4. Notes on the Anatomy of the *Erinaceidæ*.

By G. E. Dobson, M.A., M.B., &c.

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In entering upon the study of the Insectivora[1], the species of the family Erinaceidæ recommend themselves as the primary objects for examination, not only on account of their comparatively large size, but also by their remarkably central position with respect to the other species of the Order.

Experience in dealing with the natural history of another mammalian order, the Chiroptera, has specially impressed upon the writer the great importance of investigating, as far as possible, the internal structure of the leading forms before attempting to classify the species according to their natural affinities. He therefore purposes, in treating of the natural history of each family of Insectivora, to preface the systematic part of the work with an account of the anatomy of the principal species[2].

The family Erinaceidæ comprises two genera only, *Gymnura* and *Erinaceus*: the latter is represented by several species, inhabiting chiefly the temperate and subtropical parts of the Palæarctic, Ethiopian, and Oriental regions; the former by a single species, which is apparently limited to the Indo-Malayan subregion.

With the exception of a few scattered notices, all imperfect and many incorrect, and referring only to the common European Hedgehog, no account has hitherto been published of the anatomy of the species of this family.

The genus *Gymnura* is represented by a single species, *G. rafflesii*, inhabiting Southern Burma, Sumatra, Java, and Borneo, hitherto known only from a few more or less imperfect skeletons and some dried skins. Lately, however, a very perfect skeleton has been added to the collection of the British Museum; and Mr. W. T. Blanford, F.R.S., has placed in the writer's hands for examination a specimen of an adult female[3], well preserved in alcohol, which was obtained by Mr. Davison at Bánkasún, in Southern Tenasserim.

[1] The following notes on the anatomy of the species of the family Erinaceidæ are extracted from the MS. of the first part of a Systematic and Anatomical Treatise on the Order Insectivora, which the writer is about to publish as a separate work.

[2] For the material which has formed the basis of this paper the especial thanks of the writer are due to Mr. W. T. Blanford, F.R.S., who placed his excellent collection of the species of Asiatic Erinaceidæ at his disposal; to Prof. W. H. Flower, F.R.S., Conservator of the Hunterian Museum; to Dr. Günther, F.R.S., Keeper of the Zoological Department of the British Museum; and to Monsieur Fernand Lataste, President of the Zoological Society of France, who forwarded for examination the valuable specimens of Insectivora collected by him in Algeria.

[3] Described in Mr. Blanford's paper "On some Mammals from Tenasserim," in Journ. Asiat. Soc. Bengal, xlvii. part ii. 1878, p. 150.

The following points in the osteology of this very remarkable form are especially worthy of notice[1]:—

The vertebral column is made up of 7 cervical, 15 dorsal, 6 lumbar, 7 sacro-coccygeal, and 23 caudal vertebræ. All the spinous processes, from the axis backwards to the last sacro-coccygeal vertebra, are well developed; that of the axis is enormous, flattened laterally, and antero-posteriorly expanded; the second dorsal spine is greatly elongated; the ten anterior dorsal spines are narrowed towards their extremities; the succeeding spines have their extremities progressively antero-posteriorly expanded and laterally flattened, merging into the shape of the lumbar spines, which are nearly as broad at their apices as at their bases. The four anterior cervical vertebræ develop spines (hypapophyses) from the centre of the ventral surface of the body of each, that of the axis being most prominent; the inferior lamellæ of the transverse processes of the sixth cervical vertebra are enormously expanded antero-posteriorly, like the spine of the axis; inferior lamellæ are also developed in the fifth, fourth, and third cervical vertebræ, but they are very much smaller. The first lumbar vertebra develops a small postero-externally directed transverse process; the remaining five vertebræ have long antero-externally directed falciform transverse processes many times larger and quite differently shaped; these are succeeded by seven sacro-coccygeal vertebræ, whereof the first two are articulated with the iliac bones. The first caudal vertebra is distinguished, not only by the absence of spinous and articular processes, but also by the want of the chevron bones, which are attached to all the succeeding vertebræ except the terminal two or three: these bones are bifid, and consist of a pair of cylindrical splint-like bones attached by the middle, one on each side, to the infero-lateral surface of the body of each vertebra at its posterior margin, so that half of each bone projects horizontally backwards over the succeeding vertebra; the metapophyses and transverse processes of most of the caudal vertebræ are well developed, and diminish in length progressively backwards.

There are fifteen pairs of ribs; and the thorax is very capacious. Sternum narrow, not keeled; the mesosternum consists of five segments; the xiphisternum is remarkably long and spatulate, terminating in an expanded cartilage, and very like that in Soricidæ.

The pelvic opening is remarkably long and narrow, its width between the acetabula being but one ninth its long diameter; the symphysis pubis extremely weak, the conjoined rami of the pubis and ischium forming an angular projection, which merely touches the corresponding projection of the opposite side.

Humerus well developed, with a supracondylar foramen and a large supratrochlear perforation. Carpus of seven bones, no os centrale; the scaphoid and lunar bones are evidently separate in the

[1] In Mr. Mivart's paper " On the Osteology of the Insectivora " (Journ. Anat. Phys. i. pp. 281-312), owing to want of material, the author has touched but cursorily (with the exception of the skull) on the skeleton of this species.

young, but in old animals united, the line of union, however, remaining distinct.

The greater and lesser trochanters of the femur are very large; and there is a strongly convex ridge immediately below the greater trochanter, representing a third trochanter.

In the teeth the form of the crowns of the first and second molars is especially noticeable: each has five conical cusps—one at each angle, the inner pair nearly as large as the outer, the fifth near the centre of the tooth, connected by an oblique ridge with the bases of the antero- and postero-internal cusps, and separated from both the external cusps (in the unworn tooth) by a deep groove[1] (fig. 1).

Fig. 1.

Crown of first upper molar (right side) of *Gymnura rafflesii.*

Several very interesting points are noticeable in the myology of this species. The *panniculus carnosus* is thin, and consists chiefly of two pairs of extensive muscles, lining the skin between the anterior limbs and the base of the tail. These two, *m. humero-dorsales* and *humero-abdominales*, arise separately from the humerus behind the attachment of the great pectoral muscle, and, passing respectively backwards and upwards and backwards and downwards, soon become attached to and spread out over the internal surface of the integument covering the back and sides behind the scapulæ, and the sides and the abdomen behind the umbilicus; the dorsal pair are inserted into the upper surface and sides of the base of the tail, the abdominal into the under surface and sides of the same part. Added to these, other cutaneous muscles line the integument in front of the fore limbs. Of these the chief are the *sterno-faciales*, a broad muscular aponeurosis extending upwards on either side of the neck and head from a raphe occupying the centre line of the neck beneath, and connected posteriorly by two pairs of small oblique muscles with the sternum.

