, passes over the patella and is lost there; the middle and broadest (Gl. 2) passes by a tendinous expansion, over the outer side of the knee, to the edge of the tibia external to the tendo-patellæ; and the hindmost portion (Gl. 3) is inserted into the femur just above the outer condyle.

The anatomy of the *Glutæus magnus* in these animals is confirmatory of the view expressed in the preceding Vol. of this *Journal*, p. 333, that this muscle is the serial homologue of the latissimus dorsi with probably the teres major. Its origin from the sacral and caudal vertebræ, its insertion into the fibular side of the femur, it may be as low as the fibular condyle, its frequent extension upon the fibular side of the leg even to the ankle, harmonize with the origin of the latissimus dorsi from the dorsal and lumbar spines with its insertion into the ulnar side of the humerus, it may be as low as the ulnar condyle, and its frequent extension down the ulnar side of the forearm even to the wrist.

Glutæus medius, minimus, and *Pyriformis,* not separable from one another in Aï or ANTR, form a large muscle arising from the outer surface of the ilium, from the margin of the sacrum and from the transverse processes of the two foremost caudal vertebræ and inserted into the outer and fore part of the trochanter[2]. In Manis a broad thick muscle arises from the

[1] Not in the whole length as Meckel describes it to be.

[2] The gl. med. and pyriformis are represented separate in both animals by Cuvier, but I cannot make any clear divison between them. The tendon of the hinder portion is somewhat separate from the rest near the trochanter in Antr, but that is all.

outer surface of the ilium, the edge of the sacrum and the first caudal transverse process, especially from the under surface of the last. It is inserted into the fore, upper and hinder surface of the great trochanter presenting no distinct division into Gl. med., min., and Pyriformis.

Gemelli form one muscle in Aï and ANTR with the sciatic nerve passing between it and the preceding; the *Obturator internus* and the *Quadratus femoris*, if they exist, which is not clear, being united with them. In MANIS the same as in the other two.

Obturator externus large in Aï and ANTR. In MANIS it is not quite so large or so separate from the preceding muscle as it is in Aï and Antr.

Tensor vaginæ femoris (UNAU and Aï) from the outer part of the ant. sup. spine of the ilium, broad and flat, to the outer and fore part of the femur beneath the great trochanter, its fibres meeting those of the glutæus max. It has all the appearance of being a segmentation from this muscle. No distinct trace of it in ANTR. In *Manis* it is blended with the glutæus, forming one muscle with it and the sartorius.

Pectineus and *Adductor brevis* large in all three and having, especially the pectineus, extensive attachment to the femur. They are inserted, in the Sloths, into the hinder and outer aspect of the femur. In MANIS they are not so large: the pectineus arises from the pubes at the inner side of the insertion of the psoas parvus and is inserted into the middle third of the back of the shaft of the femur: the Adductor brevis arises from the under surface of the pubes, internal to the preceding, and is inserted into the back of the femur above it.

Adductor longus (UNAU and Aï) has broad origin from the margin of the pubes external to the symphysis. In UNAU it terminates in a narrow tendon which passes in front of the femoral vessels and is inserted into the inner side of the femur, just above the condyle. In Aï it divides into two; a long narrow portion which corresponds with that in Unau, passing in front of the femoral vessels to above the inner condyle; and a broader portion, passing behind the femoral vessels to the hinder and outer aspect of the lower part of the femur. In ANTR the disposition is much as in Aï except that its origin does not

extend so far outwards upon the pubes. In MANIS it arises from the surface of the pubes under cover of the gracilis and is inserted into the inner and back part of the lower end of the shaft of the femur. It is divisible into two parts, one situated behind the other but nearly parallel with it; and both run in front of the femoral vessels.

Adductor magnus is comparatively small in all. In UNAU it arises from the tuber ischii, external to and closely connected with the semi-membranosus and semi-tendinosus, passes internal to and in front of the femoral vessels, like the add. l., and is inserted into the back of the femur above the internal condyle, external to and beneath the insertion of the add. l. In Aï its origin from the tuber ischii is in close connection with that of the biceps. It is inserted chiefly into the back of the femur external to the hinder portion of the add. l.; but a tendon from it passes in front of the femoral vessels and is inserted, with the anterior portion of the add. l., just above the internal condyle. The femoral vessels, therefore, perforate the two muscles in this animal much as they do in man; but the portions of the two muscles between which they pass are more separate than they are in him. In ANTR it is a strap-like muscle arising from the tuber ischii by a tendon common to it with the biceps. It passes, as in Unau, entirely in front of the femoral vessels, and is inserted behind and a little below the anterior part of the add. l. In MANIS it consists of two portions arising from the tuber ischii—one (Pl. IV. fig. 4, *Ad. m.*) thick, arising between the adductor l. and the semi-membranosus, in close connection with the latter, and inserted into the inner side of the inner condyle of the femur. The second portion (*Ad. m.'*) is smaller, arises with the biceps or rather from the tendon of origin of the biceps and is inserted into the popliteal aspect of the inner condyle of the femur between the last portion and the inner head of the gastrocnemius, which latter derives some fibres of origin from it. Both portions, therefore, like those of the add. l., pass in front of the femoral artery.

Sartorius (UNAU) is a large muscle arising from the spine and adjacent inner surface of the ilium, where its fibres are closely connected with those of the iliacus internus. It is inserted into inner side of the femur between the vast. int.

and the add. l. In Aï it arises from the spine of the ilium; its tendinous fibres appearing, to some extent, continuous with those of the external oblique[1]. It is inserted, as in Unau, into the lower part of the inner side of the femur, but its insertion extends also upon the inner side of the upper part of the tibia. In ANTR it arises from the inner surface of the crest of the ilium a little behind the spine of the ilium, in close connection with the iliacus internus and from the fascia upon that muscle, and is inserted into the inner side of the tibia only. In MANIS it may be regarded as forming part of the glutæus, arising between it and the external oblique (which does not extend to the ilium) from the anterior surface of the ilium and the lumbar fascia, and is inserted into the anterior surface of the patella.

Thus the disposition of the muscle is different in all four. Below, it is inserted into the femur in one, into the tibia in another, into both in a third, and into the patella in the fourth. Above, it is connected with the external oblique in one, with the iliacus in two[2], and with the glutæus magnus and the external oblique in the fourth. It may be remarked that as the fascia of the thigh is indistinct near the abdomen in these and many other animals, there is no clear representative of Poupart's ligament: the abdominal muscles are inserted into the linea ilio-pectinea and the spine and symphysis of the pubes; and between these and the spine of the ilium they are, to some extent, connected with the tissue or fascia upon the iliacus. Thus the origin of the sartorius may extend, as in Aï, from the spine of the ilium in the direction of the external oblique or, as in Unau and Aï and as it more frequently does, in that of the iliacus or, as in Manis, in the direction of the glutæus.

In MANIS indeed, it appears to be a part of the glutæus, and unites that muscle with the external oblique; and one would be disposed to look upon this as its true position, and to regard it to be, as well as the tensor vaginæ femoris, a segment of the glutæus; yet in ANTR where, as in most of the higher mammals it extends to the tibia only, it has no relation with the glutæus or external oblique, and is placed upon the inner surface of the ilium in close connection with the iliacus muscle. These animals, in short, illustrate well the shifting relations of the muscle above and below. Its origin in

[1] Meckel describes it as arising not from the ilium but from the external oblique. It must be remembered, however, that the lowest fibres of the external oblique arise from the spine of the ilium.

[2] Galton found it in Dasypus arising from the outer edge of the psoas parvus. In Orycteropus (Vol. II. of this *Journal*, p. 311) I found it extending, over the iliacus, as high as the rib.

Manis squares well with the suggestion I have made (p. 40) of its being the homologue of the upper part of the supinator longus in that animal.

Quadriceps extensor cruris presents nothing peculiar in any.

Gracilis (UNAU and Aï) has a broad origin (Pl. II. *Gr.*) from the symphysis and adjacent fore part of the pubes and divides into two portions, of which one (*Gr.'*), arising more externally, is inserted into the inner side of the tibia as usual, and the other (*Gr.''*), arising nearest to the symphysis, crossing over the back of the leg to the outer side, joins the lower edge of the ischial part of the biceps, and is inserted into the fibula and the fascia on the fibular side of the leg[1]. In Unau the insertion of the inner portion is confined to the upper part of the tibia; but in Aï it extends to the inner ankle and expands upon the back of the leg, joining the femoral part of the biceps, and forming with it a sheath over the gastrocnemius, which, in the upper part, is muscular, but below, is tendinous, and is lost upon the heel. Above, in Aï, the gracilis and the external oblique are so closely united at the linea ilio-pectinea that their tendons appear to be continuous. In ANTR the gracilis has a very broad origin from the symphysis and adjacent region of the pubes, concealing the adductors and flexors, and is inserted into the inner side of the tibia and the fascia of the leg, extending to the ankle and heel. In MANIS the origin is confined to the symphysis and adjacent parts of the ramus and body of the pubes. It preserves a uniform width and is inserted on the inner side of the shaft of the tibia.

