PLATE XXX.

Fig. 1. *Arhopala drucei*, sp. n., ♂, p. 661.
2. —— ——, ♀.
3. —— *kounga*, sp. n., ♂, p. 662.
4. —— ——, ♀.
5. —— *borneensis*, sp. n., ♂, p. 666.
6. —— *bella*, sp. n., ♂, p. 664.
7. —— ——, ♀.
8. —— *havilandi*, sp. n., ♂, p. 665.
9. —— ——, ♀, p. 665.
10. —— *waterstradti*, sp. n., ♂, p. 668.
11. —— ——, ♀.
12. —— *labuana*, sp. n., ♂, p. 667.
13. —— ——, ♀.

PLATE XXXI.

Fig. 1. *Arhopala moorei*, sp. n., ♂, p. 669.
2. —— *sandakani*, sp. n., ♂, p. 670.
3. —— *deva*, sp. n., ♂, p. 669.
4. *Tajuria dacia*, sp. n., ♂, p. 674.
5. —— ——, ♀.
6. —— *berenis*, sp. n., ♂, p. 674.
7. *Drina ninoda*, H. H. Druce, ♀, p. 680.
8. *Lehera anna*, H. H. Druce, ♀, p. 680.
9. *Biduanda hewitsonii*, H. H. Druce, ♂, p. 679.
10. *Mantoides licinius*, sp. n., ♂, p. 677.
11. —— ——, ♀.
12. *Eoöxylides etias*, Dist. & Pryer, ♂, p. 680.
13. *Thrix gama*, Distant, ♂, p. 678.
14. *Deudorix diara*, Swinhoe, ♂, p. 681.
15. —— *strephanus*, sp. n., ♂, p. 681.

5. On the Anatomy of *Petrogale xanthopus*, compared with that of other Kangaroos. By F. G. PARSONS, F.R.C.S., F.Z.S., F.L.S., Lecturer on Comparative Anatomy at St. Thomas's Hospital.

[Received June 5, 1896.]

The specimen from which the following notes were made was kindly placed at my disposal by Mr. F. E. Beddard, the Society's Prosector. I have been struck by the fact that of late years the Macropodidæ have not received nearly so much attention as the other members of the Marsupial order, and for this reason I have thought it worth while making a fairly exhaustive dissection of *Petrogale*, laying special stress on the vascular, nervous, muscular, and ligamentous systems, and comparing them with the accounts of other writers to which I have had access. The other systems, which are already well known, I have passed over more rapidly, though I am fully alive to the importance of basing our knowledge of the anatomy of any animal on several dissections by different observers.

The Osseous System.

Owen, in his 'Comparative Anatomy of Vertebrates,' has given an excellent account of the Kangaroo's bones, and I only intend to draw attention to certain points which seem to me of special interest. In the first place, the chief characteristics in which the skull of *Petrogale* differs from that of *Macropus* are :—

(1) In *Macropus* the nasal bones have an equal breadth in their anterior two-thirds, the posterior third being only slightly broader. In *Petrogale* the nasals are much more slender in comparison and their posterior half is considerably broader than the anterior.

(2) In *Macropus* the fronto-nasal suture comes farther back than the most posterior point of the fronto-maxillary in most cases. In *Petrogale* the condition is reversed.

(3) In *Macropus* the zygomatic process of the maxilla projects downwards below the cutting-edge of the penultimate molar. In *Petrogale* it is seldom much lower than the alveolar margin of the maxilla. I am not inclined to lay much stress on this distinction, since it seems that the processes of the Kangaroo's skull increase with age.

(4) In my specimen of *Petrogale* the infra-orbital canal was double on both sides, a condition I have found in two out of five skulls. In *Macropus* the canal is occasionally double on one side, but I have not found it so on both sides once in the thirteen skulls I have had the opportunity of examining.

(5) In my specimen of *Petrogale* a Wormian bone (*os antiepilepticum*) was present at the junction of the coronal and sagittal sutures (see fig. 1, p. 685). This bone has been described by Gruber and Howes, and I am inclined to regard it as of some little classificatory value [1]. It occurred twice in the five skulls examined, and I have never seen it in any other Kangaroo.

(6) In *Petrogale* the palatine process of the palate-bone is only represented by a narrow bridge marking the posterior boundary of the hard palate. In *Macropus* the palatine process is complete and the back of the hard palate has no perforation of any size.

(7) The premaxilla of *Petrogale* is a larger bone in comparison with that of *Macropus*, and has not the sharp angle running back between the maxilla and nasal found in the latter.

(8) The inter-parietal bone of *Petrogale* has a very different appearance to that of *Macropus*; in the latter it is a more or less crescentic bone having a much greater breadth from side to side than from before backward, while in the former its antero-posterior measurement equals its greatest transverse, so that the bone forms either an isosceles triangle or a rough pentagon.

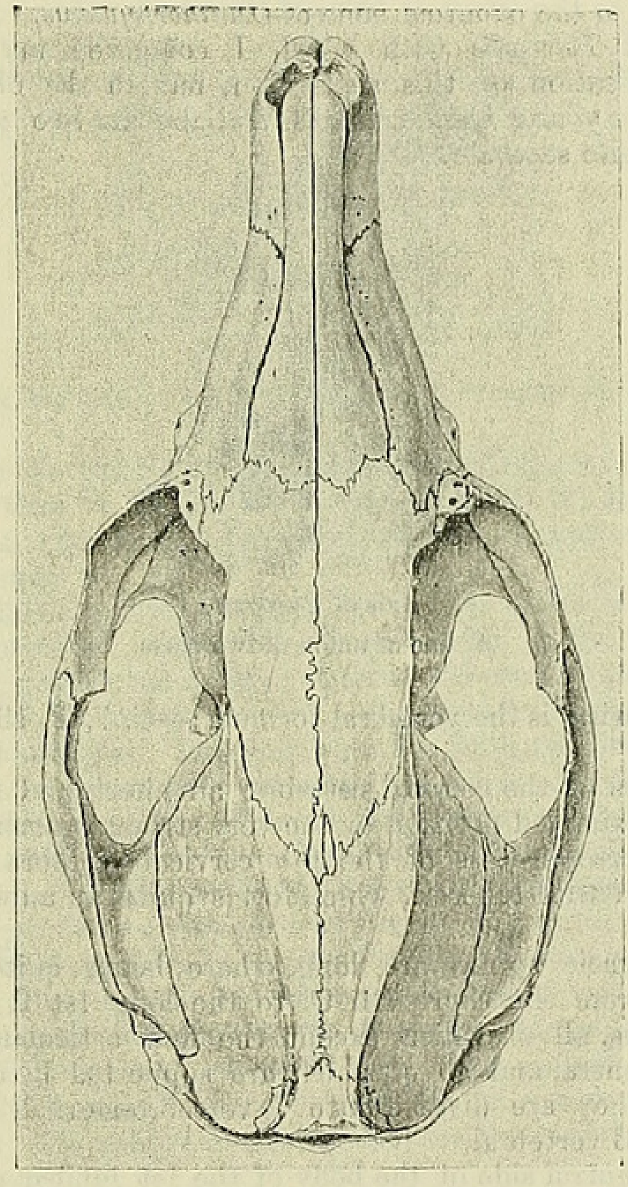
(9) The paroccipital processes are better developed in *Macropus* than in *Petrogale*.

As special stress is laid on the condition of the centres of ossification of the various bones, it will assist in determining the animal's age if the state of the teeth is noticed here. The anterior

[1] See the author's paper on *Atherura africana*, P. Z. S. 1894, p. 677.

molar is calcified and can be seen by cutting away the maxilla; it has not yet replaced the two premolars. The last (4th) molar is being cut.

Fig. 1.



Skull of *Petrogale*, showing os antiepilepticum.

The *Atlas* agrees with that of most Kangaroos in wanting the foramen in the transverse process and in the incomplete ventral arch, which is ligamentous for about one-sixth of an inch.

In an older specimen of the same animal I found this space reduced to a mere suture. The only Kangaroos in which I have found anything like a complete foramen in the transverse process are *Hypsiprymnus* and *Bettongia*.

In the *Axis* the vertebrarterial foramen is incomplete, and I found a similar condition in an older animal. On looking at the dorsal surface of the body of the axis, a line of cartilage was seen running transversely across just behind the level of the anterior articular facets; this evidently corresponded to an inter-vertebral disc, and it is interesting to notice that, if the two parts of the bone had been separated here, the anterior would have corresponded very closely to the odontoid bone of *Ornithorhynchus*. In the older specimen of *Petrogale* with which I compared my own there was no indication of this separation, but in the disarticulated skeleton of a young Labillardiere's Wallaby the two parts of the axis were quite separate.

Fig. 2.

Axis of *Petrogale*.
A, line of union of two parts.

The following is the vertebral formula:—C. 7, T. 13, L. 6, S. 2, C. 24.

The spines of the cervical vertebræ are short, and the neck is kept in an extended position by the very strong ligamenta subflava. The transverse process of the 6th cervical vertebra has a very prominent ventral tubercle, which forms quite an antero-posterior ridge.

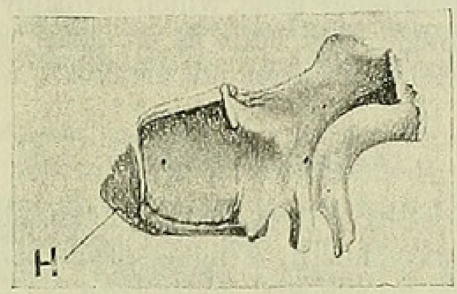
The thoracic spines are long, there being quite a sudden transition from the short 7th C. to the long 1st T. There are thirteen ribs, all of which except the first articulate with two vertebral centra, and all of which are supported by a transverse process. They are divided into 7 vertebro-sternal, 3 vertebro-costal, and 3 vertebral.

On the ventral side of the body of the 1st lumbar vertebra and just to the right of the mid-ventral line there is a single triangular bone fastened by its base to the centrum, while its apex projects ventrally; it seems to be developed in the anterior common ligament, and is more closely attached to the posterior than to the anterior part of the vertebra. From its unilateral position I regard it as one of a pair of hypapophyses or intercentra which has worked forwards from the ventral side of the disc and which may possibly be homologous with the projection from the ventral side of the centrum of the 1st lumbar in the Hare, although that process is median and has no separate centre of ossification.