The facial muscles are well developed. *Zygomaticus major* and *minor* arise from the root of the zygomatic arch; and above them a pair of similar but smaller muscles, the *levatores alæ nasi* (*inferior* and *superior*) have their origin from the space between the root of

[1] It is especially necessary to examine the crowns of unworn teeth to see the central fifth cusp and this groove separating it from the postero-external cusp; for in most specimens the central cusp is found worn down, and its base as well as that of the postero-external cusp spread out so as to obliterate wholly or in part the intervening groove; the base of the central cusp then appears as a prolongation of the ridge which, as described above, unites it with the antero-internal cusp.

the zygoma and the margin of the orbit. All four muscles form very long and slender tendons, which pass forward horizontally parallel to one another, to be inserted respectively into the upper lip, slightly in front of the first upper incisor, into the extremity of the nose below the nasal orifice, into the middle of the alæ nasi, and into the extremity of the nose above the nasal orifice. Between the origins of the *zygomaticus major* and *minor* arises another muscle, the *levator labii superioris et erector vibrissarum*, which passes directly forwards between the tendons of these muscles, and terminates in a mass of muscular fibres which invest the bases of the remarkably long vibrissæ which spring from the sides of the muzzle, and is also connected with the *orbicularis oris* beneath. The *levator labii superioris proprius* is well developed, arising from the maxillary bone above, and in front of the infraorbital foramen, forming a strong tendon, which, united over the extremity of the muzzle with the tendon of the corresponding muscle of the opposite side (as in *Equus*), is inserted with it into the upper lip below the nasal orifices.

The *temporal* muscle is remarkable for its great size and peculiar development. It arises by three heads, which are all inserted into the coronoid process:—

I. From the greatly developed occipital crest and surface of the parietal bones, in the usual position of origin, inserted into the superior and anterior margin of the coronoid process.

II. From the mastoid process, root and upper margin of the zygoma along its posterior two thirds, the fibres curve upwards, forwards, and downwards, forming a semicircular muscular mass above the zygoma on the side of the head, lying against the temporal muscle proper; inserted into the outer side of the coronoid process near its base.

III. From the inner side of the posterior two thirds of the zygomatic arch a mass of muscular fibres arises, which, curving forwards, is inserted into the postero-external margin of the upper half of the coronoid process.

We have thus a series of muscular structures having an exceedingly extended origin, and of great relative development, attached to the much-expanded coronoid process of the mandible, supplying the force needed to move such greatly extended jaws; for, probably, in no other mammal are these so much developed in comparison with the size of the animal.

Not less remarkable in its development is the *digastric*. This muscle arises normally; but at the point where the tendinous intersection occurs (nearly opposite the hyoid bone) it splits into two laminæ: one, superficial and external, continues forward in the usual direction of the muscle; the other, transverse, is directed inwards, and slightly forwards, its posterior free tendinous margin being a direct continuation of the tendinous intersection of the muscle, which unites in the middle line in front of the hyoid bone with that of the corresponding muscle of the opposite side, forming a tendinous raphè, from which the united muscles are continued forwards between the rami of the mandible, concealing the greater part of the mylo-hyoid muscles (which are very thin, and do not extend beyond the middle of the intermandibular space), and are inserted laterally (under cover of and united at their insertion with the superficial laminæ, but extending anteriorly for a short distance beyond them) into the sides of the jaws.

This peculiar development of the digastric has been described as an anomaly in man, but is known as a normal condition in *Chiromys madagascariensis* and in some other Primates[1]. The writer has found it well marked in certain species of Chiroptera, as in *Epomophorus macrocephalus* and *E. minor*, where, although the united internal laminæ of the muscles extend as far backwards as to cover the hyoid bone, there is no connexion with it. It is especially noticeable in this case that the tendinous intersection is vertical, or nearly so, corresponding to the position of the posterior margin of the united muscles, as the oblique intersection in *G. rafflesii* corresponds to the more anterior position of the posterior margin of the same muscles in the latter species; and we may reasonably conclude that the tendinous intersection of the digastric, wherever met with in Mammalia—whether as a true tendon, as in the Primates, or as a mere tendinous inscription, as in many species of Chiroptera and of Insectivora—has primarily originated as the origin of a tendinous posterior raphé, such as we find in *Gymnura rafflesii*[2].

The *sterno-mastoids* and *cleido-mastoids* are large, and, except at their insertions, separate; the *cleido-occipital* is united for a considerable distance with the *trapezius*, and really appears to be part of that muscle inserted into the clavicle. The *omo-hyoid* is well developed, and has the usual origin and insertion. *Levator scapulæ*, from the transverse process and anterior arch of the atlas, is inserted into the extremity of the outer bifurcation of the acromion, superficial to the insertion of the trapezius, to the surface of which its posterior and upper margin is attached. The *trapezius* is double. Its occipital and cervical portion is well developed, arising from the inner three fourths of the occipital crest, from the centre line of the neck, and from one or two dorsal spines. Some of the anterior fibres separate about the middle of the neck to form the *cleido*-occipital (or is the cleido-occipital united at this point with the *trapezius*?); the remaining fibres are inserted into the spine of the scapula from the acromion to its posterior root. The posterior *trapezius* arises from the last five or six dorsal vertebræ, and is inserted into the posterior third of the spine of the scapula.

The *rhomboideus anticus* has the same origin as the *trapezius*, with the addition of three or four dorsal spines; it is folded at its insertion into the posterior margin of the scapula. *Rhomboideus posticus* is a small flat muscle, which passes from the spines of the fourth, fifth, and sixth dorsal vertebræ to the internal surface of the middle of the posterior margin of the scapula beneath the *r. major*.

[1] Owen, Comp. Anat. iii. p. 53.

[2] On this subject see my paper "On the Tendinous Intersection of the Digastric," Proc. Roy. Soc. March 31, 1881.

Serratus posticus is very largely developed; it arises by an aponeurosis from the posterior third of the ligamentum nuchæ, from the first two or three dorsal spines, and from the fascia of the back, and is inserted into all the ribs with the exception of the first three. *Serratus magnus* is also very large, consisting of a cervical and a thoracic portion, the former the united *levator anguli scapulæ.* There is no distinct *splenius colli.* The *trachelo-mastoid* is large, arising by a thin muscular aponeurosis from the anterior three or four dorsal transverse processes in close connexion with the origin of the *transversalis cervicis*, also from the sixth, fifth, and fourth cervical transverse processes, and converges to form a short tendon which is inserted into the mastoid process.

Complexus tertius, from the articular processes of the sixth to the third cervical vertebræ, is in intimate connexion with the attachment of the *complexus major*, which lies internal to it, and is inserted into the extremity of the transverse process of the atlas. *Scalenus medius et posticus* are united, forming a large muscular mass, which arises from the transverse processes of the cervical vertebræ above the brachial plexus which separates it from the *longus colli.* The *longus colli* appears to commence from the body of the seventh dorsal vertebra (but small muscular fibres may be traced from the body of one vertebra to the other as far back as the diaphragm), and passes forwards from the body of one to the inferior lamellæ of the transverse process of the next, until it finally terminates at the atlas.

