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THE ANATOMY OF ERETHIZON EPIXANTHUM EPIXANTHUM

(YELLOW - HAIRED PORCUPINE)

by

EDNA IRENE PALMER

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INTRODUCTION

A tree porcupine, Erethizon epixanthum epixanthum Brandt, weighing 23 lbs., was obtained from Aspen Grove, Merritt, British Columbia at an elevation of 3400 feet, on August 17th. 1932. All the dissection was performed on this single uninjected specimen, which was preserved in a fluid consisting of formalin and glycerin.

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CLASSIFICATION

Phylum Chordata

Subphylum Vertebrata

Class Mammalia

Subclass Eutheria

Order Rodentia

Family Erethizontidae

Subfamily Erethizontinae

Genus Erethizon

Species Epixanthum

Subspecies Epixanthum

Keys: Synopsis of the Mammals of North America and the Adjacent Seas (5).

Field Book of North American Mammals (1).

THE ANATOMY OF ERETHIZON EPIXANTHUM EPIXANTHUM.

External Features.

The body is divisible into head, neck, trunk and tail. The head is relatively very small. The neck is short and thick. The trunk is very thick and bulky. The tail is curved, short and stumpy. It is moderately wide and thick, being almost four sided in appearance, and narrows towards the tip. The limbs are short, but strong and the fore and hind feet bear large claws.

The snout is short and very thick, so that from the tip of the nasal openings to the crown of the head there is only a very slight slope upwards, the head being almost completely flat. The head is broad, the greatest width being in the zygomatic region. It narrows slightly posteriorly and considerably anteriorly at the snout. The external nares consist of two large apertures. The height of the muzzle is 25 mm.

The eyes are relatively very small and are situated high up on the side of the head about 12mm. from the top, and are 41 mm. from the tip of the snout and 50 mm. from the base of the ear. The eyes have an upper and a lower eyelid and a prominent, large, nictitating membrane. The latter arises from the inner canthus of the eye and lies partly over the eyeball.

The mouth is large and measures 34 mm. from the incisors to the corner of the lips. The greater portion of the lips was cut off when the skin was removed. There are two prominent upper and lower incisor teeth, the upper protruding over the lower.

The external ear was partly cut off in removing the skin, but is apparently small and somewhat hairy within.

The forelimb consists of the upper arm or brachium, the antibrachium and the manus. The manus is broad and short. There are four digits corresponding to the second, third, fourth and fifth digits of the typical vertebrate skeleton. Each digit is armed with a strong, curved, blackish-brown claw. The volar part of the manus is naked, and the skin is thick and black and is covered with rough tubercles. Well - marked digital and palmar pads are present; the carpal pads are not clearly defined. The palmar pad has three lobes of which the outer is the largest, the inner the smallest. The digits are slightly united by naked integument at the base, more so in the manus than in the pes.

The hind limb consists of the femur, the crus and the pes. The pes is longer than the manus. The hindfoot differs from the forefoot in having five digits present. These are short, thick and not widely separable. The digits are shorter than those of the forefoot. The digital pads are fairly prominent and end at the proximal portion of the claw. The plantar pad has three lobes, but they are not well - marked; the two outer lobes are the largest. The metatarsal pads are not apparent. The hallux arises slightly lateral and in front of the inner plantar lobe. Tubercles are present on the sole of the hindfoot but differ from those of the forefoot in being overlapped.

The anus is situated in the mid - ventral line anterior to the base of the tail.

It is not possible to give a description of the external genitalia due to the fact that the skin was removed from the animal, thereby destroying any indication of the outpouchings of the scrotal sacs and the position of the external male urogenital orifice.

The skin was examined apart from the body, but the various regions were made out as far as possible and described accordingly. The protective structures in the skin consist of quills and hairs. The hairs occur in tufts near the base of the quills, leaving small bare areas of skin between the tufts. Owing to the arrangement of the hairs and quills, however, these bare areas are not visible from the surface.