The lumbar transverse or costal processes have a sharp curve towards the head at their ends; they are small on the 1st and 2nd vertebræ, but rapidly increase afterwards.

The anapophyses begin on the last three thoracic vertebræ and disappear on the last two lumbar.

Fig. 3.



1st lumbar vertebra of *Petrogale*, with hypapophysis (H).

The *Clavicle* has the usual single forward curve. The *Scapula* resembles that of *Macropus* in the absence of any sign of a metacromial process; a small metacromion is, however, found in *Hypsiprymnus*.

The *Humerus* is chiefly remarkable in that it shows all or almost all the centres of ossification; they consist of the following:—1, head; 2, greater tuberosity; 3, lesser tuberosity (quite distinct); 4, shaft; 5, internal condyle; 6, trochlea and capitellum; 7, external condyle. The centre for the internal condyle takes no part in the bridge of bone enclosing the supra-condylar foramen.

The *Radius* and *Ulna* show all the epiphyses, but that for the upper end of the radius is nearly united to the shaft. The upper epiphysis of the ulna merely forms a cap to the olecranon.

The *Carpal bones* correspond to Owen's description.

In the *Pelvis* the three parts of the os innominatum are completely fused, but there is an epiphysis on the crest of the ilium and on the tuberosity of the ischium, the latter stretching along as far as the subpubic bone, with which in more adult animals it coalesces; there is also a slight ossific deposit in the centre of the pubic symphysis. No special centre is seen for the origin of the rectus femoris.

The *Femur* shows the following epiphyses:—1, head; 2, great trochanter; 3, upper part of lesser trochanter; 4, shaft; 5, lower extremity. The epiphyses for the head and great trochanter meet on the upper surface of the neck. The outer side of the posterior part of the external condyle is lipped and forms a groove for the reception of the elevation on the posterior part of the head of the fibula during extreme flexion of the knee-joint. The *Patella* is almost entirely cartilaginous, but a small bony deposit is seen in the centre. The *Tibia* shows the following centres:—1, head; 2, upper part of cnemial crest where the ligamentum patellæ is attached; 3, shaft; 4, lower extremity. In studying the ossication of older bones, I find that the centre for the attachment of the ligamentum patellæ first unites with that for the head, and then with the shaft before the latter is united with the head. The *Fibula* has an upper and lower epiphysis. In the foot the bones are the same as in *Macropus giganteus.* On the plantar surface of the base of the fourth metatarsal there is a facet articulating with a triangular bone, which probably is the rudiment of the first metatarsal; this bone is in close contact with the internal cuneiform, though it does not articulate with it.

The Articular System.

Clavicular Articulations.—The outer end of the clavicle is attached to the tip of the acromion by a ligamentous band about $\frac{1}{4}$ inch long, so that there is no synovial cavity between these bones. In addition to this there is a coraco-clavicular ligament about $\frac{1}{3}$ inch long, which connects the outer end of the posterior border of the clavicle to the small coracoid process; this ligament passes above the origin of the biceps, with which some of its deeper fibres are continuous.

The *Shoulder-joint* has no openings at all in the capsule, the biceps tendon passing entirely superficial to it. It is not specially thickened at any point. When the posterior part of it is cut and the bones separated, a gleno-humeral ligament is seen running obliquely downwards and outwards from the base of the coracoid process towards the lower part of the lesser tuberosity. This so-called ligament is in reality only a fold of the synovial membrane, the free border of which is crenated and projects into the joint cavity; it is best marked near the scapula.

The *Elbow-joint* is remarkable for allowing a good deal of lateral movement when it is flexed. The anterior ligament has two strengthening bands, the external of which is oblique and runs from the external condyle downward and inward to the radius just above the tubercle; it helps to limit pronation when the elbow is extended. The other band is vertical and runs down from in front of the internal condyle to just below the coronoid process of the ulna. The internal lateral ligament consists of two thickened bands arranged in the form of an inverted V, the anterior runs from the internal condyle to the coronoid, the posterior from the internal condyle to the olecranon process; the interval between these is filled in by a thin membrane. The external lateral ligament is a single strong band, which passes from the external condyle to the orbicular ligament and neck of the radius; it is inseparable from the supinator brevis tendon, and from its joint surface there is a pyramidal synovial and fatty projection which occupies the triangular non-articular gap in the outer side of the great sigmoid notch where the olecranon joins the coronoid process. The posterior ligament is thin and lax.

The *Superior radio-ulnar joint* has an orbicular ligament; it allows pronation and supination to the extent of rather less than a quarter of a circle.

The *Interosseous membrane* is present between the lower two-thirds of the bones; it is strong and has the normal direction.

The *Inferior radio-ulnar joint* has no synovial cavity, and there is no triangular fibro-cartilage.

The *Wrist-joint* consists of two separate synovial cavities; the first between the radius and scapho-lunar is normal, in the second the peg-shaped lower end of the ulna fits into a deep concavity in the cuneiform.

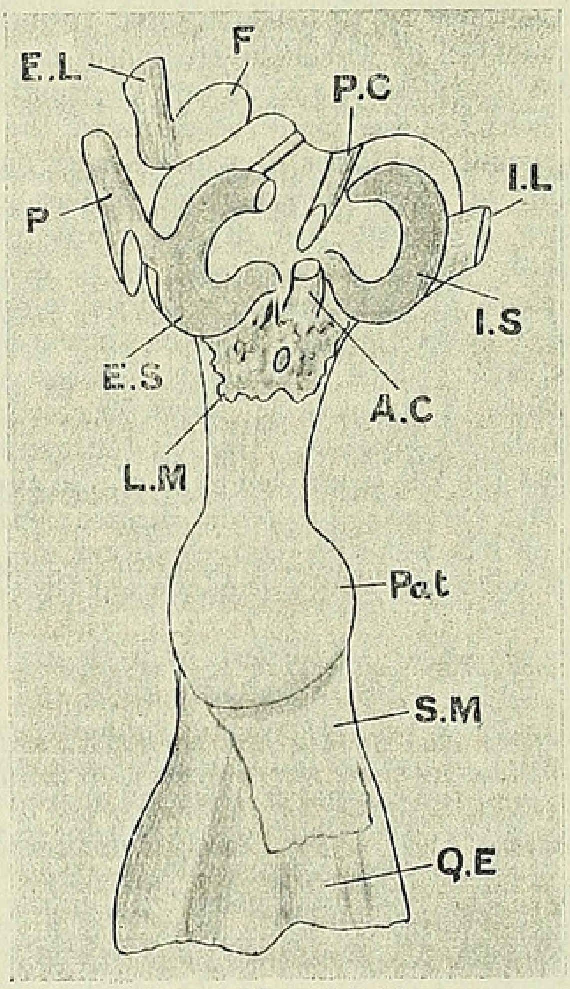
The *Sacro-iliac joint* consists of a crescentic articular surface on the sacrum and ilium, with the concavity forward, *i. e.* towards the head. In front of this articular surface the bones are very rough for a considerable area and are bound together by very powerful sacro-iliac ligaments. There is a distinct synovial cavity between the cartilage-covered surfaces, so that the joint cannot be described as a synchondrosis. Considerable gliding movement is allowed by which the crescentic surface of the ilium describes a small segment of a circle over the similar surface of the sacrum, the centre of the circle being about the middle of the sacro-iliac ligament, the fibres of which are lax enough to allow a certain amount of play. The mobility of this joint is no doubt connected with the great size of the psoas parvus ventrally and the erector spinæ dorsally, and is an adaptation to the Kangaroo's mode of progression. Before taking its leap the animal probably flexes the pelvis on the sacrum by means of the psoas parvus, after which it suddenly straightens its back and extends the pelvis by means of the powerful erector spinæ, in this way assisting the leg-muscles in taking the spring. It is worth mentioning that the left sacro-iliac joint of the animal I dissected was affected with extensive tubercular disease; Mr. Bland Sutton tells me that he has met with this condition on more than one occasion, and considers that it is connected with the mobility of the joint.

The *Pubic symphysis* is formed by a strong cartilage which connects the pubic bones of opposite sides and has no synovial cavity. At the posterior part of the joint the cartilage divides like an inverted Y to include the triangular subpubic bone.

In the *Hip-joint* the capsule is attached above to the margin of the great trochanter, the whole upper margin of the neck of the femur being covered by articular cartilage. Below it is attached to the margin of the head and neck. Anteriorly much more of the neck is included in the capsule than posteriorly. The ilio-femoral band is present, but the thickest part of the capsule is the upper and back, which is doubtless an adaptation to the usual position of the joint in the Kangaroo, a position of extreme flexion and external rotation. The cotyloid ligament is much thicker posteriorly than elsewhere; it is continued into a triangular transverse ligament across the very deep cotyloid notch. The ligamentum teres is a very strong fibrous band, which, in the usual position of the joint, passes upward and outward to the head of the femur and takes the greater part of the strain of the joint; above it is a synovial fold containing fat.

The *Knee-joint*, like the hip, is never fully extended, the capsule is strengthened by strong lateral ligaments; the external lateral runs downward and backward from the external condyle to the front of the head of the fibula; its anterior fibres are continuous with the origin of the extensor longus digitorum. The popliteus also performs the function of an external lateral ligament, since it is attached above to the femur and fabella, and below to the external semilunar cartilage and the head of the fibula. During extreme flexion, which is the usual position of the joint, the

Fig. 4.

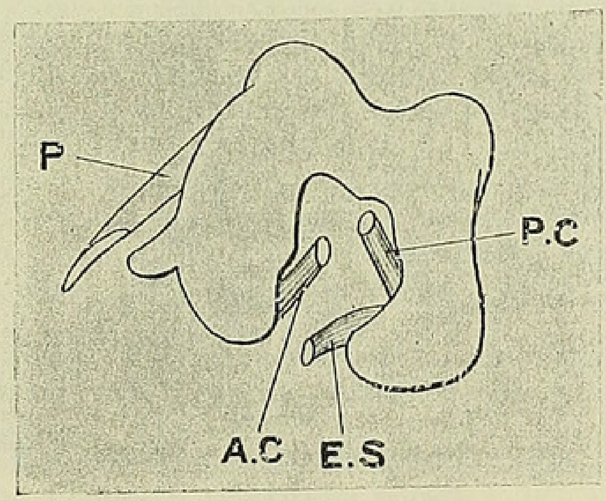


Knee-joint of *Petrogale* laid open.