Biceps consists of two parts—an ischial and a femoral part—in all four. The ischial part presents nothing peculiar: it arises in ANTR from the tuber ischii being covered by the semitendinosus. The femoral part, in Antr, arises from the outer and lower part of the hinder surface of the femur, below the insertion of the glutæus and also higher, internal to the glutæus; it tapers as it descends and is inserted into a rough space on the outer side of the fibula just above the ankle: in Aï it is inserted into the back of the fibula and also expands upon the back of the leg as far as the heel, uniting with the gracilis: in

[1] Meckel (*Vergl. Anat.* III. 613) alludes to this insertion in Aï.

UNAU (Pl. II. *B.'*), it detaches some fibres to join the semitendinosus and the gracilis[1], and expands (*B.''*) over the back of the leg, forming a sheath over the calf and united to the edges of the tibia and fibula. In MANIS the ischial portion (Pl. IV. fig. 4, *B.*) arises from the ischium, beneath the glutæus and behind the semimembranosus, by a tendon from which pass the muscular fibres of the second part of the adductor magnus; and it is inserted into the external lateral ligament, the head of the fibula and the fascia on the outer and fore part of the leg. The femoral portion (*B.'*) arises from the outer and back part of the femur, beneath the great trochanter, far above, therefore, and quite separate from the insertion of the glutæus which is into the outer condyle. It passes down, internal to the ischial portion, crossing external to the peroneal nerve, and terminates at the lower fourth of the leg, in tendinous fibres, which are closely applied upon the peronei, but which are inserted into the outer side of the os calcis.

Semitendinosus (UNAU) from the tuber ischii, in close connection with the biceps and add. magn: (Aï) from the tuber ischii, between biceps and semimembr.; some of the fibres arise from the sacral and caudal vert.: (ANTR) from the first caudal transverse process, lying superficial therefore to the biceps and the semimembranosus. It is inserted into the inner side of the tibia, beneath the semimembr., in all. I cannot discover a tendinous intersection in it. In MANIS it has a broad origin from the three foremost caudal transverse processes, passes over the tuber ischii and is inserted into the inner side of the tibia beneath the semimembranosus.

In both the long-tailed animals, therefore (Antr and Manis), it arises from the caudal vertebræ and passes over the tuber ischii.

Semimembranosus (UNAU and Aï) from the ischium, in front of the semitend., to the inner side of the head of the tibia above it. In ANTR from the tuber ischii, in connection with the biceps and adductor magnus, to the side of the head of the tibia. A few of the upper fibres, in Aï, pass to the inner side of the femur beneath the insertion of the addr. m. In MANIS from

[1] There is thus a crossing of fibres here, a part of the gracilis passing outwards to the ischial portion of the biceps and a part of the femoral portion of the biceps passing inwards to the gracilis.

the fore part of the tuber ischii is inserted broad into the inner side of the upper part of the tibia, its upper fibres joining those of the adductor magnus over the knee joint.

Popliteus is large in all, arises from the femur, overlies, to some extent, the origins of the tibialis posticus and flexor digitorum, and has an ossicle in its tendon[1] with a smooth facet which plays upon the hinder part of the inner condyle of the tibia, the articular surface of the tibia being extended a little in this direction.

An upper and smaller facet of this sesamoid is, in each instance, applied upon the interarticular cartilage, and slightly upon the condyle of the femur; and its forepart is united to the interarticular cartilage by a stout tendinous band.

The origin of the gastrocnemius from it in ANTR (see below) seems to associate it with the outer of the two post-condyloid bones which are so often found giving origin to the gastrocnemius. The popliteus, however, had not any connection with that bone in the instances in which I have paid attention to the point; and in Jerboa I find a sesamoid in the popliteus, playing upon the tibia, distinct from the post-condyloid bone which plays upon the femur and gives origin to the gastrocnemius and the plantaris. It is to be observed also that it is the soleus only which is connected with the popliteal sesamoid in Unau. It is necessary therefore to distinguish, though that is not always done (witness Meckel, *Vergl. Anat.* III. 634), between the popliteal sesamoid and the post-condyloid or gastrocnemian sesamoid, for they are not the same. The origin of the plantaris, popliteus, and soleus from the process at the upper end of the fibula in Echidna and the occasional partial origin of the popliteus from the fibula in other animals (see footnote, p. 328 of the preceding Vol. of this *Journal*) render it probable that that process is the homologue of this popliteal sesamoid, the difference being that it has not been segmented so as to form a separate bone, or 'fabella,' or that having been segmented it has become ankylosed to the fibula.

Gastrocnemius (UNAU), the portions arising from the two condyles are separate in their whole length and cross one another. The inner portion arises, muscular, from the usual situation, immediately above the internal condyle, and terminates, above the middle of the leg, in a tendon which is inserted into the outer part of the prominence of the os calcis. The outer portion has a broad muscular origin from the outer side of the back of the femur, commencing an inch above the

[1] Meckel (*Arch.* III. 28 and 53) mentions this 'sesamoid' in Antr, and Owen (*Comp. Anat.* II. 409) in Manis as the 'fabella'.

condyle. It terminates at the middle of the leg in a tendon which crosses beneath the preceding, and is inserted into the inner side of the projection of the os calcis. In Aï the origin is like that in Unau, except that the origin of the outer portion is narrower: the flat muscular bellies are continued to the level of the ankle where they unite in a tendon, which is inserted on the inner side of the projection of the os calcis. In ANTR the inner head arises as usual, and the outer head arises not from the femur but from the sesamoid bone in the popliteus. The two unite about the middle of the leg in a tendon which is inserted into the most prejecting part of the os calcis, rather on the outer than the inner side. In MANIS there are two broad musculo-tendinous origins from the condyles of the femur. The inner derives some fibres from the second portion of the add. magnus which crosses it (Pl. IV. fig. 4); and the outer extends above the condyle into the usual position of the plantaris. They unite in a tendo Achillis inserted into the os calcis; but the inner edge of the tendon is somewhat separate from the rest and is continued on the inner side of the os calcis into tissue, from which the inner fibres of the fl. br. dig. arises. This tendon represents the tendon of the plantaris (fig. 4). Below, it is lost in the under surface of the flexor brevis. Above, it passes into the deeper surface of the gastrocnemius, but is not clearly traceable into that portion of the outer head of the gastrocnemius which represents the plantaris muscle.

There are no post-condyloid sesamoid bones at the femoral origins in either of the four animals.

Soleus (UNAU), from the upper part of the back of the fibula and, by a thin muscular slip, from the sesamoid bone in the popliteus. It is inserted into the outer part of the upper surface of the os calcis, anterior to the tendon of the inner head of the gastrocnemius. Some of its fibres run into this tendon, and some are continued into the large accessorius. In Aï it arises from the upper two-thirds of the back of the fibula, and is inserted into the upper and inner surface of the os calcis anterior to the tendon of the gastrocnemius. In ANTR it passes from the upper half of the back of the fibula, and is inserted into the os calcis on the fibular side of the tendon of the gas-

trocnemius. In MANIS it arises from the back of the fibula in nearly the whole length, and is inserted in front of the tendo Achillis into the upper surface of the os calcis, between the ankle joint and the extremity of the bone. Its fibres approach close to those of the accessorius.

Plantaris is separate only in ANTR. It arises from above the outer condyle of the femur nearly in the position of that which I have described as the outer head of the gastrocnemius in UNAU. It runs beneath the gastrocnemius to its inner side, and accompanies tendinous tissue passing from the side of the projection of the os calcis to the flat supernumerary bone. It is thus inserted into the latter bone, and serves to connect it with the os calcis and to carry the pad.

Thus the *plantaris* in ANTR corresponds almost exactly with that which constitutes the only representative of the outer portion of the *gastrocnemius* and of the *plantaris* in UNAU; and in ANTR the only representative of the outer portion of the *gastrocnemius* corresponds in its origin with the slip that forms part of the soleus in UNAU. In Aï there is a peculiar feature introduced by an extension of the fl. dig. to the femur, which seems to represent the plantaris. In MANIS, so far as it is distinguishable, it takes the usual course; but it is not separate from the gastrocnemius.

Tibialis posticus (UNAU) as usual from the back of the tibia. It consists however of two portions—a larger portion (Pl. II. *Tib. p.*) the tendon of which descends behind the inner malleolus, beneath the inner part of the scaphoid but unconnected with it, along the outer surface of the ento-cuneiform bone to which it sends some fibres, and is chiefly inserted into the base of Met. II. The smaller portion (*Tib. p.'*) internal to the other, terminates in a tendon which descends in a separate channel on the inner side of the malleolus, passes over the most projecting hinder point of the ento-cuneiform, and is continued onwards into a small fusiform muscle (a portion of the flexor brevis) which terminates in a fine tendon that crosses the sole and becomes blended with the tendon of fl. br. to digit IV. In Aï it is single and small, extends along the inner and posterior surface of the tibia, a little beneath the popliteus, and has one tendon which passes in a deep groove on the back of the malleolus and is inserted into the ento-cuneiform. In ANTR it arises from the back of the tibia and also from the

head of the fibula extending up beneath the popliteus. The inner and larger portion of the muscle, including all that derived from the tibia and some of that from the fibula, terminates at the lower third of the leg in a tendon which, passing behind the malleolus, is inserted into the middle of the supernumerary bone. The outer and smaller portion, derived exclusively from the head of the fibula, terminates in the upper third of the leg in a delicate tendon which, passing in a separate channel, deeper than the other tendon, is inserted into the hinder edge of the ento-cuneiform[1].