Over the dorsal surface of the trunk, except in the posterior portion, there is a large number of very long guard hairs, straw - colored and tipped with greenish - yellow, among the quills. These are directed posteriorly and cover the quills in this region and give a yellow tinge to the dorsum and flanks. The posterior portion of the trunk is blackish - brown in color. On its dorsal surface the tail has a blackish - brown central strip on either side of which are straw - colored regions. More lateral still and also on the ventral surface of the tail, the straw and dark brown colors are mixed.

Ventrally, the trunk is grayish - black mixed with white. Over the shoulder and forelimbs grayish - black and light straw - colored hairs are mixed. In the hind limb light and darker straw - colored hairs mingle with the grayish - black hairs and there is a predominance of straw - colored hairs on the back of the foot.

The above description gives a general idea of the color of the skin of the animal; the hairs and quills will now be described more in detail.

Anterior to the pelvic region, the quills are hidden by the long, straw - colored guard hairs, and finer, shorter brown hairs, but posteriorly and over the hips the quills are more noticeable, there being no guard hairs, also the quills are directed more dorsally than on the anterior

portion of the back, They form conspicuous thickets on the hips, also over the shoulder, but not to the same extent.

The hairs and quills vary in length, thickness and color in the various regions of the body.

The hairs contain a central pith. The guard hairs are long (117 - 190 mm.) and coarse. The majority of these have a wide, dark brown band (95 mm) between a white, gray or yellowish, narrow basal portion (15mm.) and an upper straw - colored part (70mm). The tip of the hair is greenish - yellow. The basal portion varies in width, as does the brown portion. A number of hairs is uniformly straw - colored. Occurring among the quills on the dorsum and flanks is a large number of fine, short hairs (50 - 60 mm. long) having the upper half blackish - brown, the lower white. The fine hairs of the posterior portion of the trunk and tail are much darker in color. Some of the hairs in this region have no white portion but are entirely dark in color.

On the limbs the hair is directed downwards. On the forelimb most of the hairs are coarse and straw - colored with a dark brown basal portion. These are 115 - 120 mm. in length. Some are in the nature of bristles. Some have the basal portion white; this type is shorter (90 mm.). There is a large number of short, fine, grayish - brown hairs 27 mm long. Along the ventral margin of the forelimb are finer gray hairs 40 mm. in length. There are some short hairs which are uniformly white, and others that are white but gray at the base. Short fawn - colored, fairly fine hairs arise from the sides of the digits and are directed towards the claws. Similar hairs arise around the sole of the forefoot. The hairs are longer on the outer side of the forefoot than on the

inner. The hair on the side of the forefoot is short but hangs down.

The hind foot has thick bristly brown hairs about 20 mm. in length. Longer straw colored hairs arise from the upper portion of the hind foot and hang down over the brown hairs. Hair is present on the back, front and sides of the digits and hangs partly over the claws. It is short fine hair, fawn in color.

Blackish - brown hairs (50 - 60 mm. long) occur in the dorsal central strip of the tail. Lateral to this is a number of long (120 mm) straw - colored hairs, which are coarse and stiff. Among these are shorter finer hairs having the upper portion gray and the lower white. There is also a number of stiff brown bristles. Laterally and ventrally, mixed with straw - colored hairs are short, stiff brown bristles (48 mm long). These are lighter in color at the base. Also straw - colored bristles with a light band at the lower half occur in this area. The under surface of the tail is almost entirely covered with brown bristles with a few light straw - colored hairs, also white hairs, brown at the base, and some hairs uniformly straw - colored. The short straw - colored hairs are darker, more of a brown shade than the long straw - colored hairs. The straw - colored hairs of the tail are coarser than those of the back. There is a number of long straw - colored hairs forming a fringe around the end of the tail.

On the ventral surface of the trunk, the hairs are short, fairly fine and are gray in color, tipped with white and have a white base. Some of the hairs have the lower part gray, the upper part white and others are completely white. There are a few very fine short hairs, some gray and some white with gray tips. The grayish hairs are not as coarse as the

straw - colored.

The quills are modified hairs and contain a central pith. They are straight, pointed, very stiff and strong. The pointed end is barbed. The barbs overlap each other and the points of the barbs are directed towards the base of the quill. The basal portion of the quill narrows and fits into the hair follicle.