Pat. Patella.
F. Head of fibula.
Q.E. Quadriceps.
S.M. Synovial membrane.
L.M. Ligamentum mucosum.
A.C. Anterior crucial ligament.
P.C. Posterior crucial ligament.
P. Popliteus tendon.
E.S. External semilunar cartilage.
I.S. Internal do.
E.L. External lateral ligament.
I.L. Internal do.

fabella articulates with the head of the fibula. The internal lateral ligament extends down the inner side of the head of the tibia for about an inch below the level of the joint; its anterior fibres are attached highest and its posterior lowest. The two crucial ligaments are strong and have the usual attachments. The external semilunar cartilage is attached anteriorly to the tibia just behind the anterior crucial; posteriorly it turns up to be attached to the posterior part of the external surface of the internal condyle some way behind the attachment of the posterior crucial ligament. Externally the popliteus tendon is connected to the convex margin of the cartilage. Besides the above-named posterior attachment of the external semilunar cartilage there is a narrow band which binds it feebly to the posterior margin of the head of the tibia. The synovial membrane of the joint is continued upward under the quadriceps tendon for about half an inch above the top of the articular cartilage of the trochlea. The ligamentum mucosum is well marked and contains a pad of fat in its lower part; above it is continued up as a narrow tube of synovial membrane to the posterior margin of the trochlea. The internal semilunar cartilage is attached anteriorly nearly opposite the external, posteriorly it is fixed to the tibia in front of the posterior crucial ligament.

Fig. 5.



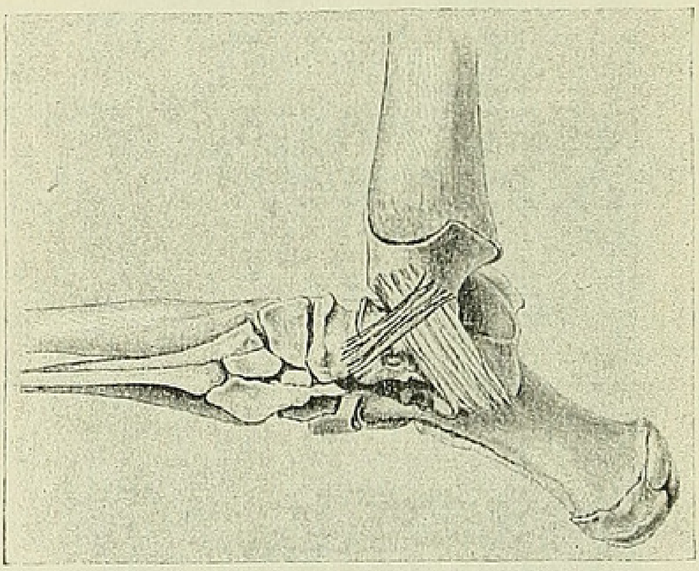
Lower end of femur of *Petrogale*, with ligaments attached.

(Same lettering as fig. 4.)

The *Tibio-fibular Articulations*.—The lower half of the fibula has a concave surface where it is in contact with the tibia and is bound to that bone by fairly strong interosseous ligaments. The upper half of the fibula allows the head to glide backward and forward on the external tuberosity of the tibia for about $\frac{1}{4}$ inch. During internal rotation of the leg on the thigh the head of the fibula is pressed back by the external condyle of the femur and forms a spring-like buffer to check that movement. The superior tibio-fibular joint has anterior and posterior ligaments; its synovial cavity is in direct communication with the knee-joint.

The *Ankle-joint* has feeble anterior and posterior as well as strong lateral ligaments. The internal lateral consists of a superficial and a deep portion; the former is a narrow flat band which passes from the back of the internal malleolus downward and forward to the navicular; the deep is much broader and stronger and runs downward and backward from the anterior part of the side of the malleolus to the sustentaculum tali, forming an **X** with the superficial part. The external lateral ligament consists of three bundles—superficial, middle, and deep; the superficial passes from the back of the external malleolus to the outer side of the calcaneum just behind the articulation with the cuboid; the middle is thicker and stronger, and runs downward and backward from the anterior part of the malleolus to the prominent tuberosity on the outer side of the calcaneum, crossing the superficial bundle to form an **X**; the deep band runs almost directly backward from the posterior part of the malleolus to the outer side of the astragalus.

Fig. 6.



Ankle-joint of *Petrogale*, from the inner side.

In the *Foot* there are two calcaneo-cuboid ligaments, the outer of which is very strong and runs from the under surface of the calcaneum to the cuboid and on to the bases of the fourth and fifth metatarsals. The inner is much smaller and passes from the sustentaculum tali to the bases of the second and third metatarsals and slightly to the cuboid. As the inner longitudinal arch of the Kangaroo's foot is not developed, the calcaneo-navicular ligament is not very strong. The mechanism of the Kangaroo's foot is interesting, and I hope to deal with it more fully in a subsequent paper.

The Muscular System.

Muscles of the Head and Neck.

The *Temporal* has the usual attachments; it rises as far back as the occipital curved line and as far forwards as the level of the postorbital process of the zygoma; the two muscles of opposite sides do not meet in the middle line of the head.

The *Masseter* is divisible into anterior and posterior portions; the former, which corresponds to the anterior superficial part of Rodents, rises by tendon from the projecting zygomatic process of the maxilla and is chiefly inserted into the inflected angle of the mandible; it is not very satisfactorily separated from the posterior part, which shows signs of being divided into a postero-superficial and a postero-deep portion by a layer of tendon.

The *Internal Pterygoid* is very large while the external is quite small.

The *Sterno-mastoid* runs from the front of the presternum to the paramastoid process.

The *Cleido-mastoid* rises from the middle of the clavicle and is inserted just behind the last, with which it is unconnected; it is pierced by the spinal accessory nerve.

The *Sterno-hyoid* and *Thyroid* are normal; the latter has a tendinous intersection about its middle.

The *Omo-hyoid* is a flat ribbon-like muscle which has the usual attachments to the scapular and hyoid bone; it, as well as the last two muscles, are supplied by branches from the 1st and 2nd cervical nerves direct, instead of through the medium of the hypoglossal. There is no central tendon.

The *Digastric* rises from the tip of the paroccipital process and is inserted into the mandible midway between the angle and the symphysis. There is no distinct tendon, but a small fibrous patch exists above and below, about the middle. It has the usual double nerve-supply.

The *Stylo-glossus* is the only styloid muscle which is well marked; it rises from a tubercle on the anterior border of the paroccipital process.

The *Mylo-hyoid* extends almost as far forward as the symphysis. There is no *Transverse mandibular* muscle.

The *Hyo-glossus* rises from the hyoid bone and from the raphe in front of it; it lies deep to the *genio-hyoid*, but superficial to the *genio-hyo-glossus*.

The *Acromio-trachelian* rises from the 1st, 2nd, 3rd, and 4th cervical transverse processes, and is inserted into the acromion and outer third of the spine of the scapula; it is entirely covered by the trapezius, into which some of its superficial fibres are inserted. Macalister[1] says that it rises from the first three cervical vertebræ in Bennett's Wallaby, and from the first two in the Great Kangaroo.

[1] Ann. & Mag. Nat. Hist. ser. 4, v. p. 154 (1870).

There is no *Scalenus anticus* ventral to the subclavian artery and brachial plexus.

The *Scalenus brevis* rises from the posterior two or three cervical transverse processes and is inserted into the first rib behind the vessels.

The *Scalenus longus* rises with the last and is inserted into the outer surfaces of the 2nd, 3rd, and 4th ribs.

The *Rectus capitis anticus major* rises from the 3rd to the 7th cervical transverse processes as well as, by an internal origin, from the bodies of the anterior four thoracic vertebræ. Its insertion is normal. On the outer side of the last muscle, separated by it from the longus colli, is a muscle which rises from the ventral part of the posterior four cervical transverse processes to be inserted into the body of the axis and the ventral arch of the atlas.

The *Longus colli* is normal, and extends as far back as the 4th thoracic vertebra.

The *Rectus capitis anticus minor* and *lateralis* are normal; the former comes from the transverse process of the atlas, lying external to the major, and ventral to the rectus lateralis.

The *Splenius capitis* is normal and entirely covers the complexus.

The *Splenius colli* is continuous with the last, and is inserted into the transverse processes of the anterior three cervical vertebræ.

The *Trachelo-mastoid* is very well developed; it is inserted into the outer part of the curved line of the occipital bone, into the paramastoid process, and into the transverse processes of the anterior cervical vertebræ. Its insertion is tendinous, and there are two other tendinous intersections further back.

The *Transversalis colli* is large and is inserted into the posterior five cervical transverse processes.

The *Cervicalis ascendens* is inserted into the last three cervical transverse processes.

The *Rectus capitis posticus major* is distinctly bilaminar, a condition I have also found in the Guinea-pig [1].

Muscles of the Anterior Extremity.

The *Trapezius* rises, as in the Great Kangaroo and Bennett's Wallaby, from the ligamentum nuchæ and anterior six thoracic spines; it has a continuous fleshy origin except opposite the first thoracic spine, where it is aponeurotic. It is inserted into the clavicle as far as the origin of the cleido-mastoid, into the acromion, the spine of the scapula, and the fascia over the infraspinatus.

The *Latissimus dorsi* rises from the 5th, 6th, 7th, and 8th

[1] Proceedings of the Anatomical Society, February 1892, p. x.

thoracic spines, and from the 9th, 10th, and 11th ribs. The most anterior fibres are connected with those of the trapezius over the infraspinatus, becoming gradually lost in the aponeurosis; the more posterior fibres wrap round the teres major, as in Man, to be inserted into the humerus.

The *Dorso-epitrochlearis* is small, and does not quite reach the olecranon.

The *Rhomboid* muscles are in one continuous layer; they rise from the ligamentum nuchæ close to the skull, as far back as the 3rd thoracic spine. They are inserted as in Man. Macalister[1] describes a rhomboideus capitis in the Great Kangaroo, as well as in Bennett's Wallaby.