In MANIS there are two distinct muscles. The first (Pl. IV. fig. 4, *Tib. p.*) arises from the back of the upper third of the fibula, in conjunction with the soleus, and from the oblique line in the tibia beneath the lower edge of the popliteus, and is inserted into the inner side of Met. I. The second (*Tib. p.'*) arises, deeper, from the inner side of the upper third of the fibula close to the flexor digitorum, and from the back of the tibia beneath the first portion, running up, like it, for some distance under the popliteus: its tendon passes in a separate channel, external to that of the first portion, and is inserted into the ento-cuneiform bone.

These divisions of the tibialis posticus, especially that in Unau, are a little perplexing and difficult to harmonize with the disposition of it and the adjacent muscles in other animals. The first or inner portion corresponds generally in its origin with the flexor digitorum of man and some others; and the course of its tendon in Unau throws it into relation with the flexors of the toes. Yet in Manis its tendon lies internal at the ankle, and has the usual insertion of the tibialis posticus. In Orycteropus (Vol. II. of this *Journal*, p. 314) the disposition is particularly interesting. The muscle consists, as in these animals, of two parts; and the inner or tibial part shows a closer relation to the flexor of the digits, for, besides being inserted into Met. I., it sends a slip to the flexor digitorum, and another to the plantar fascia. The plantar fascia is in that animal the representative of the short or superficial flexor; the slip to the plantar fascia may, therefore, be looked upon as the homologue of

[1] Meckel describes this smaller portion as the flexor hallucis. It is, however, closely connected with the tibialis posticus above, and has the usual insertion of the tibialis posticus below, and is quite on the tibial side of the fl. dig. Moreover a distinct fl. longus hallucis is by no means common in the lower animals. The division of the muscle in Antr seems rather to correspond with that stated by Meckel (*Vergl. Anat.* III. 637) to be found in Marmots. Galton, *l.c.* 558, found a *tibialis posticus secundus* in Dasypus, inserted into an ossicle alongside the fore edge of the ento-cuneiform bone.

the part of the muscle which, in Unau, is continued into one of the divisions of the flexor brevis.

The explanation, in general terms, seems to be that the segmentation of this deep muscular plane is somewhat variable. The fibular part is pretty constant as a flexor of the digits; and the tibial part is disposed in one, two, or more parts to the tarsus, metatarsus, or digits, or all three, as occasion may require. When a subdivision of this tibial part takes place the outer or fibular portion goes to the tarsus, forming the true tibialis posticus, and the inner or tibial element is distributed, partly to the tarsus and partly to the digits, or, as in man, entirely to the digits forming the flexor longus digitorum.

Flexor digitorum (UNAU) arises from the tibia and fibula, and slightly from the popliteal sesamoid. The tibial portion is deep, being covered by the fibular portion and the tibialis posticus, the fibres of which are, to some extent, blended over it; and the tendon derived from this portion, crossing beneath those proceeding from the fibular portion, goes to digit IV. The fibular portion, passing on the inner side of the astragalus in the same channel with the fibular portion, gives rise to two tendons which pass to digits II. and III. All the tendons join the deeper surface of those from the front of the leg presently to be described. In Aï it arises in three portions—the largest[1] from the line ascending from the outer condyle of the femur and forming the outer boundary of the popliteal space, above the outer head of the gastrocnemius. The smallest portion arises from the back of the tibia; and the third portion is from the back of the fibula. The three are blended at the lower part of the leg into a tendon which occupies a wide deep channel on the outer side of the malleolus and gives rise to three tendons to the three digits. The femoral portion does not maintain a superficial relation, but passes into the tendon to digit III: the chief of the tibial portion lies deep and passes to digit II; and the chief of the fibular portion lies superficial to the rest and passes into the tendon to digit IV. The crossing of the tibial portion beneath the others to digit IV, as in UNAU,

[1] I do not find that this femoral origin of the fl. dig., which may be considered to represent the upper part of the plantaris, is described by Meckel. He seems (*l. c.* 630) to regard it as part of the outer origin or the gastrocnemius, which he describes to be very large in this animal. It is described as plantaris by Prof. Macalister. It may be observed that in Pteropus (preceding vol. p. 314) the fl. dig. has an origin from the tibial condyle of the femur.

is confined to a few fibres. In ANTR it arises from the back of the tibia and fibula by two heads which lie beneath the tibialis posticus and extend up beneath the popliteus. They unite to form one strong tendon which divides to the four toes.

In MANIS it arises from the back and inner part of the fibula in nearly its whole length in conjunction with the soleus and the tibialis posticus, but deeper than these, also from the back of the lower part of the tibia. The tibial and fibular fibres meet in a penniform manner in a tendon which is large in the sole, plays upon flat smooth surfaces of the cuneiform and cuboid bones, and divides to the terminal phalanges of the five digits.

Lumbricales (UNAU) are three: one arises entirely from the tendon of the tibialis anticus which passes to digit III: the second arises partly from the tibialis anticus (from the cleft between the divisions to digits II. and III), and partly from the fibular portion of the fl. dig. or the fibres of the accessorius which join it: the third arises, partly, from the tibialis anticus (from the outer side of the division to digit III), and, partly, from the fibres of the accessorius passing to the tendon of digit IV. They run on the tibial sides of digits II, III, and IV, and join the extensor tendons, not being connected with the phalanges. They are absent in Aï. In ANTR there are three passing from the clefts of the tendon of the fl. dig. to the tibial sides of the three outer digits. I do not find one connected with digit II.

In MANIS there are three arising by flat tendons from the plantar surface of the fl. dig. close to its division to the three inner digits. There is but little interval between the origin of the lumbricales and the fibres of insertion of the accessorius; and by dissection continuity between them may be shown to some extent. In the instance of the outer one the muscular fibres are continuous with the muscular fibres of the accessorius. They pass to the tibial sides of the first phalanges of digits II, III, and IV. The third, or outermost, divides and passes to the fibular side of digit III. as well as to the tibial side of digit IV.

The origin of the lumbricales from the tibialis anticus in Unau is well worthy of note. The relation to the accessorius, remarked in Unau and in Manis, is probably not unusual. In Pteropus (preceding Vol. p. 315) several of the lumbricales pass, as in the instance of

the third in Manis, to the fibular as well as the tibial sides of the digits.

Accessorius is present and large in all. In UNAU and Aï it arises from the whole of the anterior and outer surface of the back of the long heel-bone, and (in UNAU) is continuous with the soleus. In UNAU the largest part of it joins the tendon to digit IV, and the remainder the other two tendons. It is inserted into the several tendons at the junction of the components from tib. ant. and fl. dig.; so that the two muscles—accessorius and tib. ant.—coming from opposite sides serve to neutralize the tendency of each other to draw the tendons of the toes laterally. In Aï it divides into three portions which are inserted into the plantar surfaces of the tendons to the three digits. In ANTR it arises from the fore part of the projection of the os calcis, and is inserted into the plantar surface of the flexor tendon just before its division.

In MANIS it passes from the under and outer surfaces of the os calcis to the plantar or superficial surface of the broad tendon of the fl. dig. before the division; and its fibres may, by a little dissection, be traced into all the flexor tendons as well as into the lumbricales.

The accessorius is, in these animals, not only a powerful adjunct to the flexor of the toes, but seems also to prevent the drawing of the flexor tendon inwards at the ankle. Provision against this displacement, which is partly afforded by the deepening of the inner side of the groove in which the tendon lies at the malleolus, is especially needed in the Sloths, in consequence of the strength and continued action of the flexor muscle and the inturned position of the foot. The need is further increased in Unau by the powerful tibialis anticus joining the flexor digitorum.

I suspect that this muscle, which has come to be, as its name implies, an accessory, is, in reality, the original or true flexor. I think it will turn out, though I am not able quite to satisfy myself of this, that the planes of flexors on the plantar aspect, like the two planes of extensors on the dorsal aspect (p. 69), are, in the typical condition, confined to the foot and are represented—the superficial plane—by the flexor brevis digitorum and—the deep plane—by the accessorius; that these constitute the primary and essential parts; and that the extensions up the leg—the plantaris of the superficial plane and the belly of the flexor digitorum of the deep plane, like the extensor digitorum on the dorsal aspect—are the secondary and accessory parts. The accessorius, if this view is correct, is the plantar (that is flexor or antagonistic) homologue of the

extensor brevis; the flexor digitorum and the tibialis posticus are the antagonistic homologues of the deep layer in the front of the leg[1]; and the plantaris is the antagonistic homologue of the extensor longus digitorum. The occasional interruption of continuity of the superficial flexor layer and the insertion of its crural part (the plantaris) into the tarsus (as into the heel-bone in man) becomes thus an interesting feature of similarity to the occasional interruption of the superficial extensor layer and the insertion of its crural part into the metatarsus, as witnessed in Aï (p. 68).