On the dorsal surface of the body, the quills occur very close together and are directed slightly dorsally and posteriorly; they overlap one another. They form a very deep layer in this region. On the posterior portion of the trunk and over the hips, the quills are sparser but stronger. They are also extremely sharp and stand more perpendicularly to the skin, although inclined slightly caudally.

On the back of the animal the deeper quills are whiter than those nearer the surface, which are slightly yellow. The majority of the quills are white or yellowish - white and brown towards the tip, with the extreme tip dark brown. They are from 57 - 70 mm. in length and 1.1 mm. in diameter. A few, situated on the anterior part of the back, are white except for the extreme tip. There are a few longer white quills (82.5 -84 mm. in length and about .9 mm in diameter) with a brown band below the tip. These are more in the nature of bristles being not as stiff as the typical quill and less sharp.

In the region of the posterior portion of the trunk and hips the quills are shorter and the diameter twice as great (64 mm. long and 2.5 mm. in diameter). They are white with a blackish - brown band toward the tip. The barbs on these quills are more prominent than on those of the

anterior portion of the back. Other quills are white except for the extreme tip which is brown and these are longer (85 mm. in length).

Quills, smaller in diameter and finer, occur on the flanks. They diminish gradually in diameter and become less stiff and sharp towards the trunk. The majority are white with brown tips. Ventrally, over the surface of the trunk, there are stiff bristle - like hairs in place of quills.

There are thick clumps of short quills 45 mm. in length, over the shoulder. There are no quills on the fore and hind limbs.

The quills in the tail are similar to those on the posterior portion of the trunk and are arranged in the same way. In the central strip they are covered by black hairs. Lateral to this the quills are very conspicuous. All are white and have lighter brown or darker brown tips. There is a number of much shorter quills (45 mm in length) mixed with these. Towards the lower surface of the tail, the quills occur closer together, have a smaller diameter, and form a deep layer. They are not as sharp or as large as the other quills. On the under surface of the tail there are no quills, but short bristle - like stiff hairs, very thick and occurring close together.

External Measurements.

Total length (tip of tail to end of snout)	900 mm.
Length of tail (tip to anus)	150 mm.
Trunk in abdominal region (mid-dorsal line to mid - ventral)	290 mm.
Length of manus	90 mm.
Length of pes	150 mm.

THE SKELETAL SYSTEM.

The Vertebral Column.

There are six cervical vertebrae, fifteen thoracic, six lumbar, three sacral and fourteen caudal vertebrae.

The Cervical Vertebrae:

The atlas, the first cervical vertebra, is broad with expanded transverse processes. The dorsal portion of the vertebra is wider than the ventral. Dorsally there is a very small spinous process, and ventrally a small tubercle. The lateral walls have anteriorly, two large, concave, articular surfaces which receive the occipital condyles of the skull. Posteriorly, in a similar position, are two prominent, but slightly smaller, rounded, concave articular surfaces, for the anterior articular processes of the axis vertebra. There are a number of foramina connected with one another and which are traversed by the vertebral artery. On each side there is a small aperture in the inner surface of the neural lamina above the anterior articular cavities. Dorsally there is another foramen at the anterior end with a smaller foramen posterior to it; ventrally, on the side of the vertebra, there is a large opening and another one is present posteriorly, lateral to the posterior articular cavity.

The axis is very large and has a prominent dorsal spine which extends beyond the anterior and posterior borders of the vertebra. From left to right the axis is smaller than the atlas, but it is twice as large from its anterior to its posterior margin. From the centre of the ventral arch the short thick odontoid process projects anteriorly and articulates with the atlas. On either side of this are two rounded

anterior articular processes for the atlas. The posterior margin is prolonged to form the posterior articular surface or postzygapophyses. Ventrally the centrum exhibits a slight ridge, the hypapophysial ridge. The centrum is twice as large as that of each of the remaining cervical vertebrae. The transverse processes are short, narrow and perforated and project ventrally, posteriorly, and somewhat outward. They are formed by two projections, one from the pedicle, the other, which is extremely narrow, from the centrum, the two uniting laterally and enclosing between them the vertebral canal. The remaining cervical vertebrae have dorsal spines. The neural laminae are exceedingly narrow antero- posteriorly. Laterally, there is a long anterior projection, the prezygapophysis and a similar, but smaller posterior projection, the postzygapophysis. These processes are for articulation with adjacent vertebrae. The transverse processes are formed as in the axis. The fifth cervical vertebra, however, has the ventral root from the centrum much wider. The last cervical vertebra has an articular surface posteriorly on the centrum for articulation with the head of the first rib.