The *Levator anguli scapulæ* and *Serratus magnus* are, as usual, in one layer, which rises from all the cervical transverse processes and from the anterior seven ribs. The slip which rises from the transverse process of the atlas is inserted into the inner third of the spine of the scapula; the rest of the muscle goes to the vertebral border of that bone.

The *Pectoral* mass is divided into four distinct parts: (α) the superficial part rises from the whole length of the sternum and from the inner part of the clavicle, it is inserted into the middle of the humerus with the deltoid; (β) rises from the 2nd and 3rd costal cartilages, and is inserted into the upper part of the pectoral ridge; (γ) comes from the first cartilage, and is inserted just above the last, it is supplied entirely by the internal anterior thoracic nerve; (δ) is the pectoralis quartus, and comes from the linea alba to be inserted with the ventral panniculus just below γ.

Possibly β and γ correspond to the human pectoralis minor.

The *Subclavius* is large, has the usual origin, and is inserted into the whole length of the posterior border of the clavicle.

The *Deltoid* has the three constituent parts—clavicular, acromial, and spinous—fused as in Man; the insertion is into the humerus above the middle. The circumflex nerve supplies the whole of the muscle.

The *Supraspinatus* is smaller than the infraspinatus, as in Bennett's Wallaby. In the Great Kangaroo the two muscles are equal, according to Macalister.

The *Teres minor* is easily separable from the infraspinatus, as it is in the Wallaby, but not in the Great Kangaroo.

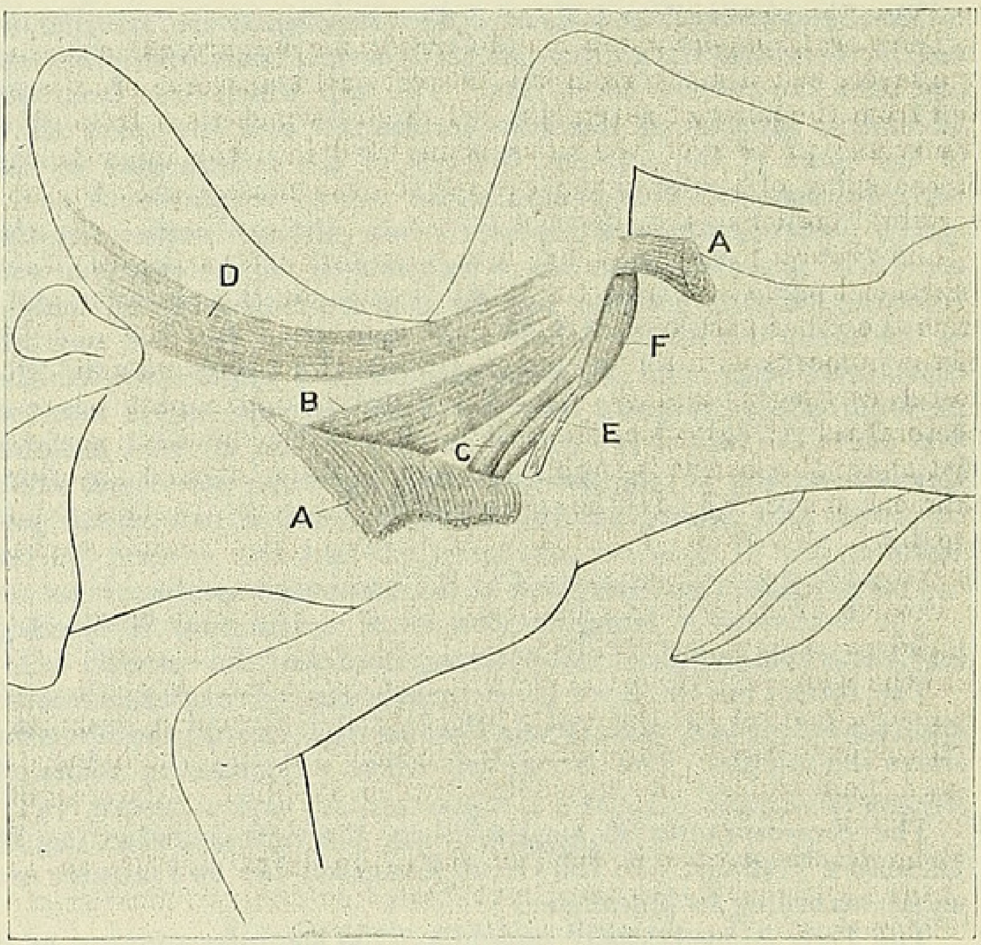
The *Teres major* is normal; its lower border is wrapped round by the latissimus dorsi tendon.

The *Coraco-brachialis*, as in all the Kangaroos, consists solely of the rotator humeri. Meckel says that the muscle is entirely absent in these animals, but the rotator humeri, if not specially looked for, is very easily missed. According to Macalister the rotator humeri is divided into two slips in *Macropus ruficollis*.

[1] *Op. cit.*

The *Biceps* has one broad head, which rises continuously from the coracoid and the top of the shoulder-joint; it is entirely outside the capsule of the shoulder. The innermost fibres, those coming from the coracoid, are inserted into the tubercle of the radius, the others pass to the ulna. Macalister describes two separate heads, coraco-radial and gleno-ulnar, in the Great Kangaroo and Bennett's Wallaby. Meckel's account of the muscle in the Great Kangaroo seems to correspond with my own.

Fig. 7.



Pectoral muscles of *Petrogale*.

A. Superficial part of pectoral.
B & C. Deeper parts of pectoral.
D. Pectoralis quartus.
E. Subclavius.
F. Deltoid.

The *Brachialis anticus* consists of two parts: the outer comes from behind the surgical neck of the humerus and from the outer part of that bone; the inner, which is small, rises from the lower third of the anterior border. The two heads unite to be inserted into the ulna with the deep part of the biceps.

The *Triceps* is large and has the human attachments.

The *Anconeus* and *Epitrochleo-anconeus* are well marked and normal.

The *Pronator radii teres* has only the condylar head, which is inserted just above the middle of the radius.

The *Flexor carpi radialis* is normal.

The *Palmaris longus* is large and ends in the palmar fascia, from the inner side of which a muscle rises, ending in tendons for the proximal and distal phalanges of the little finger; this I regard as the abductor minimi digiti.

The *Flexor carpi ulnaris* rises from the internal condyle and from the posterior border of the ulna; but there is no distinct head from the olecranon; the absence of this is also noticed by Macalister in the Great Kangaroo and Bennett's Wallaby. The tendon is inserted into the pisiform bone, over which a sesamoid cartilage is situated.

The *Flexor sublimis digitorum* is small, and rises from the surface of the flexor profundus; it quickly divides into three small muscular bellies, the tendons of which pass to the index, medius, and annularis. The descriptions of Meckel and Macalister agree with this, except that they found tendons to all the fingers.

The *Flexor profundus digitorum* rises from the internal condyle, from the flexor surfaces of the radius and ulna in their upper halves, from the inner side of the ulna, and from the olecranon process. The mass divides into five strong tendons for the thumb and fingers.

The *Lumbricales* are arranged as in Man, except that the one between the annularis and minimus tendons is wanting. This description differs from the one given by Young [1]. He describes four lumbricales in *Petrogale*, one of which is furnished to the thumb.

The *Pronator quadratus* is very thick, and occupies the lower two-thirds of the forearm.

The *Supinator longus* is inserted into the dorsum of the scaphoid. Macalister describes it as being inserted into the first metacarpal in the Wallaby, and into the trapezium and first metacarpal in the Great Kangaroo. Meckel also states that it is present in the Kangaroo.

The *Extensores carpi radialis longior et brevior* were present and normal. Macalister says that they form a single muscle, which is inserted into the 2nd and 3rd metacarpals. I have so often seen this description of these muscles by different authors in various animals, and, on trying to verify it, have always found the two muscles separate, though closely adherent, that I cannot help suspecting that they are normally separate in the Kangaroos.

The *Extensor communis digitorum* is normal, and goes to the four outer fingers.

[1] "Intrinsic Muscles of the Mammalian Hand," Journ. Anat. vol. xiv. p. 156.

The *Extensor minimi digiti* goes to the minimus and slightly to the annularis.

The *Extensor carpi ulnaris* has the usual human attachments.

The *Supinator brevis* consists of only one layer, which is superficial to the posterior interosseous nerve; its tendon forms the external lateral ligament of the elbow, and has an orbicular ligament attached to it. It is inserted into the upper quarter of the radius.

The *Extensor ossis metacarpi pollicis* rises from the ulna as high as the lower margin of the lesser sigmoid cavity, also slightly from the radius. It has the usual insertion.

There is no *Extensor primi internodii pollicis*.

The *Extensor secundi internodii* and *Extensor indicis* form one muscle, which sends tendons to the pollex, index, and medius.

The *Palmaris brevis* is large.

The *Abductor* and *Flexor brevis pollicis* are small and united.

There is no *Opponens pollicis*.

The *Abductor minimi digiti* has already been described with the palmaris longus.

The *Flexor brevis* and *Opponens* of the little finger are present, and rise from the pisiform bone and the sesamoid cartilage over it.

The *Intrinsic muscles* of the hand are arranged in three layers, as described by Cunningham and Young. The superficial and deep layers correspond to Young's description of *Petrogale*, but the intermediate layer has more muscles in it.

Muscles of the Trunk.

The *Serratus posticus* is only represented by the anterior portion, corresponding to the serratus posticus superior of human anatomy; it is well developed, and is inserted into the anterior ribs from the third to the ninth.

The *Erector spinæ* is very strongly developed, but presents nothing unusual.

The *External oblique* rises from the third to the thirteenth ribs; the marsupial bones are developed in it, while the external abdominal ring lies on the outer side of the middle of the marsupial bones. There are three tendinous intersections—one between the 11th and 12th ribs, one between the 12th and 13th, and one below the 13th.

The *Internal oblique* is inserted into the last three ribs; dorsal to the lateral line of the body it is fleshy, while ventrally it becomes aponeurotic and blends with the transversalis.