Rectus abdominis et sternalis is well developed throughout its whole length, extending from the first rib to the pelvic bones. The attachment of this pair of muscles to the latter is very peculiar, namely by four interlaced fleshy tendons; the left rectus divides about midway between the umbilicus and the symphysis pubis into a pair of fleshy tendons, which are directed backwards and outwards towards the right pubic bone, and go between a corresponding pair from the right rectus, passing towards the left pubic bone in such a manner that the internal division of the left rectus is superficial. This division is narrower than the others, and tendinous at its insertion.

This interlacement of the tendons of the recti forms a powerful support to the weak and narrow symphysis of the pubic bones, which must be separated at the time of parturition, as the extremely narrow diameter of the pelvis (referred to above, p. 390) is evidently quite insufficient to admit of the passage of the fœtus. It would also effectually prevent rupture of the abdominal walls in a vertical direction when the symphysis is widely separated, and ensure re-apposition of the pubic bones.

There are no distinct *lineæ transversæ*; the *obliqui externi* unite muscularly along the middle line between the sternum and the umbilicus; the *obliqui interni* are exceedingly thin and aponeurotic, which is also the condition of the former muscles behind the umbilicus, their places as supporters of the abdominal walls being evidently taken to a great extent by the cutaneous muscles, the *humero-abdominales*, and by the *recti.*

Of the muscles which are attached to the humerus, the *latissimus dorsi* is well developed; it is inserted, as usual, in connexion with the *teres major*, and gives off near its insertion a broad but thin *dorso-epitrochlearis*, which arises from its lower margin by a tendinous aponeurosis.

Pectoralis major is extensive in its origin. It is divisible into clavicular and sternal portions, the former from the outer half of the clavicle; the latter, from the sternum and the cartilages of the ribs, is again divided into an *anterior* and *posterior* part. The former is narrow, arising from the sternum at its anterior extremity, and from a raphé common to it and its fellow of the opposite side, which extends beyond the sternum, covering the origins of the sterno-mastoid muscles; each muscle passes directly outwards to its insertion into the humerus. The latter, or posterior part, is by far the largest, arising from the whole length of the sternum behind the preceding, from the sternal extremities of the costal cartilages, and from fascia connected with the sheath of the rectus; the muscular mass thus formed divides into four fasciculi, two *superficial* and two *deep*: the former are inserted into the middle third of the humerus; of the latter the anterior or smaller fasiculus (*m. sterno-clavicularis*) is inserted into the greater part of the outer third of the clavicle, the posterior or larger into the greater tuberosity and neck of the humerus.

The peculiar anomaly of the same muscle being inserted into and also arising from the same bone, suggests whether the so-called clavicular part of the great pectoral should not be considered a separate muscle, which might be termed *claviculo-humeralis*.

The very complete separation of the anterior division of the sternal part of the muscle from the other parts, and the united origins of the muscles of the opposite sides which compose this part, and which extend for a considerable distance beyond the anterior extremity of the sternum, recall the well-known similar conditions in *Talpa*.

The *teres major* is well developed; but there is no trace of a *teres minor*. The *triceps* is enormous in comparison with the size of the animal; it arises by three heads, a scapular and two humeral. The *biceps* arises by a single head from the scapula above the glenoid cavity, and is inserted into the *ulna*; the *brachialis anticus*, on the other hand, is inserted into the *radius*. There is no trace of either *coraco-brachialis longus* or *brevis*.

Of the forearm-muscles the *supinator longus* is absent, the *supinator brevis* present but very small; the *pronator radii teres* is inserted by a broad muscular expansion into the middle part of the lower third of the radius; the *extensor digitorum communis* and the *extensor minimi digiti* are united in the arm, the muscular mass dividing into two tendons, which cross the carpus, the smaller of these representing the tendon of the latter muscle, being distributed by slips to the fifth and fourth digits; the larger divides into four, which are distributed to the three middle toes. The *extensor secundi internodii pollicis et extensor indicis* is small, arising by a few muscular fibres from the interosseous ligament and adjoining surfaces of the ulna and radius.

The *palmaris longus* arises in common with the *flexor carpi ulnaris* and *flexor digitorum sublimis*, and forms a thin flat tendon which, passing down alongside and internal to that of the former muscle, is inserted into the palmar fascia. The *flexor digitorum sublimis* arises as above described, and is also connected with the origin of the *pronator radii teres* and the *flexor digitorum profundus*, and divides in the manus into three tendons for the three middle toes. *Flexor digitorum profundus* arises by five heads, which unite into a common tendon, which in the manus divides into tendons for each of the five toes. There are four *lumbricales*, inserted respectively into the inner sides of the bases of the first phalanges of the four outer toes.

Of the muscles attached to the hind limbs the *psoas magnus* and *psoas parvus* are both well developed and nearly equal in size. Their tendons, passing backwards, unite with the outer and inner sides respectively of the fleshy tendon of the *iliacus*, and are, with it, inserted into the lesser trochanter.

The *quadratus lumborum* is remarkable for its rudimentary form and interrupted connections. It arises as a small bundle of muscular fibres from the side of the fifteenth dorsal vertebra, and from the surface of part of the last intercostal muscle, forms four slender tendons, which are attached respectively to the tips of the long transverse processes of the second to the fifth lumbar vertebra; the tip of the sixth vertebra receives its tendon from a separate bundle of muscular fibres, which are attached to the inferior surface of the fourth transverse process; and other fibres, arising from the posterior margin and inferior surface of the fifth transverse process, pass backwards to the crest of the ilium, a large part uniting with the *iliacus* muscle. Thus the four muscles, the *psoas magnus* and *p. parvus*, the *quadratus lumborum* and the *iliacus*, may all be said to be the same muscle, having various origins but the same insertion. This muscle may be considered a differentiated intercostal[1], to which the name *m. costo-ileo-femoralis* might be applied.

The *sartorius* is represented by a muscular *aponeurosis*, which covers the muscles on the inner side of the thigh connected with the fascia covering the *iliacus* muscle, and more internally with the pectineal eminence by a slender muscle which arises therefrom, inserted along the prominent ridge on the anterior surface of the tibia. The *semitendinosus* is also peculiar in its connections. It arises partly from the *tuber ischii*, and partly from a dense tendinous aponeurosis attached across the upper surface and sides of the tail, by which it is connected with the corresponding muscle of the opposite side. It consists of two laminæ, which unite and again divide; the outer division, smaller, passes outside the leg, and, becoming united with the lower margin of the *biceps flexor cruris*, is inserted with it into the tibial ridge; the inner, the *m. semitendinosus* proper, is inserted into the inner side of the same ridge. The leg, there-

[1] See Dr. Gadow's paper in Morpholog. Jahrbuch, 1881, pp. 57–100.

fore, is enclosed in a sling formed by the two divisions of this muscle.