The Thoracic Vertebrae:

The thoracic vertebrae have well - developed dorsal spines, with the exception of the last five, in which the spines are reduced to form broad ridges. The spines are higher than those of the cervical vertebrae. The size of the neural laminae from the anterior to the posterior margin increases from the first to the sixth thoracic vertebrae, the remaining laminae being similar in size. The first thoracic vertebra has the neural arch the same size from left to right as that of each of the cervical vertebrae; the neural arch of the second thoracic vertebra is slightly

larger, while that of the third is narrower than the neural arch of each of the cervical vertebrae and the neural canal is accordingly smaller. The anterior and posterior articular surfaces are similar to the last four cervical vertebrae with the exception of the last five which have very large and long prezygapophyses and postzygapophyses, particularly those of the last two thoracic vertebrae. The articular surfaces are so arranged that the prezygapophyses of one vertebra embraces the postzygapophyses of the preceding vertebra. The prezygapophysial surface is concave, the postzygapophysial surface convex. The transverse processes are shorter but broader than those of the cervical vertebrae and arise by one root only from the summit of the pedicle. They project laterally and slightly dorsally. They have a tubercular surface distally for articulation with the tubercle of the rib. The seventh to the tenth thoracic vertebrae have their transverse processes projecting anteriorly and posteriorly to form a metapophysis and an anapophysis. The eleventh to the fifteenth thoracic vertebrae have an anapophysis only, and those of the fourteenth and fifteenth thoracic vertebrae are very long and prominent. The centra have two capitular surfaces, an anterior and a posterior, for articulating with the heads of the ribs.

The Lumbar Vertebrae:

The lumbar vertebrae are much more massive and increase in size posteriorly. The prezygapophyses and postzygapophyses are similar to those of the last five thoracic but are thicker and longer. The dorsal spines are prominent, elongated from before backwards, and project dorsally. The transverse processes are broad but short and project laterally. The anapophyses, with the exception of the last, are extremely well developed

projecting caudally as far as the anterior margin of the succeeding transverse processes. There are no anapophyses present on the last lumbar vertebra. None of the lumbar vertebrae have metapophyses.

The Sacral Vertebrae:

The three sacral vertebrae are fused to form the sacrum. Ventrally, two transverse lines indicate the limits of the vertebral centra and at each end of each line there is a large foramen, the ventral sacral foramen. The dorsal spines are similar to those of the thoracic vertebrae. The zygapophyses are fused but the ridge formed by the postzygapophysis is apparent. External to these on either side is a large foramen, the dorsal sacral foramen; there are four in all. The transverse processes coalesce to form "lateral masses." The prezygapophyses of the first sacral vertebra are large and articulate with the last thoracic vertebra, while the postzygapophyses of the third sacral vertebra articulate with the first caudal vertebra.

The Caudal Vertebrae:

The first caudal vertebra resembles the last lumbar in regard to its spine and articular processes. The transverse processes however, are much larger and project posteriorly. The second caudal vertebra is smaller, the transverse processes narrower, and the articular processes are smaller. The neural canal is also smaller and the centrum, from before back, is about one half the size of that of the first caudal vertebra. There is a gradual decrease in the size of the caudal vertebrae and their processes posteriorly, and the neural canal likewise becomes smaller. The last vertebra is one half the size of the one anterior to it, to which it is fused, and consists of the centrum, small transverse processes and very small prezygapophyses. The transverse processes of the first six caudal

vertebrae are large; beyond this point, they gradually diminish. The neural spine is distinct but becomes smaller posteriorly and is absent on the last two vertebrae. The postzygapophyses decrease in size posteriorly and are absent in the last two vertebrae. The prezygapophyses are present in all the caudal vertebrae, and are larger than the postzygapophyses. Chevron bones are articulated ventrally beneath the adjacent ends of the caudal vertebrae and are seven in number. They commence below the third and fourth caudal vertebrae. They are comparatively large in size but diminish posteriorly. They were not found between the last three vertebrae but there is a possibility that these may have been lost in the cleaning of the skeleton. The chevron bones are composed of two flat bones, concave on their outer surface and fused at their inner surface. At the ventral margin, some are not completely fused and a narrow furrow is left between the two halves. The dorsal parts of the two plates are not fused together but extend slightly ower the sides of the centrum. The first chevron bone has the two plates fused only at the ventral margin forming a haemal arch, and a canal is left between this margin and the centrum. The second chevron bone has a small canal also.