The *Transversalis* rises from the lower six ribs as well as the lumbar fascia and iliac crest. In the anterior two-thirds of the abdomen it passes deep to the rectus; in the posterior third it splits to enclose that muscle.

The *Rectus abdominis* rises from the body, crest, and pectineal line of the pubes behind the marsupial bone. It is inserted into the first rib by a very short flat tendon, as well as by its inner border into the cartilages of the second, third, and fourth ribs. It has a few indistinct intersections.

The *Pyramidalis* rises from the inner side and tip of the marsupial bone, and from the fascia over the lower part of the rectus. About midway between the pubes and xiphoid it blends with the linea alba.

The *Supracostalis* rises from the sternal ends of the cartilages of the 3rd, 4th, and 5th ribs, and is inserted into the first rib just external to the attachment of the rectus. It is well marked, and continues the plane of the external oblique, lying between the rectus and the pectoral.

The *Quadratus lumborum* is present, but is extremely difficult to separate from the erector spinæ.

The *Psoas parvus* is very large, and rises from the bodies of all the lumbar vertebræ except the last; it is inserted into the prominent ilio-pectineal eminence.

The *Psoas magnus* is smaller than the last, and rises from the transverse process and side of the body of the last lumbar vertebra, as well as from the anterior part of the sacrum; it joins the iliacus to form a very broad ilio-psoas, which is inserted into the flat lesser trochanter.

Muscles of the Tail.

These muscles are by no means easy to distinguish one from the other, but the following seems the most satisfactory division.

The *Extensor caudæ externus* rises from the accessory processes of all the lumbar vertebræ, from the sacrum, and from the caudal vertebræ nearly as far as the middle of the tail. The tendons, which are very long, are inserted into the transverse processes of the caudal vertebræ, those which rise most anteriorly being inserted first. Meckel[1] describes this muscle as being distinctly divided into two in the Kangaroo, but I was unable to make out the division satisfactorily.

The *Extensor caudæ internus* is fleshy, and rises from the spines of the sacral and caudal vertebræ; short tendons pass to the transverse processes of the vertebræ close behind.

The *Abductor caudæ externus* rises from the ischium, and is inserted into the transverse processes of the 5th, 6th, and 7th caudal vertebræ.

The *Abductor caudæ internus* is simply a continuation of the intertransversales muscles.

The *Flexor caudæ externus* comes from the ventral surface of the sacrum and tail, and is inserted into the ventral surface of the transverse processes by long tendons, which are arranged in the same manner that was noticed in *Sphingurus*[2]—that is to say the most superficial tendons are first inserted, and the deeper ones reach the surface round the inner side of these.

[1] 'Anatomie comparée,' vol. vi. p. 177.
[2] "Myology of Rodents," P. Z. S. 1894, p. 279.

The *Flexor caudæ internus* is inserted by long tendons into the ventral surface of the roots of the transverse processes, the most internal tendons being first inserted, while the deeper ones reach the surface round the outer side of them.

The *Flexor caudæ profundus* is fleshy, and runs along the ventral surface of the tail close to the middle line, being concealed by the last muscle and separated by a nerve from the flexor caudæ externus.

Muscles of the Posterior Extremity.

The *Gluteus maximus* or *Ectogluteus* is a small thin sheet of muscle rising from the sacral spines and fusing anteriorly with the sacro-lumbalis. It is inserted just below the great trochanter.

The *Gluteus medius* is much larger than the last, and rises from the greater part of the gluteal surface of the ilium by two perfectly distinct layers, of which the superficial is inserted by flesh and the deep by tendon into the outer side of the great trochanter.

The *Gluteus minimus* is small, and is covered by the medius; it is inserted by tendon into the front of the great trochanter.

The *Gluteus quartus* or *Scansorius* is very distinct and comes from the ventral border of the ilium; it is inserted into the anterior surface of the femur just below the great trochanter.

The *Tensor fasciæ femoris* and *Sartorius* are inseparable, the latter part being feebly marked; they rise from the anterior ventral spine of the ilium and are inserted into the fascia of the thigh nearly as far as the patella. This sheet of muscle is supplied entirely by the anterior crural nerve.

The *Pyriformis* is well marked and normal.

The *Obturator internus* is normal; on its deep surface the tendon is divided into three bands.

The *Gemelli* are represented by one continuous muscle, which rises from the ventral margin of the lesser sciatic notch; it is best seen when the obturator internus is cut and reflected. Meckel[1] states that these muscles are absent in the Kangaroo.

The *Quadratus femoris* is a large triangular muscle, which is inserted by tendon into the second quarter of the femur.

The *Obturator externus* is large and normal.

The *Biceps* consists of two parts, though I am doubtful whether the part described first should not rather be included with the gluteus maximus. The anterior portion rises from the posterior sacral and anterior caudal spines and transverse processes; it is inserted by a narrow tendon into the outer side of the patella. The posterior part is large and rises from the ischial tuberosity as well as by a small origin from the caudal vertebræ; it is inserted into the fascia of the upper half of the leg.

The *Semitendinosus* rises from the tuber ischii with the biceps, and is inserted into the cnemial crest of the tibia.

The *Semimembranosus* is a small muscle; it rises from the tuber

[1] 'Anatomie comparée,' vol. vi. p. 364.

ischii and is inserted into the internal tuberosity of the tibia, deep to the internal lateral ligament of the knee. Meckel says that it is more or less fused with the semitendinosus.

The *Rectus femoris* rises from the ventral border of the ilium and from the posterior ventral spine by two distinct heads ; there is no origin from the usual place in front of the acetabulum.

Macalister found only one head in the Great Kangaroo and Bennett's Wallaby.

The *Vastus externus* is a large muscle and rises from the great trochanter by two heads, which embrace the insertion of the gluteus quartus.

The *Vastus internus* and *Crureus* are small and normal.

The *Gracilis* comes from the whole length of the symphysis and from the subpubic arch, nearly as far as the tuberosity; it is inserted into the cnemial crest above the semitendinosus.

Macalister found it rising from the marsupial bone, a condition which he regards as normal in all Marsupials.

The *Pectineus* is normal.

The *Adductor longus* is represented by a small muscle, which rises from the outer part of the base of the marsupial bone; it is inserted into the second quarter of the femur and is separated from the rest of the adductor mass by a branch of the obturator nerve.

The *Adductores magnus et brevis* form one large mass which cannot be satisfactorily separated. The femoral artery pierces it, but the part of the muscle which lies superficial to the artery, and which corresponds to the supracondylar slip of many mammals, cannot be separated from the rest. According to Macalister the adductor magnus can easily be separated from the brevis in the Great Kangaroo and Bennett's Wallaby.

The *Ischio-femoral* muscle lies behind the adductors and is quite distinct from them ; it rises from the whole length of the tuberosity and ramus of the ischium, and is inserted by a triangular tendon into the middle of the back of the femur. It is supplied by the nerve to the hamstrings.

The *Tibialis anticus* comes from the upper quarter of the external surface of the tibia and is inserted into the entocuneiform by a single tendon. In the Great Kangaroo, Macalister found it inserted into the two inner metatarsal bones.

The *Extensor proprius hallucis* rises from the outer tuberosity of the tibia by a small fusiform belly ending in a long tendon, which runs to the inner two of the four toes. This is another instance of the much greater persistence of the extensor tendon of the hallux than of the hallux itself; it is curious, however, that it should have transferred its attachments to the next two toes, and reminds one somewhat of the arrangement of the extensor indicis in the anterior extremity. It should, moreover, be borne in mind that the latter muscle is often one with the extensor secundi internodii pollicis.

The *Extensor longus digitorum* comes from the front of the head and upper third of the fibula, a strong tendon continues this origin up to the external condyle of the femur; but, as the muscle has contracted attachments similar to those found in Man to the fibula, the upper tendinous part of its origin takes on the function of a ligament. The muscle is inserted in the usual manner into the two outer toes.

The *Peroneus longus* rises from the head and upper quarter of the fibula, as well as from the ligament already mentioned, belonging to the extensor longus digitorum. It is inserted into the entocuneiform.

The *Peroneus brevis* is absent. Macalister, however, found it in the Great Kangaroo and Bennett's Wallaby.

The *Peroneus quarti digiti* is very small and runs from the second quarter of the fibula to the great fourth toe.

The *Peroneus quinti digiti* equals the peroneus longus in size; it rises from the upper third of the fibula and runs to the outermost toe. All three peroneals pass through the same synovial sheath and groove on the back of the external malleolus.

The *Gastrocnemius* has the usual two heads, the outer of which has three origins: (1) a small head from the outer side of the patella; (2) larger, from the same place, and separated from the last by the external popliteal nerve; (3) from the large fabella over the external condyle and from the external semilunar cartilage. The inner head is normal in origin and has no fabella developed in it.

The *Soleus* is absent, unless the origin of the gastrocnemius from the semilunar cartilage represents it. Meckel also describes it as wanting.

Macalister found the fibular head in the Great Kangaroo and Bennett's Wallaby.

The *Plantaris* comes from the external fabella and the back of the external condyle; it soon forms a tendon which passes round the tuberosity of the calcaneum, after which it divides into a large internal and a small external portion. The small slip runs to the outer toe, is pierced by the flexor longus digitorum tendon, and is inserted into the outer side of the second phalanx. The large inner portion gives off a tendon from its outer side which is attached to both sides of the proximal phalanx of the outer toe, being perforated in its course by the last-named slip as well as by the tendon of the flexor longus digitorum to that toe. The main part of the inner portion goes to the proximal and distal phalanges of the great fourth toe.