The *solæus* is well developed, but arises by a short tendon from the head of the fibula only. *Extensor hallucis longus*, from the middle of the tibia beneath the large *tibialis posticus*, is very small; but the *extensor digitorum longus*, which arises by a tendon from the external condyle of the femur, is moderately developed. The *peronei* muscles arise together from the head of the fibula, but divide at once into the *p. brevis, longus*, and *quinti digiti*; the tendons of the latter are inserted into the distal phalanges of the fourth and fifth toes respectively.

The *plantaris* is well developed, arising by two heads from the external condyle. Its tendon becomes at the heel superficial to that of the *tendo Achillis*, over the insertion of which it glides, and, passing into the sole of the foot, gives origin altogether to the *flexor digitorum brevis*, and becomes connected with the plantar fascia. The *flexor digitorum longus* and *flexor hallucis longus* are inseparably united.

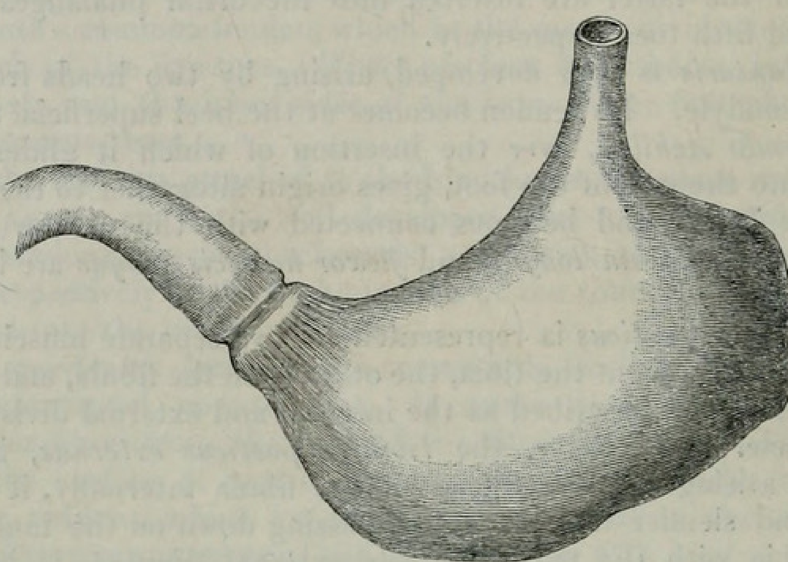
The *tibialis posticus* is represented by two separate muscles, one having its origin from the tibia, the other from the fibula, and which may therefore be described as the internal and external divisions of this muscle. The latter, the *tibialis posticus externus*, is very slender; arising from the head of the fibula internally, it forms a long and slender tendon, which, passing down on the inner side of the tibia with the tendon of the external division, is inserted into the scaphoid bone. The internal division, *tibialis posticus internus*, is much larger; arising from the head of the tibia, and from half the length of the bone by a fascial aponeurosis, it forms also a long tendon, which extends along the side of the foot between the integument and the plantar fascia, and, spreading out, is inserted round the base of the central callosity of the integument.

It is remarkable that the first described of these muscles has the insertion usually observed in the *tibialis posticus* of other mammals, while the latter has the origin of that muscle, but not its insertion. The action of this latter muscle is evidently to fix the central callosity of the sole of the foot, and so assist progression on smooth or inclined surfaces.

Flexor digitorum brevis arises, as above described, from the tendon of the *plantaris*, and is not connected with the os calcis; it divides into five flat tendons, which form the perforated tendons for the five toes. The *flexor accessorius* is well developed; arising from behind the prominent bony tubercle on the os calcis which supports the tendon of the *peroneus longus*, it is inserted obliquely into the outer side of the *flexor digitorum longus* tendon, opposite the base of the fifth metatarsal bone. There are, as in the manus, four *lumbricales* for the four outer toes, and with similar attachments.

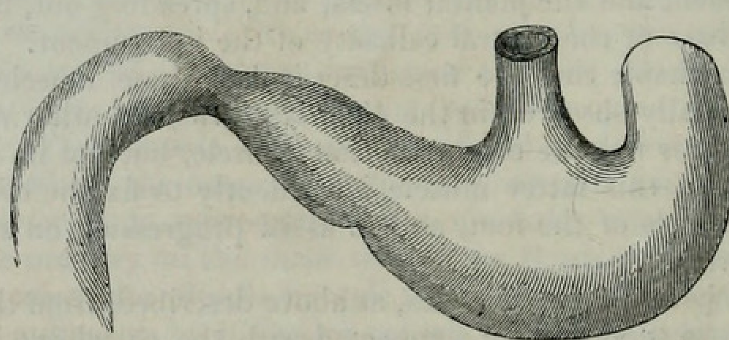
The palate is marked by eleven ridges, all simple and undivided; the first corresponds to the space between the first and second incisors, the second to the canines and first premolars, the third to the second premolars, the fourth to the third premolars. The tonsils consist each of a deep oval depression with raised edges, partly concealed by a membranous fold in front, so that the opening of the depression is directed backwards towards the pharynx. Tongue moderately long and obtusely pointed, soft and flexible, covered all over with fine trifid papillæ, each consisting of a long central filiform papilla having a shorter and more slender papilla at either side;

Fig. 2.



Stomach of *Gymnura rafflesii.*

Fig. 3.

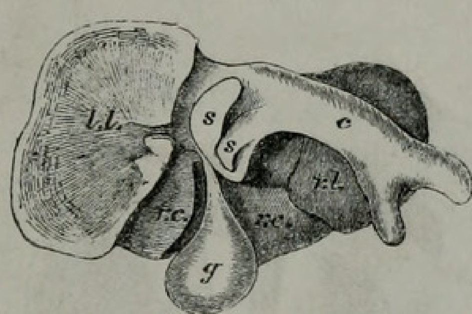


Stomach of *Erinaceus europæus.*

fungiform papillæ few but conspicuous; circumvallate papillæ two only, very large, elongated, in deep oval pits placed obliquely at the back of the tongue; beneath, close to the symphysis menti, at the anterior extremity of the floor of the mouth, are a pair of long pointed papillæ, at the bases of which the apertures of the ducts of the submaxillary glands open. The latter are rather small, consisting each of a small anterior and a large posterior lobe; the duct, passing between the digastric muscle and the ramus of the mandible, and curving forwards, under cover of the *mylo-hyoid* and *genio-hyoglossus* muscles, passes along under the mucous membrane of the floor of the mouth, opening at the base of the above-noticed papilla. In the specimen examined there was no trace of sublingual glands. The parotids are larger than the submaxillaries, but very similar to them in structure.

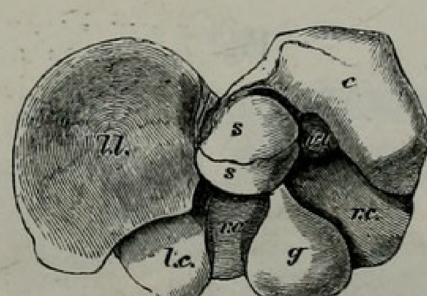
The stomach (fig. 2) resembles that of man in general outline; the œsophagus enters it by a narrow orifice far removed from the pylorus. The cardiac portion has the mucous membrane thrown into very deep rugæ, which extend from the entrance of the œso-

Fig. 4.