The Sternum:

The sternum is composed of seven segments, the sternebrae. The first, or manubrium, is broad and strong. It consists of a comparatively flat area anterior to which the clavicles are attached laterally. Posterior to this is a large medial elevation.

The body of the sternum is composed of the next five sternebrae. The second sternebrae is shorter than the manubrium.

The seventh sternebra forms the xiphoid process. It is long and narrow, widening posteriorly where it is attached to the xiphoid cartilage. The latter is large, thin and somewhat crescent - shaped.

The Ribs:

There are fifteen pairs of ribs; eight true ribs and seven false ribs, of which, the last five are floating ribs.

The rib consists of a dorsal part, the vertebral rib, and a ventral portion, the sternal rib or costal cartilage.

The true ribs are attached to the sternum by their costal cartilages. Of these, the first is attached to the manubrium towards its posterior end, the remainder at the junction of the sternebrae. Of the false ribs the ninth is attached by its cartilage to the eighth, and similarly the tenth to the ninth rib. The floating ribs end freely.

The proximal end of the rib is thickened and forms the capitulum which is attached to the centra of the vertebrae. Posterior to the capitulum the rib narrows to form the neck and this terminates in the tuberculum which is the surface for articulation with the transverse process of the vertebra.

The first rib articulates with the centra of the sixth cervical and the first thoracic vertebrae by its capitulum, and with the transverse process of the first thoracic vertebra by its tuberculum. All the ribs are similarly attached.

The Skull:

The skull is elongated and its roof is very flat. The skull, from the nuchal crest to the tip of the nasal bones, is 10.5 cm. long. The zygomatic width is 7.5 cm. From the condyles to the crest of the supra-occipital is 2.2 cm, and from the base of the incisors to the nasal bones is 2.6 cm. The sutures are clearly defined.

Posterior to the external nares, on the facial portion of the roof of the skull are the paired nasal bones. These are extremely elongated (4.1 cm. in length), somewhat narrower posteriorly than anteriorly.

Lateral to the anterior three fourths of the nasal bones are the premaxillae which form the anterior part of the upper jaw. These are very large plates extending back to the anterior margin of the infra - orbital foramen, and thus forming the lateral wall of the skull anterior to that foramen. The ventral portions of each premaxilla projects beyond the nasal bones. These portions meet in the mid ventral - line and support the two upper incisor teeth. Ventrally, anterior to the palatine process of the maxilla there is a long foramen, the incisive foramen.

Behind the nasals are the paired frontal bones. These are not as long as the nasals, but are wider. Anteriorly, together, they send a very small triangular process between the nasal bones. They extend lateral to the nasals for 1 cm. and meet the premaxillae. There are no poster-bital processes and thus the orbit and the temporal fossa are confluent. The lateral part of the frontal bone forms part of the medial wall of the orbit and temporal fossa. The two frontal bones are separated by the frontal suture. Posterior to the frontal bones and separated from them by the coronal suture are the large paired parietal bones. The parietal

crest is well marked and after proceeding anteriorly for 2.5 cm. it curves outwards and forms a less prominent ridge which extends to the posterior margin of the temporal fossa where it is continued in a ventral direction by the frontal bone. There is no indication of an interparietal bone.