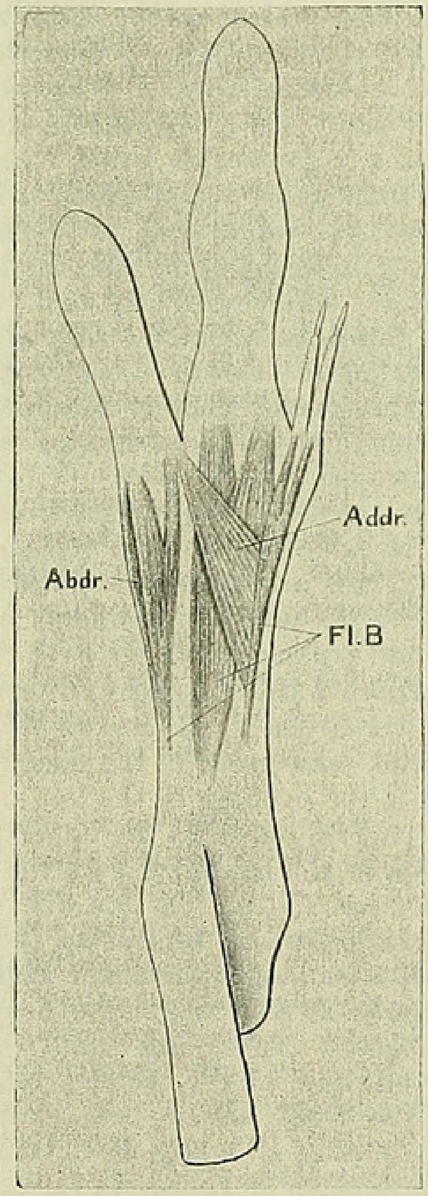
The *Flexor longus digitorum* (*Flexor tibialis*).—There is only one deep flexor at the back of the leg, which comes from about a third of the tibia and fibula below the popliteus. In the sole it divides into three tendons, of which the innermost again subdivides for the two small inner toes. There are only two *Lumbricales*.

The *Popliteus* rises from the external condyle, partly from in front of the groove and partly from the groove itself, which is deep and narrow, and not adapted for the tendon to lie in. The muscle also has an origin from the external semilunar cartilage and from the head of the fibula. There is the usual insertion into the upper part of the inner border of the tibia.

The *Rotator fibulæ* lies deep to the last, with which it is partially blended; it rises from the posterior surface of the tibia in its upper part, and is inserted into rather less of the back of the fibula. Its fibres run obliquely upwards and outwards.

Muscles of the Sole.—There is no muscular *flexor brevis digitorum* or *accesorius*. The intrinsic muscles form three layers, the first of

Fig. 8.



Muscles of the Sole of *Petrogale*.

Abdr. Abductor minimi digiti. | Fl.B. Flexores breves.
Addr. Adductor do.

which consists of one adductor, which rises from the third metatarsal bone and runs to the proximal phalanx of the fifth toe. The middle layer consists of three double-headed flexores breves, the innermost serving for the two small inner toes. The deep layer contains two abductor muscles, one to the fourth, the other to the fifth toe.

The Vascular System.

The *Heart* in *Petrogale* agrees in most respects with Owen's description of the organ in the Great Kangaroo[1]; I propose, however, to describe it a little more in detail. On opening the right ventricle the ventral wall is seen to be covered by columnæ carneæ of the second and third kinds; these are so broad and numerous that the wall presents quite a smooth appearance, the intervals between the columnæ appearing as small rounded pits. There are no musculi papillares or chordæ tendineæ attached to this wall, nor is there any moderator band. The right auriculo-ventricular valve has four cusps, one of which is much larger than the rest and lies against the septal wall, to which its free edge is connected by a large number of short chordæ tendineæ without any musculi papillares. There are only two (Owen says three) musculi papillares in the right ventricle; they are attached to the septal wall, the larger about halfway down, the smaller dorsally and above. Each of these sends chordæ tendineæ to two cusps, and in this way the three anterior segments of the right auriculo-ventricular valve are stayed.

In the left ventricle the auriculo-ventricular or mitral valve has only two cusps, one of which is close to the aortic opening, the other away from it. There are numerous chordæ tendineæ which spring from several large musculi papillares arranged in two groups. The aortic and pulmonary valves have the normal human arrangement, the corpora Arantii being well marked. The right auricle is elongated transversely, at its right extremity is the opening of the posterior vena cava; in the dorsal wall close to this and a little to the left is the opening of the left anterior vena cava. The right anterior vena cava opens on the upper part of the dorsal wall about the junction of the left third with the right two-thirds. At the left extremity of the auricle are the openings of two appendages, one of which projects ventral to the aorta, the other dorsal. Owen describes the right auricular appendage as being notched, but in *Petrogale* the notching is so deep that there are two distinct appendages. There are many and well-marked musculi pectinati in the right auricle, which are best developed on the ventral wall. The right auricle, as Owen points out, is remarkable for the absence of all traces of fœtal structures; there are no signs of the Eustachian or Thebesian valves, nor is there any indication of the fossa or annulus ovalis. The left auricle has musculi pectinati only in the appendage, which is large and forms a great part of the cavity. Owen describes it as being notched, but this I failed to make out. The two pulmonary veins open close together into the dorsal wall.

[1] 'Anatomy of Vertebrates,' vol. iii. p. 517.

The *Thyroid body* consists of two separate oval lobes about $\frac{3}{4}$ inch long, lying one on each side of the trachea without any isthmus connecting them.

The *Arch of the Aorta* has only two branches, the innominate and the left subclavian; the former gives off the right subclavian, soon after which it divides into right and left carotids.

The *Subclavian arteries* pursue a normal course and give off vertebral, internal mammary, and transverse cervical branches, but no inferior thyroid or superior intercostal were seen. The *common Carotid* gives off the superior thyroid and, at the anterior margin of the larynx, divides into external and internal carotids, the former giving off lingual, facial, and occipital branches, and ending almost entirely in the internal maxillary, the temporal being very small. The superior laryngeal branch comes off from the lingual.

The *Axillary artery* gives off well-marked thoracic, subscapular, and circumflex branches. The *Brachial* gives off a small superior profunda which accompanies the musculo-spiral nerve, as well as a large nutrient branch to the humerus. About the middle of the arm, at the place where the median nerve is finally formed, a superficial branch comes off, which possibly represents the inferior profunda though it does not accompany the ulnar nerve. The brachial artery then passes through the supra-condylar foramen, after which it gives off some muscular branches and soon divides into posterior interosseous and median.

The *posterior Interosseous* passes to the back of the forearm between the two bones, giving off a large posterior interosseous recurrent branch; while the *median* accompanies its nerve into the palm of the hand, where it divides into four digital branches for the clefts between the digits. There is no radial or ulnar artery and no deep palmar arch. Owen[1] describes the artery which I have called median as the ulnar, and says that there is also a radial artery.

The *Thoracic aorta* shows nothing worthy of special notice.

The *Abdominal aorta* gives off the cæliac, mesenteric, and two renal arteries close together, just behind the opening in the diaphragm. Of the two renals the right is a little in front of the left. There is no posterior mesenteric artery, a condition which Owen has noticed in all Marsupials. The aorta trifurcates opposite the disc between the fifth and sixth lumbar vertebræ into the caudal and two external iliacs. The internal iliacs are given off from the caudal opposite the posterior part of the sixth lumbar vertebra, as has been pointed out by Owen.

The *External Iliac* gives off a large ilio-lumbar branch, and, just before reaching the brim of the pelvis, a common trunk, which divides into obturator and deep epigastric.

The *Common Femoral* soon after its commencement gives off an external circumflex branch, which runs outward between the super-

[1] 'Anatomy of Vertebrates,' vol. iii. p. 541.

ficial and deep divisions of the anterior crural nerve. A little lower down an internal circumflex comes off, which divides into a large transverse and a small ascending branch. The femoral artery then continues down Hunter's canal, but no profunda femoris is given off. At the lower part of the canal it divides into two large branches, of which the anterior accompanies the internal saphenous nerve to the inner side of the leg. A little above the internal malleolus it divides into anterior and posterior, the former passing in front of the malleolus and deep to the tendon of the tibialis anticus, to supply the inner side of the dorsum of the foot, the latter supplying the sole of the foot, though no distinct external and internal plantar arteries are present. The posterior of the two branches of the femoral in Hunter's canal is the popliteal, this passes between the semimembranosus and the femur, and divides into superficial and deep. The superficial is a muscular branch to the calf-muscles and runs down between the gastrocnemius and plantaris. The deep passes deeply to the plantaris, pierces the interosseous membrane to become the anterior tibial, and runs down along the outer side of the tendon of the extensor longus digitorum to the dorsum of the foot, the outer side of which it supplies. As soon as it reaches the commencement of the dorsum it gives off a communicating branch which passes superficial to the extensor longus digitorum to join the anterior branch of the internal saphenous artery already mentioned.

The *Internal Iliac* artery divides into gluteal, pudic, and sciatic, of which the last is the largest.

The *Veins* correspond fairly accurately with the arteries, the chief points worthy of notice being the large size of the external jugular, the presence of two anterior and a single undivided posterior venæ cavæ, also of a single azygos vein, which lies on the right side and receives the intercostal veins from both sides of the thorax.