Liver of *Gymnura rafflesii.*

Fig. 5.



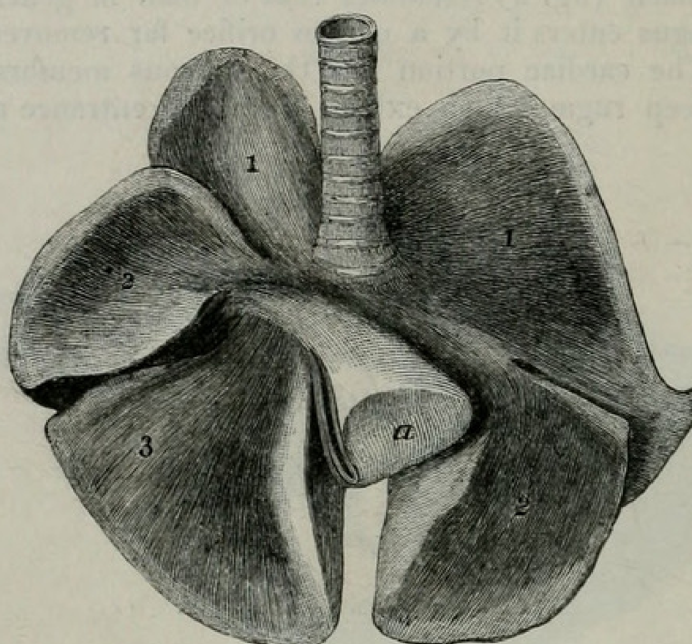
Liver of *Erinaceus europæus.*

phagus. The intestinal canal is about six times the length of the head and body, of nearly the same calibre throughout, without cæcum, and suspended typically in the mesentery. The liver (fig. 4) is wide and deeply divided into lobes; the spigelian lobe bifid, the caudate very long, divided at its posterior extremity by the deep renal fossa; umbilical and cystic fissures well marked; the gall-bladder large and pyriform, projecting considerably beyond the margin of the right central lobe, on which it is placed.

The lungs (fig. 6) are large and deeply divided into lobes, the right lung into three, the fissures extending to the root of the lung, the left into two nearly equal lobes; the azygos lobe well developed and pyramidal in outline.

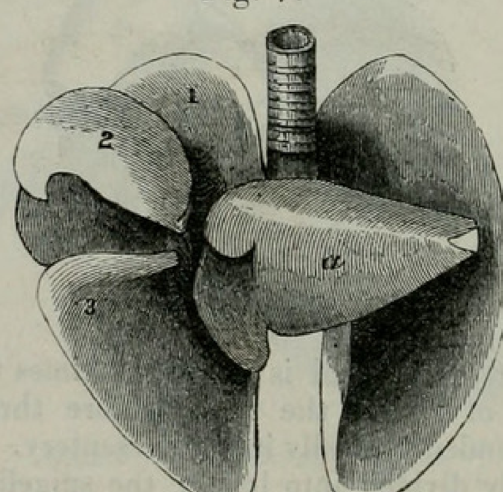
Bladder small, pyriform, the ureters opening by longitudinal slits close to the neck, and three fourths of an inch from the extremity of the urethra in the female.

Fig. 6.



Lungs of *Gymnura rafflesii*, half nat. size.

Fig. 7.



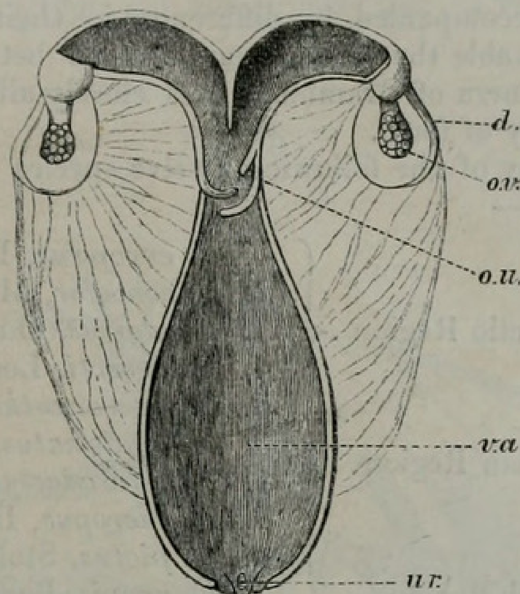
Lungs of *Erinaceus europæus*, half nat. size.

The uterus[1] is almost double, the cornua uteri extending nearly to the os uteri; and there is no true corpus uteri. In both specimens examined there was found a peculiar fleshy hood, extending

[1] Both specimens of this species examined were females; the writer has not yet had an opportunity of dissecting a male.

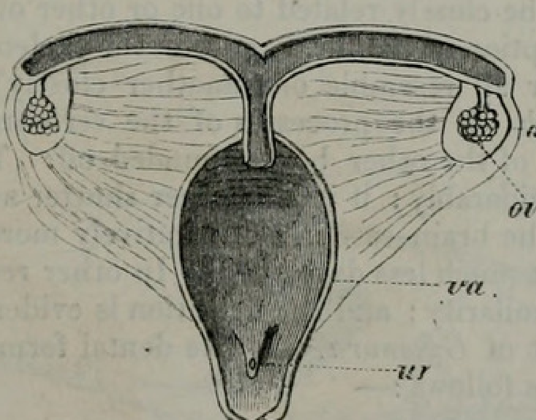
over the os uteri, the lateral opening of which at first appeared to be the os (see fig. 8); on dividing this the true os was found to have been concealed in its deep recess. The ovaries are botryoidal, and enclosed in peritoneal sacs.

Fig. 8.



Uterus and vagina of *Gymnura rafflesii* (horizontal section).

Fig. 9.



Uterus and vagina of *Erinaceus europæus* (horizontal section).

On either side of the rectum a large preanal gland, about the size of half a walnut, is found, invested externally with circularly disposed muscular fibres, and its cavity lined internally with a glandular membrane having several deep lacunæ, and filled with a large quantity of a friable brown substance. The openings of these glands are small and circular, placed immediately in front of the anterior margin of the anus.

Genus Erinaceus, L.

In the form of the head and body all the known species agree together remarkably closely; and, as might be expected, the anatomy of these parts is much the same throughout the species; but the limbs, being nearly free from the great panniculus carnosus (which as it were moulds the shape of the parts included within it), vary very considerably in form and relative length of parts; and this variability is accompanied by differences in their internal structure not less remarkable than have been observed between the species of some other genera of Mammalia less closely allied by general external similarity of form.

The anatomy of the following twelve species has been examined by the writer:—

Palæarctic Region	1. *E. europæus*, L.
	2. *E. concolor*, Martin.
	3. *E. algirus*, Duvernoy.
	4. *E. deserti*, Loche.
	5. *E, macracanthus*, Blanford.
Ethiopian Region	6. *E. diadematus*, Württ.
	7. *E. heterodactylus*, Sund.
Oriental Region	8. *E. micropus*, Blyth.
	9. *E. pictus*, Stoliczka.
	10. *E. grayii*, Bennett.
	11. *E. blanfordi*, Anderson.
	12. *E. niger*, Blanford.