The occipital bone is unpaired and consists of the supra - occipital bone above the foramen magnum, the ex-occipitals lateral to the foramen and the basi - occipital, ventrally placed. The supra - occipital bone measures 4.3 cm. from left to right and medially has a slight ridge. Where the supra - occipital meets the parietal bones it forms a prominent ridge, the nuchal crest. The foramen magnum has its upper margin rounded, while its lower margin converges to a point ventrally. Lateral to the foramen magnum are two occipital condyles for articulation with the atlas vertebra, and they are supported by the ex - occipital bones. The par-occipital processes are prominent vertical bones and are applied to the posterior portion of the auditory bullae. The basi - occipital is long and extends forward to meet the basisphenoid in a line with the ends of the pterygoid processes.

Posterior to the premaxilla on the lateral surface of the skull is the maxilla. It bears the infra - orbital foramen which is exceedingly large, measuring 2.5 cm. from the dorsal to the ventral margin and being 1.5 cm. wide. The maxilla extends only a few millimeters anterior to the foramen, but it is quite extensive ventrally and posteriorly, this part being triangular in shape. The palatine process of the maxilla is wide anteriorly but narrows posteriorly and forms part of the hard palate, which is extremely narrow. The alveolar margin supports the premolar and molar teeth. The palatine processes of the maxillae meet in the mid - ventral

line to form a ridge at the side of which are two pairs of foramina. Between the premolar and the incisor foramen there is a prominent ridge on either side of the mid-line. Near the base of the premolar, the maxilla sends a narrow bar of bone, the malar process, dorsally and slightly posteriorly, which expands to meet the malar bone. Anterior to the base of this process there is a small concavity. On the inner side of the process at the base there are two small foramina.

The zygomatic arch is formed anteriorly by the malar, and posteriorly by the zygomatic process of the squamous portion of the temporal bone. It is supported anteriorly by two slender portions of the maxilla. The malar bone is greatly expanded anteriorly and is almost rectangular in shape. It forms the greater part of the orbit. Posteriorly the narrow zygomatic process of the malar curves inward to meet the slightly wider zygomatic process of the squamous portion of the temporal bone.

The squamous portion of the temporal bone occurs below the lateral border of the parietal bone. It is narrow and elongated reaching to the mastoid process. Its zygomatic process arches laterally to meet the zygomatic process of the malar bone.

The mastoid process is a small triangular bone forming the lower portion of the nuchal crest. It lies lateral to the paramastoid process of the occipital bone and is applied to the tympanic bulla. Anterior to the mastoid process is the stylomastoid foramen for the facial nerve.

The auditory bulla is large and contains the external auditory meatus.

The basisphenoid is situated anterior to the basi-occipital. The suture between the former and the presphenoid anterior to it is not distinguishable. From the basisphenoid a narrow bar of bone extends later-

ally on each side in front of the auditory bulla and expands anteriorly and posteriorly to meet the squamous part of the temporal bone, this is the alisphenoid bone. At their roots the alisphenoids extend forward as the pterygoid processes to meet the posterior ends of the palatines. There is a narrow backward projection from each process which curves slightly dorsally. The posterior ends of the processes are fused to the auditory bulla on each side of the head. Between this process and the expanded portion of the alisphenoid is situated the pterygoid fossa. The alisphenoid bears three foramina.

The palatine bones are situated posterior to the palatine processes of the maxillae. The perpendicular parts of the palatines form the lateral walls of the posterior mares; the horizontal parts the posterior portion of the hard palate. The ventral plate on each side is pierced by the posterior palatine foramen which is situated posterior to the expanded portion of the maxilla. The vomer is a narrow median bone anterior to the presphenoid.

The roof of the nasal fossae consists of the nasal bones and a small part of the frontals. The nasal fossae are separated by a median perpendicular plate the ethmoid plate. The cribriform plate extends transversely across the nasal fossae and meets the ethmoid plate posteriorly. There are two thin lateral ethmoid plates on either side of the mesethmoid extending from the cribriform plate.

While the bones of the roof of the skull were being removed, several sinuses were noticed. There is a large, deep, frontal sinus present. Anterior to this there is a long, wide sinus, the outer wall of which is formed by bone lining the nasal fossa. This is apparently an air space in

the premaxilla, and is extra to the sinuses present in the cat, (12).