The large size of the muscle in these four animals is in remarkable contrast with its rudimentary, merely tendinous, condition in Orycteropus (Vol. II. 317).

Flexor brevis digitorum (UNAU) well marked in three portions, one to each of the digits. One portion (Pl. II. Fl. br'.) arising from the projecting hinder part of the ento-cuneiform, is joined by a portion (Fl. br".) from the os calcis: it passes to digit II. The two other portions (Fl. br.) arise from the extremity of the os calcis superficial to the accessorius, that to digit IV. receives an accession from the internal division of the tibialis posticus (see description of that muscle): all terminate in the flexor sheaths, that to digit II. on the fibular side, that to digit IV. on the tibial side, that to digit III. in the middle. In Aï it is a small flat thin muscle arising from the point of the heel-bone and having three tendons which are disposed as in Unau. In ANTR it arises as usual and sends a tendon to each of the four digits. In MANIS it consists of four portions arising from the fore part of the extremity of the os calcis and passing to the four outer digits where they are disposed in the usual manner, except that the division to digit V., which arises rather deeper than the others, in closer relation to the accessorius, as well as external to them, passes only to the outer or fibular side of the digit and is inserted into the outer sesamoid bone of the metacarpo-phalangeal joint. The inner portion is connected with the outer part of the tendo-Achillis which represents the plantaris.

[1] The segmentation in the two cases however is somewhat different, inasmuch as the deep extensor of the digits (Ext. br.) is confined to the foot, and is not usually, like its antagonistic homologue in the sole, continuous with any part of the muscular structure of the leg.

I drew attention (preceding Vol. p. 320) to this 'antagonistic homology' of muscles, without using the term, in the instance of the flexors and extensors of the leg and forearm.

The similar peculiarity of the superficial flexor passing to the ulnar side of digit V. is noted with regard to the fore limb in Manis (p. 44).

Transversalis; a very distinct muscle in UNAU, arising tendinous from near the distal end of Met. V; it divides into two portions, of which one is inserted into the distal end of Met. I. and the other into the fibular side of the proximal end of the first phalanx of digit II. (See account of this muscle in MANIS in the description of the small muscles of the palm and sole, p. 74.)

There are three *cutaneous* muscles in the sole of the foot in UNAU; one radiates from the slightly enlarged end of Met. I, backwards into the skin, and another radiates in a similar manner from Met. V. Some of the fibres of these two nearly or quite meet. A third passes backwards from the flexor sheath over the metatarso-phalangeal joint of digit II. In MANIS a broad muscle extends from the metatarso-phalangeal joints of digits I. and II. backwards into the skin of the sole, and another from the metatarso-phalangeal joint of digit V. radiates also into the sole.

Tibialis anticus in UNAU and Aï consists of three portions—one arising from the outer surface of the upper half of the tibia; a second arising from the middle third of the fibula where the ext. hallucis, which it appears to represent, usually arises. These two portions come into contact in the lower part of the leg, and in Aï are inserted together into the inner margin of the conjoined entocuneiform and rudimentary first metatarsal, the fibres of the tibial portion being more internal or marginal than those of the fibular portion. In UNAU (Pl. II. *Tib. a.*) their conjoined tendon does not stop at this the usual terminus but passes over the inner side of the instep in a wide groove in the entocuneiform which is deepened behind, by the projection of that bone, and in front, by the projection of the base of Met. I. Here it divides into three tendons which join the surface of the tendons of the flexor digitorum. The fibular portion furnishes the tendon to digit II., the tibial portion that to digit IV., and both furnish that to digit III. The third portion of the muscle (*Tib. a'.*) arises from the lower and fore part of the fibula including the malleolus, internal to the peroneus brevis. It

passes athwart the ankle and is inserted into the entocuneiform and base of Met. I., its fibres lining, in Unau, the groove in which the tendon from the remainder of the muscle passes and, in Aï, being inserted just beneath that tendon[1]. In ANTR the muscle consists of two portions only, corresponding with the first and second of Unau and Ai; and the tendon of these is inserted into the entocuneiform bone between the supernumerary bone and the metatarsal.

In MANIS also the tibialis anticus (Pl. IV. fig. 2. *Tib. a.*) consists of two portions. One, larger and internal, arises from the outer side of the upper two thirds of the tibia and from the head of the fibula, lying beneath the extensor longus digitorum; and the other from the anterior edge of the upper three fourths of the shaft of the fibula, between the first portion of the tibialis anticus and the extensor hallucis and in a plane with them. The tendons of the two run together over the ankle; that of the tibial portion is inserted into the entocuneiform bone and that of the fibular portion into the inner side of the base of the metatarsal of hallux.

In all four therefore, the muscle arising from the part of the fibula which usually furnishes attachments to the ext. hallucis passes with the tibialis anticus and contributes with it to form a powerful rotator of the foot inwards; and this movement is in the Sloths strengthened by the third portion from the lower end of the fibula.

The continuation of portions 1 and 2 to the flexor tendons in Unau is very remarkable. I do not know any other instance of the same thing; and a flexor action is thus given to muscles which are usually extensors. This becomes less striking when we remember that the tibialis anticus is often associated in its action as a rotator inwards with the flexors of the foot and toes; and in cases of ordinary club foot (talipes varus) it combines with the muscles which we are in the habit of regarding as its antagonists to produce the deformity, and requires to be divided with them in the operation for cure. Its association with the flexors, its prolongation to the sole in Unau may be compared with what is usual in the case of its fibular compeers—the peronei. These, two of them at least—peroneus longus and brevis—though members of the extensor group, become, by virtue of their relations to the outer malleolus and the continuation of one of them into the sole, flexors of the ankle, and are associated in their

[1] This portion, which is not mentioned by Meckel or Macalister, seems to correspond with a muscle in the Frog, passing from the lower end of the fibular side of the leg bone to the fore part and inner side of the astragalus and called by Dugés (*Recherches sur les Batrachiens*) *pêronêo susastragalien*, and by Ecker (*Anatomie des Frosches*) *flexor tarsi.*

action with the tibialis posticus and the flexors of the toes. Moreover the combination in one muscle of flexor action upon one joint and extensor action upon another joint is not so unfrequent as we might suppose. In Manis (p. 35) the latissimus dorsi extends the elbow and flexes the digits; and in some birds the rectus extensor cruris is continued into the flexor digitorum.

Extensor digitorum in UNAU and Aï arises by a tendon from the external condyle of the femur, in front of the external lateral ligament. In Unau it is a thin muscle and divides into two tendons to the digits III. and IV. In Aï it is larger, muscular all down the leg, and is inserted by a short thick tendon into the upper surface of the proximal end of Met. III. not extending to the digits at all. In ANTR its origin is confined to the head of the tibia, it is not large and divides into four tendons to the four digits. (In MANIS, see below.)

Extensor brevis digitorum is large in all. In UNAU and Aï it arises from the dorsal surface of the tarsal bones and of the proximal parts of the metatarsals and passes to the terminal phalanges of all the digits, having no connection with the proximal phalanges. It constitutes with the interossei the only extensor of the several digits in Aï and of the inner or second digit in UNAU. In the latter animal it joins the under surface and both sides of the extensor tendons to digits III. and IV. In ANTR it arises from upper surface of the os calcis and divides into four separate portions which become united with the tendons of the long extensor.

In MANIS the *ext. digitorum* (Pl. IV. fig. 2, *Ext. d.*) has a thin flat tendinous connection with the fore part of the outer condyle of the femur and a muscular origin from the head of the tibia and of the fibula and from the upper fourth of the fibula in conjunction with the peroneus longus. It divides into four tendons which are inserted into the dorsum of the first phalanges of digits II, III. and IV.; and it sends a delicate slip to digit V. This joins the peroneus tertius and is inserted into the terminal phalanx.

The *Ext. brevis* (*Ext. br.*) arises from the fore part of the os calcis and divides into three portions, one to the outer side of digit IV., a second to the adjacent sides of digits IV. and III., and a third to the adjacent sides of digits III. and II. All the tendons pass on to the terminal phalanges.

Extensor longus hallucis (*Ext. h.*) arises from the lower fourth of the anterior surface of the fibula, beneath the peroneus tertius, below and in the same plane with the tibialis anticus. Having passed over the ankle it divides into three portions, one to the inner side of digit II. extending to the terminal phalanx, a second to the terminal phalanx of digit I., and a third to the proximal phalanx of digit I.

The study of the extensor group in these four animals and the comparison of them with the corresponding group in the frog are highly interesting and instructive, and afford, I think, a key to the arrangement of these muscles.

In the FROG the middle muscle in the front of the leg, which corresponds apparently with the crural or upper part of the extensor digitorum in mammals, reaches only to the tarsus, being inserted into the tibial and fibular sides of the two long tarsal bones; and the extensors of the digits are limited to the foot and are in two planes. A *superficial* plane proceeds from the anterior surface of the upper part of the os calcis and divides into four or five portions, the tendons of which are inserted into the several *proximal* phalanges of the digits. The *deeper* plane arises from the os calcis lower down, divides into twice as many bundles as the superficial plane, and two bundles pass along the sides of each of the superficial tendons, extend beyond them and reach the terminal phalanx of each digit. This is only a general description, but it is sufficient for my purpose[1].