These species sufficiently represent the genus; other known forms will be found to be closely related to one or other of them.

With the exception of the head and tail, the skeleton of any species of *Erinaceus* (for all resemble one another closely) resembles that of *Gymnura* with all the processes of the vertebræ shortened and the prominences of the other bones rounded off. The form of the skull differs considerably: it is altogether shorter and broader than in that genus; the brain-case is comparatively more capacious, and the occipital crest much less developed. In other respects, however, there is much similarity; and the dentition is evidently but a modified form of that of *Gymnura*. If the dental formula of the latter be represented as follows:—

$$i.\ \frac{3-3}{3-3},\ c.\ \frac{1-1}{1-1},\ pm.\ \frac{4-4}{4-4},\ m.\ \frac{3-3}{3-3}=44 \text{ teeth},$$

then that of *Erinaceus* is

$$i.\ \frac{3-3}{2-2},\ c.\ \frac{1-1}{1-1},\ pm.\ \frac{3-3}{2-2},\ m.\ \frac{3-3}{3-3}=36 \text{ teeth}.$$

By modifying the usual manner of writing the dental formula, the homologies[1] of the teeth of the latter with those of the former genus may be thus graphically expressed:—

[1] As determined by the writer on grounds which are fully stated in the work referred to in note to p. 389.

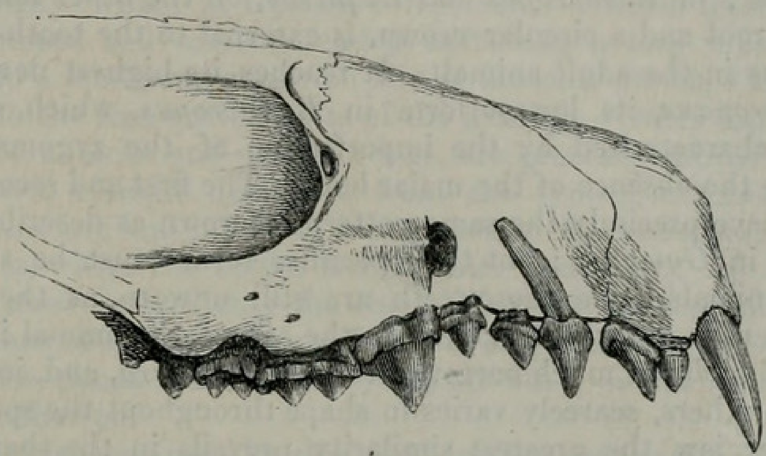
Gymnura.

$$i.\ \frac{6=(2a+2b+2c)}{6=(2a'+2b'+2c')},\ c.\ \frac{2=(d+d)}{2=(d'+d')},\ pm.\ \frac{8=(2e+2f+2g+2h)}{8=(2e'+2f'+2g'+2h')},\ m.\ \frac{6=(2i+2j+2k)}{6=(2i'+2j'+2k')}.$$

Erinaceus.

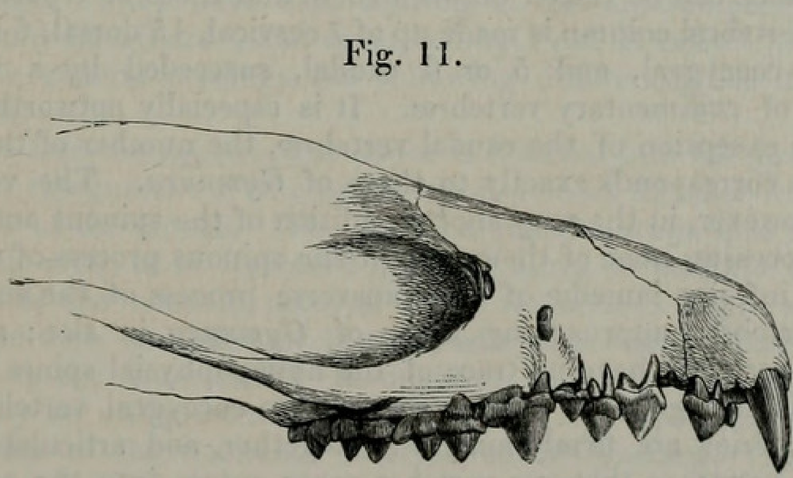
$$i.\ \frac{6=(2a+2b+2c)}{4=(2a'+2b')},\ c.\ \frac{2=(d+d)}{2=(d'+d')},\ pm.\ \frac{6=(2f+2g+2h)}{4=(2f'+2h')},\ m.\ \frac{6=(2i+2j+2k)}{6=(2i'+2j'+2k')}.$$

Fig. 10.



Skull of *E. europæus*[1].

Fig. 11.



Skull of *E. blanfordi*[1].

[1] These drawings show how remarkably *E. europæus* differs in the form and relative size of its second and third upper incisors and first upper premolars from the other species of the genus, which resemble one another very closely in the form and relative size of their teeth.

It will thus be seen that *Erinaceus* differs in wanting the third lower incisor, and the first upper and lower, and third lower premolars. The first tooth behind the premaxillary suture is undoubtedly the representative of the corresponding tooth in *Gymnura*, which, although provided with two roots, must be regarded as a canine, having not only the position but also the form of that tooth in Carnivora. This tooth in *Erinaceus* has, as a rule, two roots also; but occasionally, especially in *E. europæus* and its varieties, these grow together; and in a skull in the British Museum (see above, fig. 10) the canine has a single long root which extends upwards and backwards over the premolars. The second upper premolar is the most variable tooth: in most species it has three roots with a triangular crown, having its longest horizontal diameter transverse; in *E. micropus* and *E. pictus*, on the other hand, it has a single root and a circular crown, is external to the tooth-row, and deciduous in the adult animal. It reaches its highest development in *E. europæus*, its lowest form in *E. micropus*, which species is further characterized by the imperfection of the zygomatic arch, owing to the absence of the malar bone. The first and second upper molars have precisely the same pattern of crown as described above (p. 391) in *Gymnura*; but their peculiar form must be studied in young animals while these teeth are still unworn, as the acutely-pointed cusps quickly disappear as the age of the animal increases: the third molar is much narrower than in *Gymnura*, and, in common with the others, scarcely varies in shape throughout the species. In the lower jaw the greatest similarity prevails in the shape of the teeth between even the most widely separated species; but, except in the form of the first and second molars (as in the upper jaw), no resemblance can be traced between them and those of *Gymnura*.