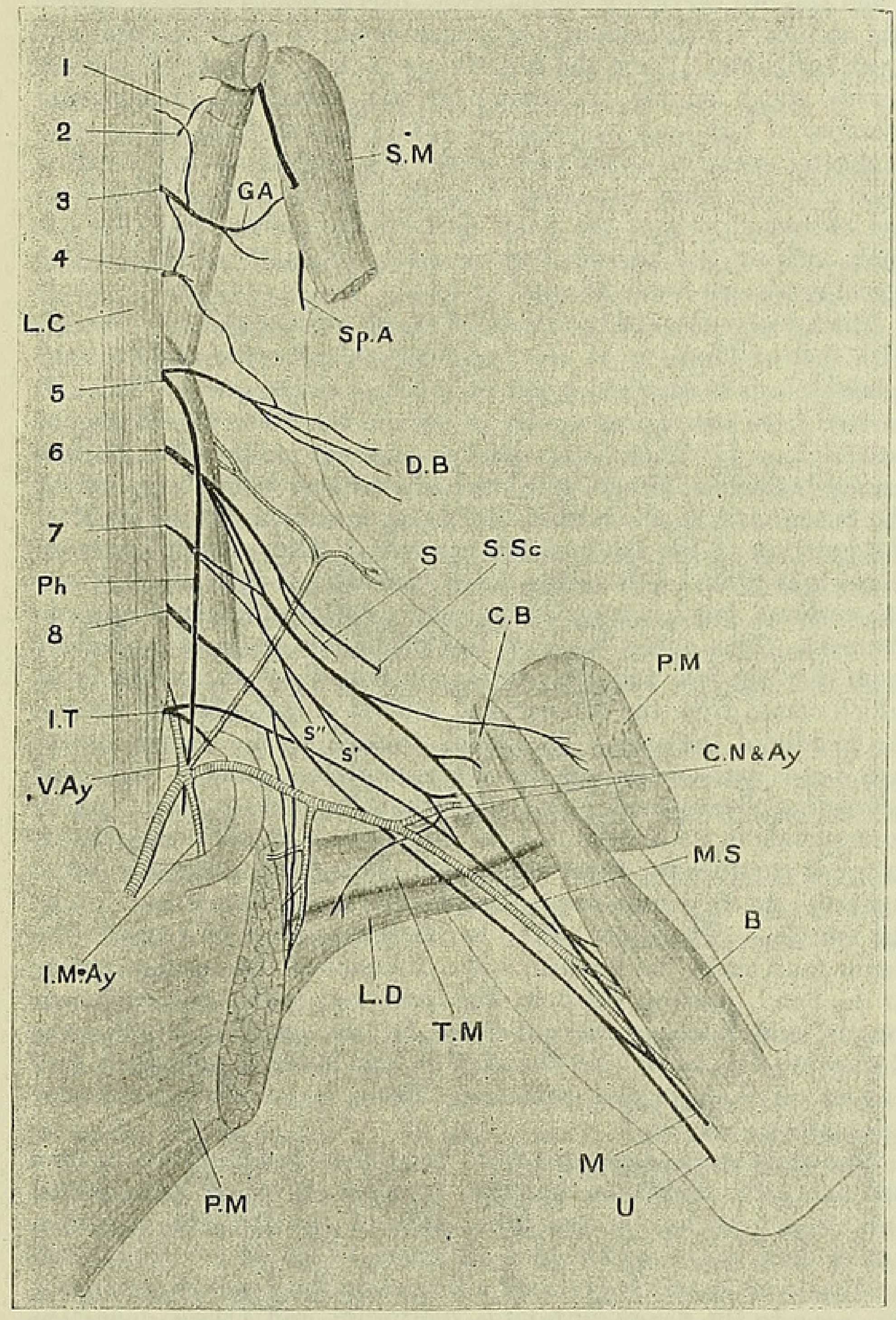
The Nervous System.

As the animal was not received in a perfectly fresh condition, I made no attempt to examine the brain and spinal cord.

The *Cranial Nerves* differ but slightly from those of Man: the chief points of divergence noticed are:—(1) That the seventh nerve only divides into three chief branches on the face; (2) that the depressor nerve is separate from the vagus and comes off from the superior laryngeal as in the Rabbit; (3) that the eleventh nerve pierces the cleido-mastoid after supplying the sterno-mastoid and then passes on to the trapezius; (4) that there is no descending branch from the hypoglossal corresponding to the descendens cervicis of human anatomy, but the omo-hyoid, sterno-hyoid, and sterno-thyroid are supplied by a well-marked nerve which comes off from the 1st and 2nd cervical and corresponds to the communicans cervicis.

The *Cervical Plexus* is formed by the first four cervical nerves; there is the usual loop on the ventral side of the transverse process

Fig. 9.



Cervical and Brachial plexuses of *Petrogale.*

S.M. Sterno-mastoid.
P.M. Pectoral muscle.
T.M. Teres major.
C.B. Coraco-brachialis.
L.C. Longus colli.
L.D. Latissimus dorsi.
B. Biceps.
G.A. Great auricular nerve.
Sp.A. Spinal accessory nerve.
D.B. Descending branches.
Ph. Phrenic.

S.Sc. Suprascapular nerve.
M. Median nerve.
S, S', S''. Subscapular nerves.
C.N & Ay. Circumflex nerve and artery.
M.S. Musculo-spiral nerve.
I.M.Ay. Internal mammary artery.
U. Ulnar nerve.
V.Ay. Vertebral artery.
I.T. 1st thoracic nerve.

of the atlas from which communicating branches are given off. From the 3rd cervical a single large nerve passes to the auricle and occiput, which evidently corresponds to the small occipital and great auricular. From the 3rd also come two superficial cervical nerves, which supply the skin over the anterior and posterior triangles of the neck respectively. The 4th cervical nerve communicates with the upper part of the 5th, and from the junction come off descending cutaneous branches to the skin of the arm and shoulder. From the deep part of the plexus branches are given off to the surrounding muscles, a small communicating spinal accessory coming from the 4th.

The arrangement of the *Brachial Plexus* corresponds very closely with that of Man; it is chiefly remarkable for the fact that the subscapularis is supplied by three separate twigs, one of which is derived from the suprascapular nerve and the other two from the posterior cord. There is no distinct musculo-cutaneous nerve, the coraco-brachialis, biceps, and brachialis anticus being supplied by the outer head of the median. The suprascapular comes off after the junction of the 5th and 6th cervicals. The external anterior thoracic is given off from the outer cord after the junction of the 7th cervical, but has no communication with the internal anterior thoracic. The outer head of the median is, as in Man, derived from the 5th, 6th, and 7th; it is not joined by the inner head, which comes from the 8th cervical and 1st dorsal, until it reaches the middle of the arm. The trunk formed by the union of the two heads passes through the supracondylar foramen and just below the elbow divides into two branches, the outer of which corresponds in its distribution to the human radial nerve, that is to say it supplies the three and a half outer fingers on their dorsal surfaces; in its course down the forearm it lies superficial to all the muscles. The inner of the two branches gives off twigs to the flexor muscles of the forearm and accompanies the median artery to the hand, passing deep to the pronator radii teres, palmaris longus, and flexor carpi radialis. In the hand it supplies the thenar muscles as well as the skin of the outer three and a half fingers on their palmar surfaces. There is no distinct anterior interosseous branch.

The ulnar nerve separates from the inner head of the median just above the middle of the arm; it at once gives off two internal cutaneous branches for the inner side of the forearm and then passes deep to the epitrochleo-anconeus, which it supplies. Immediately after this it gives off a branch to the flexor carpi ulnaris, but none to the flexor profundus digitorum, and passes down the forearm under cover of the flexor carpi ulnaris to the radial side of the pisiform bone, giving off, at the junction of the middle and lower thirds of the forearm, a dorsal cutaneous branch, which supplies the back of the inner one and a half fingers. At the pisiform the main stem of the ulnar divides into superficial and deep branches, the former supplying the skin of the ulnar one and a half fingers on their palmar surfaces, the latter passing between the layers of the adductors and flexores breves to supply these as well as the interosseous muscles.

The internal anterior thoracic nerve is not nearly as large as it is in animals with a better developed panniculus: it rises by two roots from the 8th cervical and 1st thoracic nerves respectively; these roots unite and supply the posterior and deep parts of the pectoral mass as well as the ventro-lateral panniculus.

The musculo-spiral nerve is formed by the union of two branches in front of the teres major muscle; the upper of these comes from the 5th, 6th, and 7th cervical, the lower from the union of the 8th cervical and 1st thoracic nerves. The musculo-spiral winds round the back of the humerus, giving off branches to the triceps and dorso-epitrochlearis as well as a descending branch to the anconeus, but no filament to the brachialis anticus or cutaneous twigs. In front of the external supracondylar ridge a branch to the supinator longus is given off, after which the nerve passes deep to the supinator brevis and supplies all the muscles of the back of the forearm, as well as a cutaneous branch to the skin of that region.

The circumflex nerve is given off from the upper branch of the musculo-spiral and so can only obtain fibres from the 5th, 6th, and 7th cervical nerves; it accompanies the circumflex artery through the quadrilateral space, giving off branches to the teres minor and shoulder-joint; it then gives off a large branch to the skin of the outer side of the arm and finally supplies the three parts of the deltoid.

The phrenic nerve comes from the junction of the 5th and 6th cervicals, and runs back ventral to the plexus and subclavian artery, to pursue its usual course through the thorax to the diaphragm.

The posterior thoracic nerve cannot be seen in the axilla until just before its distribution; it rises from the 4th and 5th cervicals, and runs back in the substance of the scalenus longus to the serratus magnus.

No intercosto-humeral nerve was seen.

In studying the foregoing nerves the arrangement of the radial is worthy of special attention, because it is opposed to the law laid down by Paterson in his most interesting paper on the limb plexuses of Mammals[1]. In that paper the following passage occurs:—"In the case of the fore limb the nerves of distribution are derived from the inferior primary divisions of the hinder cervical and first thoracic nerves. The nerves entering the plexus divide into ventral and dorsal parts, the ventral divisions of the nerves combining to form one set, the dorsal divisions combining to form another set of nerves of distribution. In no case do ventral divisions ever combine with dorsal divisions of adjacent nerves. In no case does a nerve of distribution derived in one animal from ventral divisions, in another spring from dorsal divisions and *vice versa*." The musculo-spiral is rightly described

[1] Journ. Anat. vol. xxi. p. 622.

by Paterson as derived from the dorsal divisions of the plexus, the median as derived from the ventral. In all the animals dissected by Paterson, and in all that I have hitherto dissected, the radial nerve came from the musculo-spiral; in this case, however, the radial rose on both sides from the median, although no connection between that nerve and the dorsal roots was observed in the plexus.

The arrangement of the *Lumbar Plexus* of the Rock-Kangaroo closely resembles that of the *Cuscus* described by Cunningham [1]; it is formed by the 2nd, 3rd, 4th, and a large part of the 5th lumbar nerves, the 1st lumbar being distributed to the abdominal walls.

The genito-crural nerve is very small and rises from the 2nd and 3rd lumbar, whence it runs down to supply the cremaster, no crural branch being seen.

The anterior crural comes from the 3rd, 4th, and 5th lumbars, and emerges from the outer surface of the psoas, soon after which it gives off the external cutaneous to supply the skin of the outer side of the thigh. As soon as the nerve has passed under Poupart's ligament it gives off a cutaneous branch to the skin of the front and inner side of the thigh. Soon after this a branch runs outwards to supply the sartorius, and from this a twig enters the superficial surface of the rectus femoris. The next branch is the long saphenous which comes off from the inner side of the nerve, passes superficial to the external circumflex artery, and supplies the skin on the inner side of the leg below the knee. The rest of the branches of the anterior crural pass deep to the external circumflex artery and supply the quadriceps extensor set of muscles. The obturator nerve comes from the anterior divisions of the 4th and 5th lumbar, passes to the obturator foramen, and divides into a brush of branches which supply the adductor muscles as well as the gracilis. No distinct division into superficial and deep parts was noticed.