In AÏ the disposition so far resembles this of the frog that the crural part of the extensor group reaches only to the metatarsus, and the tendons to the phalanges are entirely derived from the pedal portions; but, owing probably to the comparative immobility of the proximal phalanges, none of the tendons are inserted into them; they are all continued on to the distal row; and the muscle is, accordingly, not distinctly divisible into two planes. In UNAU, in like manner, the extensor tendons all pass on to the terminal phalanges, and the pedal part is in one plane, and is the sole extensor of digit II. Here however, there is a further departure from the frog, inasmuch as the crural portion does not stop at the tarsus, but is continued on as an extensor of digits III. and IV. It is not, however, continued to digit II., the extensor of that digit being, like the extensors of all the digits in AÏ and the Frog, confined to the foot. In ANTR the deviation from the Frog is greater still, for the superficial plane from all the digits extends up the leg and has become altogether crural; and the pedal part or deep plane, though more separate than in the Sloths, is still a good deal blended with the superficial or crural plane.

In MANIS (and we may probably take this as the typical arrangement when the superficial plane extends up the leg and acquires a

[1] The deep plane is not segmented from the interossei, and its componenta are described as interossei by Dugés and Ecker.

crural or femoral attachment) the tendons of the superficial, which is also the crural plane, are inserted into the proximal phalanges; and each is flanked, on both sides, by the tendons of the deep or pedal plane which pass on to the terminal phalanx. There is here, therefore, a reversion to the plan of the frog though a difference from the Frog is shown, in that the crural and pedal parts of the superficial plane are united into a continuous muscle.

In Mammals generally a conformity to this typical plan is shown in the following way: the tendons of the superficial or crural plane (the *extensor digitorum longus*) extend to and are attached to the middle of the dorsal surface of the proximal or middle phalanges; while the tendons of the deep or pedal plane (the *extensor digitorum brevis*) run more laterally and reach the terminal phalanges. There are, however, commonly deviations from the plan in that the deep tendons are single, instead of being double, to each digit and are confined to the fibular side; they are more closely united with the tendons of the superficial plane than in Manis and the Frog; and prolongations of the superficial tendons extend, especially on the tibial sides, to the terminal phalanges. I have in a former paper (Vol. III. of this *Journal*, p. 317) suggested that the passage of the lumbricales to the tibial side of the digits may perhaps be explained by the absence of the short extensor tendons on this side; and I drew attention to the fact that in Pteropus, where the short extensors are disposed on both sides of the long extensors, the lumbricales also pass on to both sides of the digits.

To prevent obscurity I have reserved the consideration of the marginal digits (I. and V.) because, being more specialized, these present still greater deviations from the regular plan. In digit I. both the extensor tendons—*proprius* and *brevis*—are inserted into the terminal phalanx, thus presenting the usual insertion of the tendons of the deeper plane; and the disposition in Manis shows pretty clearly that they really belong to this plane. In that animal they both spring from the same muscle, which, by its manner of connection with digit II. is linked on to the deep series notwithstanding the peculiarity which it presents, in imitation of the components of the superficial series, by shifting its ground from the pedal to the crural region and acquiring an origin from the fibula instead of being confined to the tarsus. If this view be correct it is the superficial or 'long' element which is wanting in digit I; and we may associate the deficiency with the absence of that phalanx into which the superficial tendon is usually inserted.

Now the last-mentioned muscle (*extensor hallucis*) is, in Manis distinctly and in most mammals more or less distinctly, in the same plane with the *tibialis anticus* as well as with the *extensor brevis*, and is closely connected with it. So that we find here a deep plane, arising from the tarsus, the fibula, and the tibia, the fibres of which run with more or less obliquity from the fibular to the tibial side, and which is segmented in the direction of its fibres—somewhat differently in different animals—into two chief parts, of which one (*tibialis anticus*) is inserted into the inner side of the tarsus, and the

other (*extensor brevis digitorum*) is inserted into the terminal phalanges of the digits. There is also, commonly, a third or intermediate segment (*extensor hallucis*) which may be derived from either or both of the others and which connects the others, but which from the intervention of the ankle joint is more separate from the extensor brevis than from the tibialis anticus. Indeed it is not unfrequently merged in the latter. This seems to be the case in Unau, Aï and Antr; and in Manis it occupies a part of the ground of the fibula from which the ext. hallucis usually arises.

With regard to the other marginal digit (v.) the deep or short extensor often fails in it, as I have just said the superficial or long extensor fails in digit 1; and the deficiency is in many animals compensated for by an extension from the peronei to the phalanges. The peronei are parts of the superficial plane, so that digit v. usually receives two tendons from the superficial plane, digit i. has two tendons from the deep plane, and the intermediate digits have one tendon from each plane.

In the fore limb also a similar plan may be traced, though it is more often and more largely departed from to meet the freer movements and more special requirements of this member. The two layers are easily distinguished; and both usually extend beyond the carpal region upon the forearm. The superficial layer forms the extensor digitorum, and even in the Frog springs from the outer condyle of the humerus, constituting the middle muscle on this surface of the forearm. It supplies the three outer digits, being inserted into one of the proximal phalanges or extending to a terminal phalanx. Beneath this is the deeper layer, which in the Frog is partly pedal, that is to say, the muscles which supply the three outer digits arise from the carpus, and pass on either side of the digits mostly to the terminal phalanges. The inner digit (No. ii.) like the hallux in Manis, receives two tendons which pass from the ulnar side of the forearm, beneath the long extensor, and are inserted into a proximal and the terminal phalanges, or are both inserted into the terminal phalanx.

In Mammals, as in the Frog, the superficial, long, vertical muscle passes from the humerus to the three or four outer digits, and is inserted, in great part at any rate, into the proximal or middle phalanges. The deeper short, oblique layer we have found in Unau and Aï, corresponding with the deep layer in the hind limb and with the same layer in the fore limb of the Frog, to arise in part from the carpus, to be applied (in Unau) to both sides of the long extensors, and to reach the terminal phalanges. In Antr this part of the deep layer extends upon the ulna; and in most mammals where it exists it extends up the forearm, and is not unfrequently blended with the extensor longus. Its tendons may, however, usually be recognised by their reaching to the terminal phalanx, and by their running on the ulnar side of the long extensors[1]. In most instances the pollex, like the hallux, is supplied exclusively from this deep oblique layer,

[1] I have described it as '*extensor digitorum secundus*' in Phoca (Vol. ii. of this *Journal*, p. 307).

receiving one, two, or more tendons from it; and the index digit often receives a tendon on its ulnar side from the same source; or it may be entirely indebted to the superficial layer for its extensor muscles.

Continuous with this deep layer, and forming indeed the most constant element of it, and related to it in the same way that the tibialis anticus is related to the deep extensors in the hind limb, is a muscle which, from human anatomy, is usually called *extensor ossis metacarpi pollicis*, but which from its far more constant insertion into the carpus is better designated *rotator carpi*. Its course and relations as well as its action indicate this muscle to be the serial homologue of the outer part of the tibialis anticus. I say of the outer part because the inner part seems to be represented by the extensor carpi radialis. I do not say this at all positively; but the relations of the tendon of the extensor carpi radialis and its position close to the bones beneath even the rotator carpi—a position very regularly observed—show that it belongs to a deep series, although, above, it has like some of the other members of the deep series just mentioned, and like the rotator carpi in Antr, passed into the superficial level and reached the outer condyle of the humerus. By the process of exhaustion there is no other representative of this muscle left in the hind limb except a part —the inner or tibial part—of the tibialis anticus. The fibres of this part show a tendency as they descend to cross beneath those which have a more external origin, and it seems not improbable that their homologues in the fore limb do so cross and form a separate muscle or muscles which reach the third metacarpal, or the second as well as the third, and constitute the single or double radial extensors of the wrist[1]. With regard to the marginal digits (I. and V.) in the fore limb the pollex (I.) is, as above said, supplied exclusively, like the hallux, from the deep or oblique layer. The small digit (V.), like its homologue in the hind limb, is supplied from the superficial layer; and to compensate, as it were, for the want of supply from the deep layer it receives an accession (*extensor minimi digiti*) from the superficial layer, from between the extensor carpi ulnaris and the extensor digitorum, which corresponds therefore in position with the *peroneus tertius*. Like this its homologue it not unfrequently supplies the adjacent digit (IV.) as well as V. In Manis this muscle is of large size, and the similarity of it and of the extensor carpi ulnaris to the peronei is very obvious.

It will be perceived therefore that in the fore limb, as well as in the hind limb, digit I. is supplied exclusively from the deep plane, and digit V. from the superficial plane, each commonly receiving two tendons

[1] In a large dog of the St Bernard breed I found two tendons inserted into the second and third metatarsals and apparently, therefore, serially homologous with those of the extensores carpi radiales. These were derived from the contiguous parts of the extensor brevis digitorum and the extensor hallucis. To have shown a more full correspondence with what I suppose to be their homologues in the fore limb, their muscular parts should have run up beneath extensor hallucis; but the attempt, as one may call it, at similarity is interesting and rare.

from its plane. The intermediate digits are not so frequently as in the hind limb supplied from both planes; their extensors are usually derived from the superficial series only, or the deep elements which belong to them are more or less blended with the superficial.