The vertebral column is made up of 7 cervical, 15 dorsal, 6 lumbar, 7 sacro-coccygeal, and 5 or 6 caudal, succeeded by a variable number of rudimentary vertebræ. It is especially notworthy that, with the exception of the caudal vertebræ, the number of the other divisions corresponds exactly to those of *Gymnura*. The vertebræ differ, however, in the very short condition of the spinous and transverse processes, none of them, except the spinous process of the axis and the inferior lamellæ of the transverse process of the sixth cervical vertebra, approaching those of *Gymnura* in size; and the cervical vertebræ have no trace of the hypapophysial spines so prominent in that genus. Of the seven sacro-coccygeal vertebræ, the three anterior are firmly ankylosed together, and articulated with the iliac bones, so that one vertebra more enters into the articulation, and a much more perfect sacrum is formed, than in *Gymnura*. The short caudal vertebræ show their fundamental similarity of structure with those of *Gymnura* by the presence of similar but rudimentary chevron bones. As in that genus, there are fifteen pairs of ribs (in *E. deserti* fourteen only); but the thorax is comparatively much less capacious, these animals seeking protection from their defensive armour, not from speed in making their escape. The sternum is similarly narrow and bilobate in front, but differs in the shortness of the xiphisternum; and the mesosternum is made up of three or two segments only.

The pelvic opening contrasts remarkably with that of *Gymnura*; its transverse diameter, measured between the acetabula, is nearly or quite half its longitudinal, whereas in *G. rafflesii* it is scarcely one ninth; the symphysis pubis is also much deeper, especially in *E. europæus*; the tuber ischii is short and rounded off; and the posterior margin of the ramus of the pubis and ischium is convex, not concave.

Except in *E. europæus* and its varieties, there is a supracondylar foramen in the humerus. The carpus is formed on the same plan as in *Gymnura*; but the scaphoid and lunar bones are early united, leaving no trace of their original separate condition. In the femur the convexity which in *Gymnura* represents a third trochanter is less prominent and more extended, indicating a long muscular, as opposed to a tendinous, insertion of the muscles attached to it, and pointing to the less active habits of the animals. Other limb bones, both in the anterior and posterior legs, are generally similar to those of *Gymnura*, a single departure from the typical number of five digits in the fore and hind feet being seen in *E. heterodactylus* and its varieties, where the hallux is altogether wanting.

In the muscular anatomy the chief differences between the species of this genus and *Gymnura* are found in the much greater development of the panniculus carnosus, and in other minor points to be noticed further on.

To the cutaneous muscles described in *Gymnura rafflesii* there are in all the species of *Erinaceus* others superadded, which are related to the well-known defensive attitude assumed by these animals when frightened. They have been figured in the anatomical plates of Cuvier and Laurillard[1], and described by Prof. Huxley[2].

In the general myology the following differences are especially noticeable:—

In the face the *zygomaticus major* is inserted into the *orbicularis oris* and integument of the upper lip at a short distance in front of the angle of the mouth. The *temporal* muscle arises also from the zygomatic arch, as in *Gymnura*; but its fibres do not take origin so far back as the mastoid process. The *digastric* is single, and does not unite with its fellow of the opposite side between the jaws; it has nearly the same calibre throughout, but is crossed about the middle by an oblique tendinous inscription, corresponding precisely in position to the tendinous intersection in *Gymnura*. The *mylohyoid* is well developed, consisting of an anterior and posterior portion. *Cleido-occipital* is slender and quite unconnected with the *trapezius*. The *serratus magnus* is not united with the *levator anguli scapulæ*.

The *pyramidales* are well developed, in striking contrast with *Gymnura*, in which they are rudimentary or absent. The *recti abdominis et sternalis* are connected with the pubic bones by three instead of four tendons, the missing tendon corresponding to the

[1] Planches de Myologie. [2] Anat. Vert. Animals, p. 445.

most superficial of the four in *Gymnura*, while the least superficial of the three is much smaller than the others. This smaller number of tendons, and evident tendency towards still further reduction, appears to be related to the greater depth of the symphysis pubis, and consequently greater union of the bones of opposite sides, as well as to the lessened proclivity to their separation, owing to the greater transverse diameter of the pelvic opening, which is probably quite sufficient to freely permit of the passage of the fœtus during parturition.

Quadratus lumborum is much larger and more fleshy than in *Gymnura*, extending without interruption from the last intercostal space and base of last rib to the crest of the ilium, inserted successively by small tendons into the extremity of each lumbar transverse process. *Psoas magnus* and *psoas parvus* are large ; but the latter is inserted into the anterior sacro-iliac ligament and into the margin of the pelvis.

The *pectoralis major* has no separate anterior sternal part, as in *Gymnura*; nor has its deep lamina any insertion into the clavicle. The *coraco-brachialis*, which is altogether wanting in that genus, is well developed here, and consists of two parts:—the superficial, a long slender muscle inserted into the lower third of the humerus; the deep (*coraco-brachialis brevis*), short, and inserted below the lesser tuberosity. There is a small *teres minor*, but, as in *Gymnura*, no trace of the *supinator longus*. The *palmaris longus* is large, with a distinct tendon, which, passing downwards internal to that of the *flexor carpi ulnaris*, becomes superficial to it, and glides over the prominent pisiform bone (to which the latter is attached) into the hand, becoming there connected with the palmar fascia, and giving origin wholly or in part to the *palmaris brevis*, from which is derived the *flexor perforatus* for the pollex and outer finger, the *flexor sublimis digitorum* supplying the three middle toes only. *Lumbricales*, when present, are rudimentary, and connected with the third and fourth digits only.

In the hind limbs the *sartorius*, so feebly developed in *Gymnura*, is represented by two strong muscles:—one from the fascia covering the *iliacus* and from the margin of the pelvis in front of the acetabulum; the other, as large, from the margin of the pelvis lower down, midway between the acetabulum and the symphysis pubis. Both are inserted into the tibia, the first above the second, below the attachment of the internal lateral ligament of the knee-joint.

These two well-developed muscles are evidently the differentiated representatives of the muscular aponeurosis covering the adductors, and of the small muscle which joins it from the pectineal line in *Gymnura*.

The *semitendinosus* arises simply from the tuber ischii, and is inserted into the tibia behind the tendon of the *gracilis*; it has no connexion with the *biceps flexor cruris*. *Extensor digitorum longus*, as in *Gymnura*, arises from the external condyle of the femur, and supplies tendons to the four outer toes; these vary considerably in number, arrangement, and connections with other tendons. The *peronei* muscles are quite similar to those in *Gymnura*, but vary very much in the different species in their modes of origin and connections with the tendons of other muscles. *Plantaris* is well developed; and its tendon passes into the sole of the foot precisely as in *Gymnura*; but in some species the *flexor digitorum brevis* has also a calcaneal origin. The *tibialis posticus* is represented, as in *Gymnura*, by a pair of muscles in *E. europæus, concolor, macracanthus, niger*, and *blanfordi*; the internal muscle, however, is much smaller than in that genus, and arises from the head of the tibia only, and is altogether wanting in *E. deserti, algirus, pictus*[1], *heterodactylus*, and *diadematus*, which have the centre callosity of the sole of the foot rudimentary or absent.