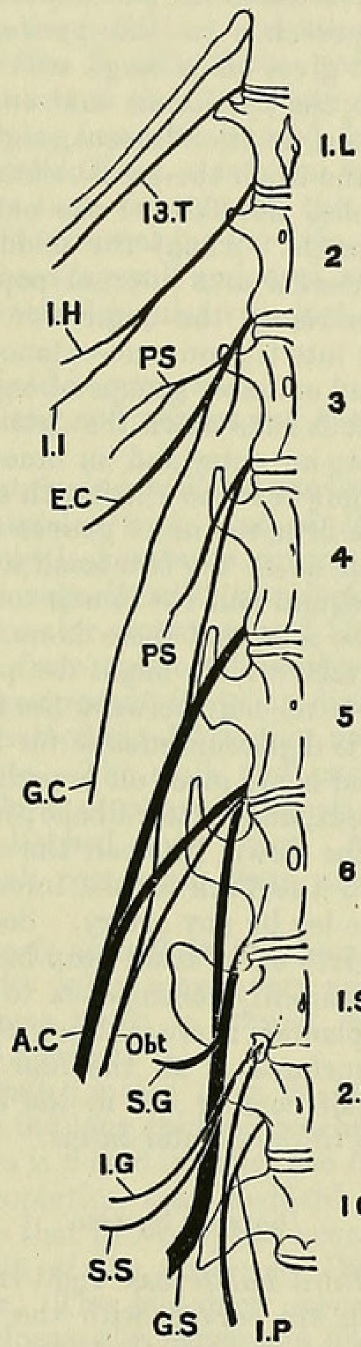
In the plexus, branches to the psoas come from the 2nd and 3rd as well as the junction between the 4th and 5th lumbar nerves.

The *Sacral Plexus* is formed by the 5th and 6th lumbar and the greater part of the first sacral nerves, which all unite to form the main trunk of the great sciatic. From the junction of the 5th and 6th lumbar nerves the superior gluteal is given off, as is the case in the sacral plexus of the *Cuscus*; this nerve supplies the gluteus medius, minimus, and quartus. The inferior gluteal comes off in common with the small sciatic after the union of the 1st sacral with the cord formed by the 5th and 6th lumbar (lumbo-sacral cord); it supplies the gluteus maximus and the anterior part of the biceps. The small sciatic supplies the skin of the back of the thigh as usual.

The pudic nerve is formed by the part of the 1st sacral which

[1] Journ. Anat. vol. xv. p. 265.

Fig. 10.



Lumbo-sacral plexus.

I.H.	Ilio-hypogastric.	I.G.	Inferior gluteal.
I.I.	Ilio-inguinal.	S.S.	Small sciatic.
PS.	Branches to Psoas.	G.S.	Great sciatic.
E.C.	External cutaneous.	I P.	Internal pudic.
G.C.	Genito-crural.	I.L.	1st lumbar vertebra.
A.C.	Anterior crural.	I.S.	1st sacral vertebra.
Obt.	Obturator.	I.C.	1st caudal vertebra.
S.G.	Superior gluteal.		

does not enter the sciatic trunk, joining the 2nd sacral; it supplies the pelvis and perineum.

The great sciatic nerve leaves the pelvis through the great sciatic foramen, passing superficial to the pyriformis; just before reaching that muscle it gives off a large nerve to the hamstrings, which passes deep to the pyriformis and supplies the posterior biceps, semimembranosus, semitendinosus, and the ischio-femoral. In the upper third of the thigh the great sciatic gives off the short saphenous which supplies the skin of the outer side of the leg from the knee to the ankle. About the middle of the thigh the sciatic divides into external and internal popliteal branches, the former of which winds round the outer side of the head of the fibula, where it divides into the musculo-cutaneous and branches to supply the peroneal and extensor groups of leg-muscles.

The musculo-cutaneous runs down the outer side of the leg and divides at the ankle into an outer and an inner branch; the outer of these supplies the cleft between the fourth and fifth toes as well as the outer side of the fifth, the inner goes to the inner side of the large fourth toe as well as to the two small inner toes, that is to say to the second, third, and half the fourth toes, the first toe being absent. It will thus be seen that there is no anterior tibial nerve in the Kangaroo, a fact which might be predicted when one remembers that there is no cleft between the first and second toes nor any extensor brevis digitorum muscle for it to supply.

The internal popliteal nerve gives off branches for the gastrocnemius, plantaris, popliteus, and rotator fibulæ; it passes through the popliteal space and runs down, between the superficial and deep muscles of the calf, to the back of the internal malleolus, being unaccompanied in the leg by any artery. Soon after passing the internal malleolus it gives off a small deep branch to the muscles of the sole, which apparently corresponds to the greater part of the human external plantar nerve. After this the main trunk supplies the plantar surfaces of all the four toes, the branch for the outer one and a half coming off in the anterior part of the sole and passing deep to the plantar fascia.

Digestive System.

The roof of the *Hard Palate* has eight transverse ridges, the anterior two of which are curved, with the convexity forwards. In the anterior half of the palate there are many tubercles between the ridges, a condition which has been described by Flower in the Didelphyidæ [1]. The *Soft Palate* is smooth on both its nasal and buccal surfaces; it ends posteriorly in a deep sharp notch, and there is no sign of a uvula.

The *Tongue* has four transverse ridges rather behind the centre of the dorsum. There are backwardly directed filiform papillæ all over the surface, while the fungiform papillæ are best

[1] Lectures on the Comparative Anatomy of the Organs of Digestion of the Mammalia, College of Surgeons, 1872, Lecture XII.

marked on the posterior part of the dorsum. Foliate papillæ are present in their normal position but are feebly marked. There are three circumvallate papillæ, the central one being well marked, while the lateral ones are indistinct and situated just in front of the papillæ foliatæ. The *Tonsils* answer to Owen's description [1]; each consists of eight or ten nodules of lymphatic tissue about the size of a pin's head lying in a well-marked fossa just beneath the soft palate. The *Parotid Gland*, as is usual in the Macropodidæ, is very large and reaches from the root of the ear along the side of the neck, dorsal to the external jugular vein, almost to the scapula. The *Submaxillary Gland* is small and oval, and is situated on the ventral side of the external jugular vein just clear of the angle of the jaw.

The *Sublingual Gland* is very small.

The *Œsophagus* is long and narrow and has a considerable course in the abdomen.

The *Stomach* of *Petrogale penicillata* has been carefully examined by Beddard and contrasted with that of *Dendrolagus bennettii* [2]. The stomach of *Petrogale xanthopus* agrees with his description and I shall content myself with mentioning that it measured 24 inches along the greater curvature and 13 along the lesser.

The *Spleen* differs from that of *Dendrolagus* and resembles the normal marsupial arrangement in being distinctly λ-shaped; the stalk and posterior limb of the λ together measure $5\frac{1}{2}$ inches, the anterior limb 2 inches. The stalk and posterior limb evidently correspond to the spleen of other mammals, because the gastro-splenic omentum is attached along them. Apart from the place where the extra limb comes off there are no notches in the spleen.

The *Liver* of *Petrogale penicillata* has been figured by Beddard: the arrangement of its lobes agrees very accurately with that of *P. xanthopus*; the same notch is present in the Spigelian lobe, though it is less well marked.

The *Pancreas* is about 6 inches long, its head is surrounded by the duodenum, while the long thin tail reaches the spleen.

The *Small Intestine* is 8 ft. 6 in. long, the *Large*, 3 ft. 8 in.; this is about the same proportion that Beddard describes in *Dendrolagus*. Garrod [3] says that in *Dorcopsis luctuosa* the large intestine is one-third the length of the small; in *Petrogale*, however, the proportion is greater. The bile-duct opens into the duodenum 3 inches from the pylorus, the pancreatic duct just beyond. In the Great Kangaroo, Owen says that the bile and pancreatic ducts unite and open 5 inches from the pylorus.

The *Cæcum* is 6 inches long, and is not sacculated as Owen describes it in the Great Kangaroo; its calibre is greater than that of the rest of the colon; the ileum joins it at an acute angle, and

[1] 'Anatomy of Vertebrates,' vol. iii. p. 385.
[2] P. Z. S. 1895, p. 131.
[3] P. Z. S. 1875, p. 56.

the two portions of gut are connected by a fold of peritoneum which reaches almost to the extremity of the cæcum.

The Genito-urinary System.

The male genito-urinary organs answered so well to Owen's description that I refrain from making any remarks about them.

The Respiratory System.

The *Larynx* is remarkable for the great size of the arytenoids, which, as Owen points out [1], are situated at the side instead of on the dorsal surface. The part of these cartilages which points towards the head of the animal is a broad convex border instead of forming the apex of a pyramid; from the anterior end of this border the short vocal cords pass to the thyroid. There are no false vocal cords or ventricles. The epiglottis is large, and is deeply notched in the middle of its free edge. The ventral part of the anterior edge of the thyroid cartilage curls over towards the cavity of the larynx and forms a little pouch just behind the stalk of the epiglottis.

The *Trachea* is a little over 4 inches long; the cartilaginous rings form rather more than complete circles, so that one end overlaps the other on the dorsum: this arrangement allows a considerable dilatation of the tube.

The *Thyroid Gland* is described in the account of the vascular system.

The *Lungs* are remarkable, as is usual in Kangaroos, for the small amount of lobulation which they exhibit. The right lung is much larger than the left and has a well-marked azygos lobe; from the ventral border of this lung a long triangular process projects, in front of which are two notches. The left lung has one notch on its ventral border, but, like the right, is undivided by fissures. Owen [2] states that in *Macropus major* the right lung has two notches in its anterior (ventral) border, while the left is undivided; in *M. parryi* both have one or two notches; in another Kangaroo he found the right lung divided into four lobes and the left into two. On neither side is there any eparterial bronchus.

[1] 'Anatomy of Vertebrates,' vol. iii. p. 584.
[2] 'Anatomy of Vertebrates,' vol. iii. p. 577.