Interossei in UNAU and AI are large, situated on the dorsal aspect of the foot, lie nearly in the same plane, and terminate in the extensor tendons. There is one on each side between each of the three large metacarpals, i.e. two between Mets. II. and III. passing to the fibular side of the tendon to digit II. and to the tibial side of the tendon to digit III., and two between Mets. III. and IV. which are similarly arranged with regard to the adjacent tendons. There is also one on the tibial side of Met. II. extending between it and Met. I. and passing to the tibial side of the tendon to digit II.; and there is one on the fibular side of Met. IV. extending between it and Met. V., passing to the fibular side of the tendon to digit IV. They extend through, on to the plantar aspect, between the large metacarpals; and the palmar portions appear to be connected chiefly if not exclusively with digits II. and IV. so as to adduct them to digit III. In Unau there are fibres corresponding with what I have described as phalangeal interossei in the fore limb, but less distinct. Each extensor has thus two interossei attached to it, one on each side. In ANTR there is one on each side of each of the four outer digits, and passing chiefly to the extensor tendons. The muscles adducting to digit III. are distinctly on the plantar surface and are large, whereas those abducting from the line through digit III. are smaller and more on the dorsal surface; the distinction between plantar and dorsal interossei being more clear than usual. There is an adductor, a short flexor, and an adductor of digit I.; the two first arising from the supernumerary bone, the adductor from the ento-cuneiform. A thick muscle, covered by tendinous tissue, passes from the outer part of the os calcis to a projection on the outer surface of the base of Met. V.; and some of the fibres are continued on to the first phalanx; this is *abductor* of the fifth digit.

In MANIS (Pl. IV. fig. 5), the arrangement of the small muscles, though generally resembling that in the fore limb of this animal, presents some differences. The *abductor* and *flexor brevis pollicis* arise together by a tendon from the scaphoid bone,

lying internal to the tendons of the tibialis posticus. The abductor, receiving accessorial fibres from the side of the metacarpal, is inserted into the tibial side of the first phalanx. The fl. brevis is inserted into the inner or tibial side of the sesamoid. The *flexor brevis* and *abductor minimi digiti* are very small, arising only from the short metacarpal and inserted into the outer sesamoid and side of the phalanx. There are five *plantar interossei*. Three arising from the fore part of the cuboid and cuneiform bones, near the middle of the foot, radiate to the fibular side of digits I. (the *adductor pollicis*) and II. and to the tibial side of digit V: they are inserted chiefly into the phalanges and slightly into the sesamoids, and are adductors to the middle digit. The two remaining plantar interossei are situated on a rather deeper plane, nearer to the metatarsals, and pass, one to the fibular side of digit III., and one to the fibular side of digit IV. They are therefore abductors from the axis of the middle digit. A *transversus* connects the interossei of digits V. and II. by passing, muscular, from the first phalanx of V., across Mets. IV. and III. and the two abductor interossei of these digits, and being inserted into the first phalanx of digit II.

The *dorsal interossei*, corresponding very closely with those in the fore limb, pass to both sides of the three middle digits, and to the tibial side of digit V. reaching the terminal phalanges in company with the short extensor tendons. The abductors from the axis of the middle finger preponderate, and are superficial, as do the adductors to the same line in the sole. Thus the first and third dorsal interossei arise from both the respective adjacent metatarsals, and pass to the tibial sides of digits II. and III.; whereas the second dorsal interosseus is deeper, arises from Met. II. and passes to the fibular side of digit II. In like manner the muscle to the fibular side of digit III. (abductor), usurps the chief of the space between Mets. III. and IV. covering and dwarfing that (abductor) to the tibial side of digit II. Those occupying the remaining interspace are more equal and pass to the apposed sides of digits IV. and V.

The disposition of the interossei in UNAU, AÏ, and ANTR is in accordance with the mammalian rule that those on the palmar aspect adduct to digit III., and those on the dorsal aspect abduct from the axis of that digit.

In the fully developed condition of these muscles there is one palmar and one dorsal interosseus on each side of each digit; that is, there are four in each metacarpal interspace, two passing on each side. This is the case in the Scinc. Now in Manis there is an intermediate condition between the ordinary Mammalian and the Reptilian condition. Both on the plantar and the dorsal aspect, especially on the latter, the muscles are double in some of the metacarpal interspaces; but even then, in accordance with the mammalian tendency, the adductors to the middle digit encroach upon the palmar aspect and the abductors from the same preponderate upon the dorsum.

Peroneus longus (UNAU) from the back of the fibula in nearly its whole length, passes behind the outer malleolus, along the groove in the cuboid, and is inserted chiefly into the base of Met. IV. A small portion of the tendon extends on to Mets. III. and II.; and a few fibres even reach the rudimentary Met. I. In Aï it arises partly from the outer condyle of the femur by the tendon common to it with extensor digitorum, and partly from the upper two-thirds of the fibula. It is broad and flat, lies in front of the ankle, and is inserted into the outer surface of the rudimentary Met. V., not extending into the sole. In ANTR it arises from the fore part of the head of the fibula, descends on the outer side of the malleolus, passes as usual into the sole, is connected with the heads of the metatarsal bones sending a few fibres to III. and II., and terminates by being inserted into the ento-cuneiform.

In MANIS (Pl. I.) it arises from the fore and outer part of the upper end of the fibula. Its tendon passes behind the outer malleolus, along the groove in the cuboid as usual, detaches some fibres to the outer part of the base of Met. V., and is chiefly inserted into Met. II. Some fibres, however, pass into Met. I.

The insertion of this muscle in Aï into Met V., which agrees with the account given by Macalister (p. 15) and by Meckel (p. 626), is an interesting and rarely presented similarity to the usual disposition of its serial homologue the ext. carpi ulnaris, which seldom extends beyond the base of the fifth metacarpal. The view taken in Cuvier's *leçons* (641, 642) is that this muscle is the peroneus brevis, and that the peroneus longus is absent. Forasmuch however as it has so high an origin, and as there are two or three peronei, it may, I think, be fairly regarded to be the Peroneus longus. Moreover we find intermediate conditions transitional, as it were, to this. Thus in Manis and Orycteropus (Vol. II. 319) some fibres are detached, from

the tendon, to Met. v.; and this is not uncommon: in Antr fibres are inserted into Mets. II. and III.; and in Unau the chief insertion is into Met. IV., though some fibres pass on to Mets. III. II. and I.

Peroneus brevis (UNAU and AI), quite a short flat muscle arising from the fore and under part of the lower end of the fibula, from the malleolus that is, to the outer part of the base of Met. V. It thus diverges from the lowest portion of the tibialis anticus, and acts as an antagonist to it. In ANTR it arises from the outer and back part of the shaft of the fibula, is larger than the peroneus longus, internal to which it crosses at the ankle, and is inserted into the outer side of Met. V. just in front of the projection at its base. A thin tendon from its fore part runs along digit V. joining the extensor tendon.

In MANIS (Pl. II. fig. 2) it arises from the back part of the middle of the fibula, comes beneath the per. l. behind the outer malleolus, and is then joined by a thick muscular portion which arises from the lower end of the fibula, and which corresponds with the only representative of the muscle in the Sloths. This muscular portion joins its inner aspect; and the broad tendon resulting from the two is inserted into the base and along the outer border of Met. V., and the outer side of the first phalanx. A thin tendinous slip passes forwards from it to join the extensor tendon of digit V. and is inserted into the first phalanx.

Peroneus tertius (UNAU) from the fore part of the fibula to the upper edge of Met. V., some fibres going to Met. IV. In AI it arises from the same tendon as the ext. dig. and is inserted into the upper surface of the base of Met. IV. In ANTR I do not find any representative of it. In MANIS (Pl. III.) it arises from the lower half of the anterior edge of the fibula, there being an interval between it and the ext. digitorum. It forms the chief part of the extensor tendon of digit V., but is inserted into its first phalanx. A part of it also passes to the first phalanx of digit IV.

PLATE I.

The bones in situ of the fore and hind feet of Unau, Aï, Ant-eater, and Manis.

PLATE II.

Hind limb of Unau. *Gr.*, upper part of gracilis reflected. *S.*, sartorius. *Ad. l.*, adductor longus. *Pect.*, pectineus. *Ad. br.*, adductor brevis. *Ad. m.*, adductor magnus. *V. i.*, vastus internus. *Gr'.*, lower part of gracilis reflected. *Tib. a.*, tibialis anticus continued into the flexor digitorum. *Tib. a'.*, third part of tibialis anticus inserted into entocuneiform and Met. I. beneath, and on either side of Tib. a. *Inteross.*, internal interosseus. *Lumbr.*, lumbricales. *Fl. br.*, flexor brevis digitorum. *Fl. br'.* portion of flexor brevis from entocuneiform joining *Fl. br.*" from os calcis. *Ac.*, accessorius. *Fl. d.*, flexor digitorum. *T. A.*, tendo-achillis. *Tib. p.*, tibialis posticus. *Tib. p'.*, part of tibialis posticus passing to flexor dig. br. *B.*, ischial part of biceps. *B'.*, portion of femoral part of biceps passing to gracilis and semitendinosus. *B''.*, portion of femoral part of biceps expanding upon back of leg. *S. Memb.*, semimembranosus. *Ad. m.*, adductor magnus. *S. tend.*, semitendinosus. *Gl.*, glutæus magnus.