Flexores digitorum et hallucis longi, although united into a single tendon before crossing the ankle-joint, are easily distinguishable in the leg. In the foot this tendon (in *E. macracanthus, niger, blanfordi, pictus, micropus*) is joined by a *flexor accessorius* arising from the os calcis. *Lumbricales* exist in *E. europæus, concolor, grayi, macracanthus*, and *micropus*, but are represented by one or two very small muscles connected with the deep flexor tendons for the third and fourth toes, or, as in *E. micropus*, for the second toe only. *Flexor digitorum brevis* (noticed above), in the long-toed species, as *E. europæus, concolor, macracanthus, blanfordi, niger*, arises almost wholly from the expanded tendon of the plantaris; in the short-toed, as *E. micropus, heterodactylus, diadematus*, it is also largely connected with the fibrous aponeurosis, attaching the sides of the *plantaris* tendon to the os calcis, and a few fibres arise directly from the bone itself; but nearly all the muscular fibres arising from the os calcis external to the tendon of the deep flexor really belong to the *abductor ossis metacarpi minimi digiti*.

Many other points of great interest are noticeable in the muscular anatomy of the species of the genus *Erinaceus*, which will be found treated of in the work from which these notes are taken (referred to in the footnote to the first page of this paper), which the writer hopes soon to publish.

As might be expected from the comparatively much shorter jaws of the species of *Erinaceus*, the palate-ridges are less in number than in *Gymnura*, being nine only. The tongue is similar in general appearance; but the filiform papillæ are bifid, and there are three circumvallate papillæ; tonsils comparatively small, the depression shallow and vertical, opening outwards and backwards.

The digestive organs in the Common Hedgehog have been described by Prof. Flower[2]. They probably more closely resemble those of *G. rafflesii* than do those of any of the other species of the genus. The chief differences observable are in the shape of the stomach (fig. 3, p. 398), which has the cardiac extremity more expanded

[1] Probably absent in *E. micropus* also; but the specimens of that species examined had had the upper parts of the legs removed.

[2] Lectures on the Comparative Anatomy of the Organs of Digestion of the Mammalia, by W. H. Flower, F.R.S., Hunterian Professor. Publ. in 'Medical Times and Gazette,' 1872, ii. p. 2.

upwards and to the left side; and in the liver (fig. 5), which has a much shorter and thicker caudate lobe (as indeed might be expected in a comparatively much shorter animal). But very considerable variability in the forms of both these organs is observable in the different species, no two species agreeing closely. The intestinal canal, however, in length and in its general construction is very similar throughout the whole family.

The lungs are constructed very much on the same plan as in *Gymnura*; but they are comparatively smaller, as might be expected in animals depending on their armour, and not on their speed, in making their escape when attacked by enemies. The right lung is divided more or less completely into three lobes; but the left is quite undivided; the azygos lobe is well developed and pyramidal in outline, the apex of the pyramid, not the base, as in *Gymnura*, being at its lower extremity (fig. 7, p. 400).

The *uterus* (fig. 9, p. 401) scarcely differs in form throughout the species. It exibits an advance in development; for, although the cornua are even longer than in *Gymnura*, there is a true corpus uteri, into which they open at right angles. The os uteri is not enclosed in a hood, as in *G. rafflesii*; but one or two deep folds occupy the uterine extremity of the vagina, which are so large that, as John Hunter remarked, they appear at first as if they were the os uteri[1].

A review of the anatomy of the species of *Erinaceus* not only adds valuable aid in attempting their systematic arrangement, but also, when we compare it with that of *Gymnura*, leads to the conclusion that they are but differentiated forms of some animal of which we have very probably a close representative in *G. rafflesii*, which we may expect will be hereafter proved to be a very ancient form, perhaps one of the sole survivors of a once widely extended group of predaceous Insectivora.

EXPLANATION OF THE WOODCUTS.

Fig. 1. Crown of first upper molar, right side, of *Gymnura rafflesii*, showing the fifth central cusp, which is connected by a $\wedge$-shaped ridge with the bases of the two internal cusps.

2, 3. Stomach of *Gymnura rafflesii* and of *Erinaceus europæus* (reduced).

4, 5. Posterior surfaces of livers of the same species (much reduced).

6, 7. Lungs of the same species, from below, half natural size.

8, 9, Uteri and vaginæ of the same species. The uterus of each is shown in section; the vaginal walls are divided and reflected. The different positions of the urethral aperture (*ur*) in the two species is noticeable, and the presence in *G. rafflesii* of a hood concealing the os uteri (*o u*).

10, 11. Anterior halves of the skulls of *Erinaceus europæus* and *E. blanfordi* (enlarged).

Figures 1, 10, 11 are from enlarged drawings by Mr. Mintern, from specimens in the collections of the British Museum and of Mr. W. T. Blanford, F.R.S.; figures 2–9 have been reduced by Mr. Smit from drawings by the author.

[1] As no specimen of a male *Gymnura* has yet been obtained for examination, the male organs of *Erinaceus* are not referred to here; they will be found fully described in the work referred to on p. 389, as well as all other parts which have been but cursorily touched upon or are not described in this abstract.

March 15, 1881.

Prof. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of February 1881:—

The total number of registered additions to the Society's Menagerie during the month of February was 60, of which 1 was by birth, 24 by presentation, 23 by purchase, 2 by exchange, and 10 were received on deposit. The total number of departures during the same period, by death and removals, was 95.

The most noticeable additions during the month of February were as follows:—

1. A female Bactrian Camel (*Camelus bactrianus*), formerly belonging to Ayoub Khan, which Col. O. H. St. John, F.Z.S., has purchased from its capturers at Kandahar and presented to the Society.

2. A male Wild Sheep, obtained from Afghanistan, and presented to the Society by Capt. W. Cotton, F.Z.S. I had at first registered this animal as *Ovis cycloceros*, not knowing where else to refer it, although it obviously deviated somewhat in the more open and backward curvature of the horns from the ordinary character of that species. But Mr. Blanford has pointed out to me that it clearly belongs to the Afghan form of this species, lately described and figured by Mr. Hume as *Ovis blanfordi*[1].

Mr. R. Bowdler Sharpe exhibited a specimen of the so-called Sabine's Snipe (*Scolopax sabinii*, Vigors), which had been shot by the Hon. W. W. Palmer, at Woolmer Pond, near Selbourne, Hants. This form was now well understood to be a melanoid variety of the Common Snipe (*Gallinago scolopacina*).

Mr. A. G. More exhibited some eggs of the Red-necked Phalarope (*Phalaropus hyperboreus*), believed to have been taken in England, and an egg of the Tree-Pipit (*Anthus arboreus*), taken near Dublin, this bird having been considered only doubtfully Irish. Mr. More also exhibited a specimen of the Red-crested Pochard (*Fuligula rufina*), obtained near Tralee, being the first instance on record of the occurrence of this species in Ireland.

The following papers were read:—

[1] J. A. S. B. xlvi. pt. 2, p. 327 (1877).