PLATE III.

Fig. 1. One side of Manis superficially dissected showing the pannicle, &c. *Trap. delt.*, trapezio-deltoid muscle. *Fl. d. s.*, flexor digitorum sublimis; the pin is passed under the part connected with pollex. *P.*, part of pannicle passing upon the back and neck, divided and reflected. *Lat. d.*, latissimus dorsi. *Br. l.*, brachio-lateral. *Pect.*, pectoralis major. Behind, the mixed fibres of the panicle, brachio-lateral and external oblique cover the body and pass upon the thigh.

Fig. 2. Deeper dissection of the front of the forearm on larger scale. *Tr.*, triceps. *Lat. d.*, latissimus dorsi continuous with the part of *Fl. d. s.*, (flexor digitorum sublimis) to digit III., which has been divided and reflected over the olecranon. *Fl. d. s'.*, reflected second origin (from internal condyle) of the part of flexor digitorum sublimis to digit III. *Fl. d. s''.*, flexor digitorum sublimis to digit II., arising from inner condyle. *Fl. d. s'''.*, and *Fl. d. s''''.*, flexor digitorum sublimis to digits IV. and V. (see p. 44). *Fl. d. p.*, flexor digitorum profundus. *Fl. c. u.*, flexor carpi ulnaris. *Fl. c. r.*, flexor carpi radialis. *A. p.*, abductor pollicis. *Fl. br. p.*, flexor brevis pollicis. *Fl. p.*, tendon of flexor profundus to pollex. *Lumbr.*, lumbricales.

PLATE IV.

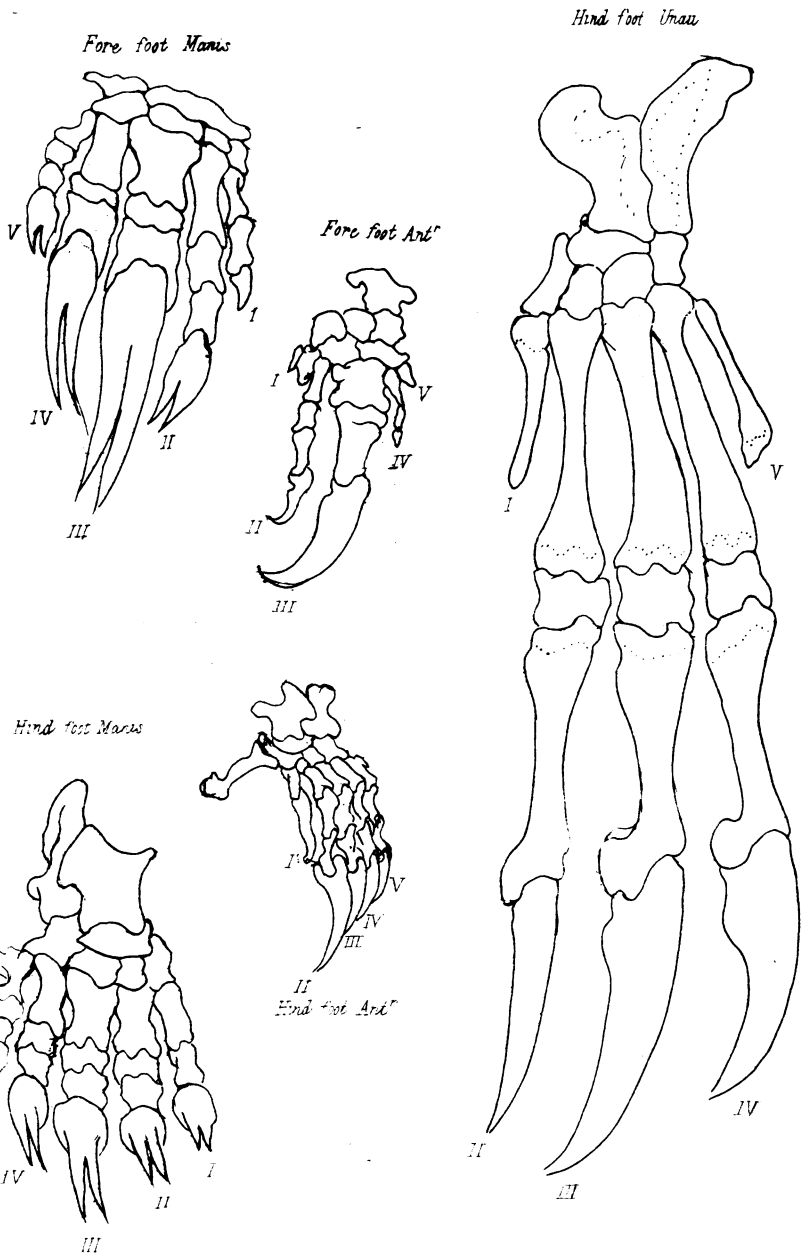
Fig. 1. Fore limb Manis, outer side. *Tri.*, triceps. *Ext. c. r.*, extensor carpi radialis. *Ext. c. u.*, extensor carpi ulnaris. *Ext. d.*, extensor digitorum (1, 2, 3, 4; see p. 47). *Ext. i.*, extensor indicis, *Ex. p. pr.*, extensor pollicis primus. *Sup. l.*, supinator longus. *Trap.*, trapezius. *M. S.*, masto-scapular. *O. S.*, occipito-scapular.

Fig. 2. Hind limb of Manis, outer side. *S. tend.*, semitendinosus. *B.*, biceps. *P.* 1, 2, 3, peroneus primus, secundus, tertius. *Ext. br.*, extensor brevis. *Ext. h.*, extensor hallucis. *Tib. a.*, tibialis anticus. *Ext. d.*, extensor digitorum. *Gl.*, glutæus.

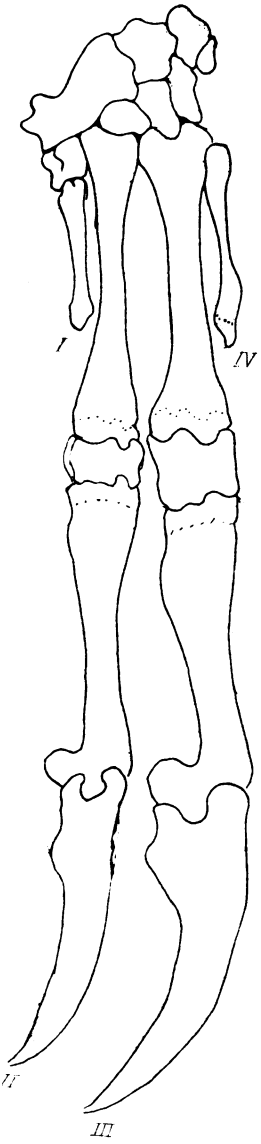
Fig. 3. *Ad. l.*, adductor longus. *Ad. m.*, adductor magnus inserted into inner condyle. *Ad. m'.*, portion of adductor magnus inserted into popliteal aspect of femur and connected with inner head of gastrocnemius. *S. membr.*, semimembranosus. *Gr.*, gracilis. *S. tend.*, semitendinosus. *Tib. p.*, tibialis posticus. *Tib. p'.*, tibialis posticus secundus. *Abd.*, abductor hallucis. *Ac.*, accessorius. *Fl. br.*, flexor brevis. *Fl. br.*, flexor brevis hallucis. *Fl. d.*, flexor digitorum. *Pl.*, plantaris. *S.*, soleus. *Gastr.*, gastrocnemius. *B.*, ischial part of biceps. *B'.*, femoral part of biceps.

Fig. 4. Palmar interossei in Manis. *Fl. c. r.*, flexor carpi radialis. *Ab. p.*, abductor pollicis. *Fl. br. p.*, flexor brevis pollicis. *Fl. br.*, flexor brevis minimi digiti. *Fl. c. u.*, flexor carpi ulnaris.

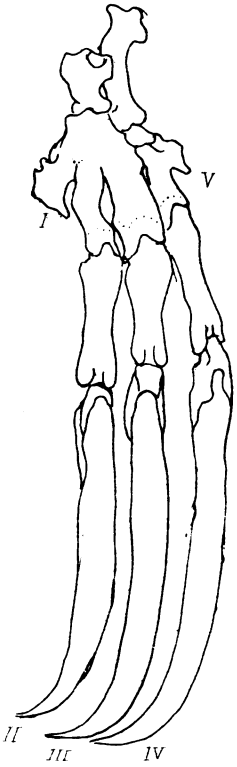
Fig. 5. Plantar interossei. *Ab.*, abductor hallucis. *Fl. br.*, flexor brevis hallucis. *P. l.*, peroneus longus.



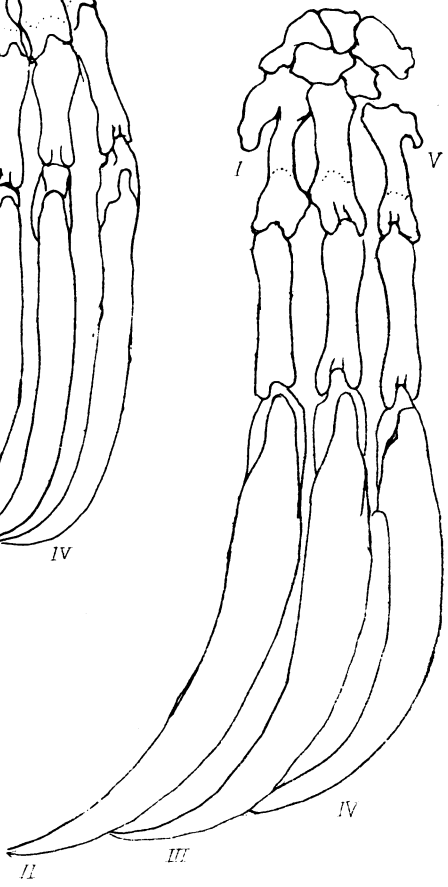
Fore foot Unau

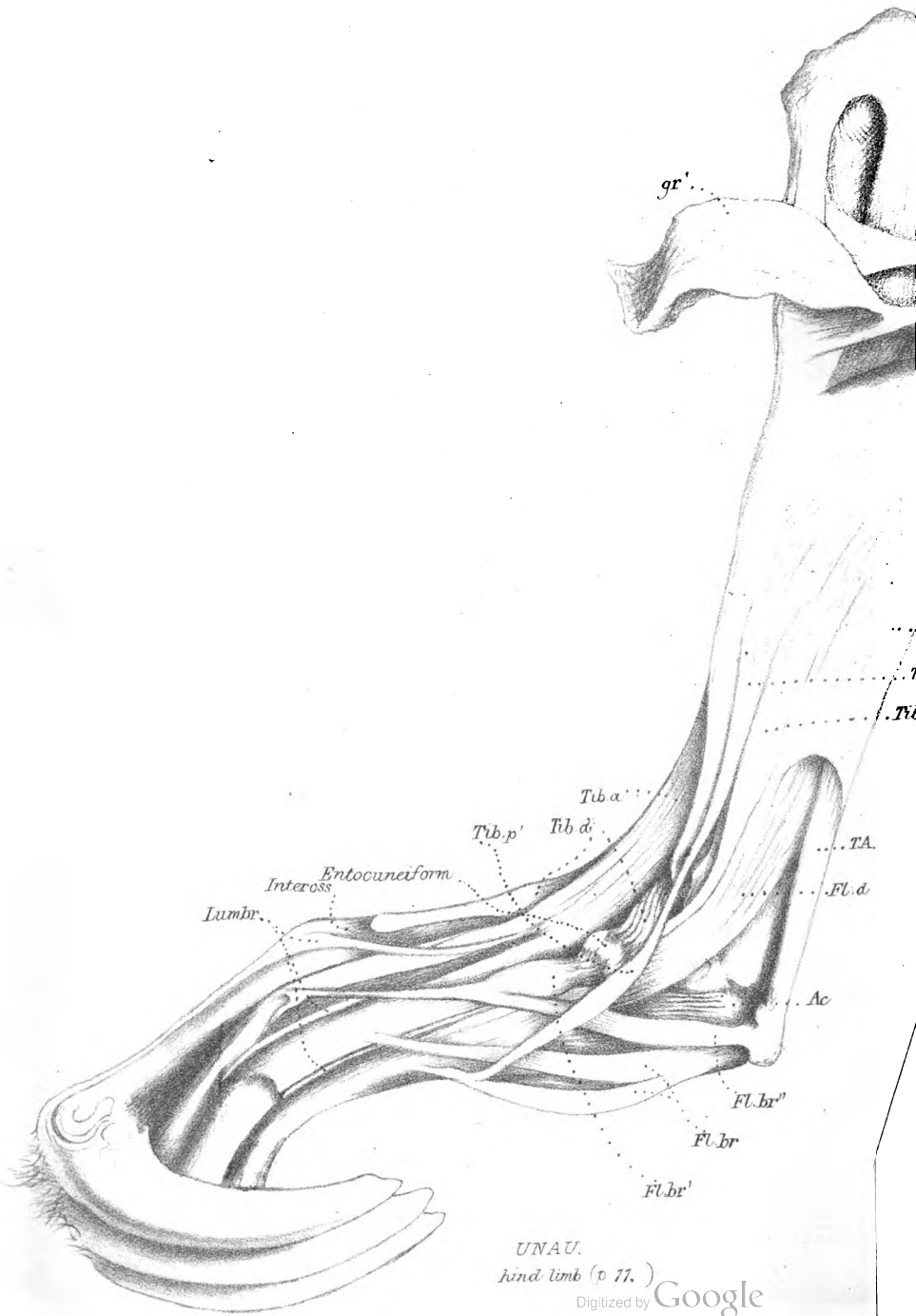


Hind foot Ai

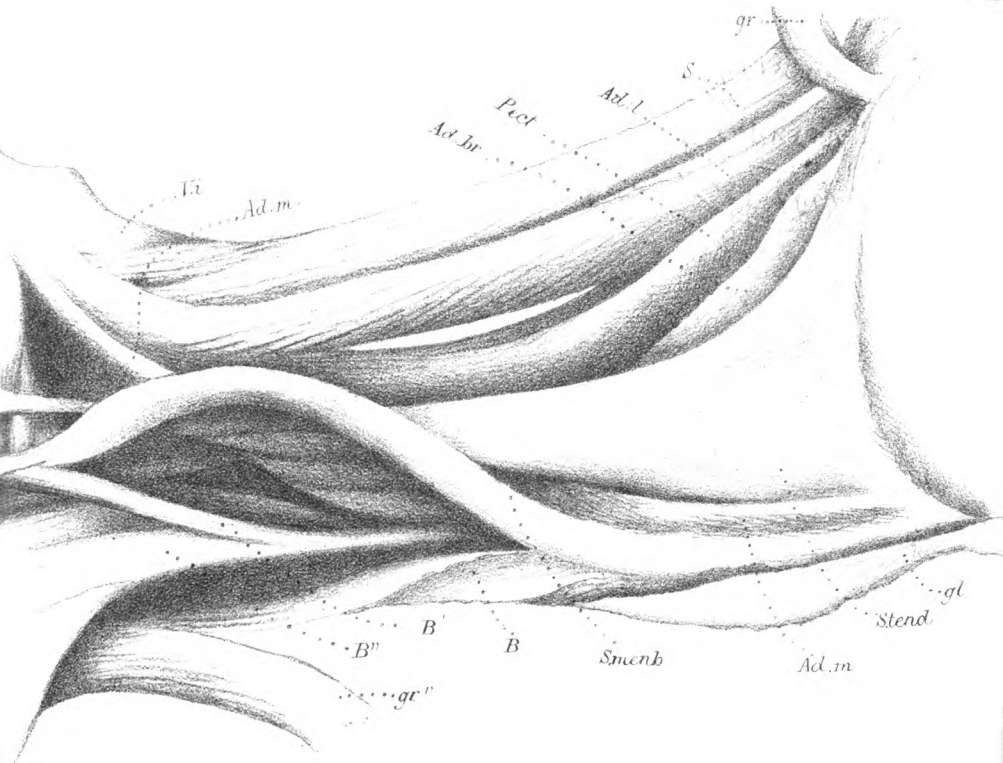


Fore foot Ai





UNAU.
hind limb (p 77.)



B''

b.p'

Fig. 2.

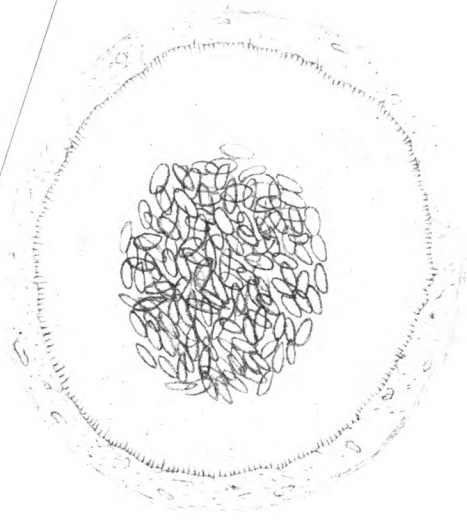
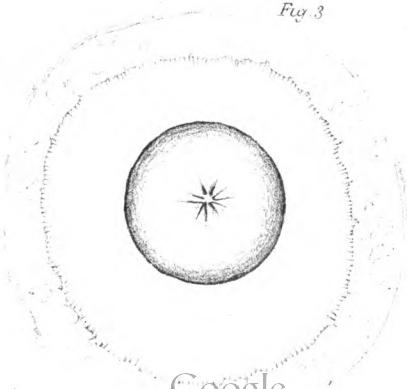


Fig. 1

Fig 3



2000ths of an inch

Fig. 2

ig. 1.