The Mandible:

The lower jaw or Mandible is massive and consists of an ascending ramus on each side and two horizontal rami which meet in a well-developed symphysis. The lower border of the horizontal ramus of the mandible is very strongly concave. The upper border contains the alveoli for the teeth. There is a comparatively large diastema between the incisors and the premolars. The angular process is large and projects posteriorly from the lower border of the ascending ramus for 11 mm. It forms a narrow shelf in the inner side of the mandible. The posterior border of the ascending ramus is concave and forms dorsally a small process, above which is the short rounded condyle of the mandible for articulation with the glenoid surface of the zygomatic process of the squamous portion of the temporal bone. This is the highest prominence of the mandible. Anterior to this the upper margin slopes ventrally. At the level of the beginning of the third molar, the coronoid process projects dorsally and slightly posteriorly. Its anterior margin is much larger than its posterior. The outer surface of the mandible is considerably grooved. There is a very deep depression near the upper border between the condyle and the coronoid process. The inner surface of the ascending ramus has a deep fossa. Behind the last molar on the inner side there is the dental foramen.

The Hyoid Apparatus:

The hyoid apparatus consists of the body of the hyoid, or basi - hyal and two pairs of cornua. The body of the hyoid is a strong transverse bar having its anterior border projecting medially to form a cranial process. The process is compressed laterally and has a blunt end. The cornua extend from the lateral margins of the basi-hyal. The anterior cornua are long, narrow, bony rods passing over the ventral surface of the tympanic bullae to their more posterior portion. The posterior cornua pass back and articulate with the superior cornua of the thyroid cartilage. The posterior cornua are thick and strong anteriorly, but thin posteriorly.

The Pectoral or Shoulder Girdle:

The pectoral girdle consists of the scapula and clavicles. The scapula is an exceedingly thin, flat, bone with a well-developed dorsal spine. The axillary border is straight, the vertebral slightly curved, and the anterior border very strongly convex. The scapula narrows ventrally to form the neck, at the extremity of which is the glenoid cavity which receives the head of the humerus. The anterior border, beyond the point where it narrows ventrally, forms a rounded short projection, which is directed ventrally; this is the coracoid process and it forms part of the glenoid cavity. At the termination of the spine there is a large flat triangular porcess projecting backward, the metacromion, and the large process the acromion projects beyond it anteriorly. Both of the latter extend beyond the glenoid cavity over the more proximal portion of the humerus. Anterior to the spine is the supraspinous fossa, and posterior to it is the infraspinous fossa, both of which are well-marked, as is also the subscapular fossa on the inner surface of the scapula.

The clavicles are curved and narrow but quite well-developed. The anterior margin of each is concave, the posterior convex. The part of the clavicle nearest the scapula becomes wider and flatter. The clavicle is firmly attached to the coracoid process by the coraco-clavicular ligament, and to the acromion process by a ligament. It is more loosely connected with the sternum by a cartilaginous portion at its inner end. This is the only portion of the clavicle which is cartilaginous.

The Skeleton of the Forelimb:

The humerus is short but stout. It articulates with the glenoid cavity by a rounded head which is directed slightly caudally. Its inner surface at its proximal end is marked by a deep depression, the bicipital groove. There is a small tuberosity lying medial to the head, the lesser tuberosity of the humerus, and a larger tuberosity external to the bicipital groove, the greater tuberosity. Extending from the greater tuberosity is the deltoid ridge which is extremely well-developed. Its distal portion reaches slightly beyond the middle of the humerus. Extending distally from the lesser tuberosity is the medial ridge. The distal extremity of the humerus is considerably expanded. The external and internal epicondyles occur at the end of two prominent ridges the external and internal epicondylar ridges. Between the two condyles on the posterior surface is a very deep triangular-shaped fossa, the olecranon fossa. This is separated from the coronoid fossa on the anterior surface by a thin bone. The articular surface has a rounded prominence at its outer portion, the capitellum; this articulates with the radius. Internal to this is the surface for articulation with the ulna, the trochlea.

The radius is about the same length as the humerus. It is situated

upon the cranial aspect of the forearm. It is arched considerably leaving a large space between it and the ulna. Its lower half increases in width towards its extremity. Its upper portion is narrowed to form the neck, above which it enlarges to form the head of the bone. The head is concave above for articulation with the humerus. Upon the inner border, below the neck, there is a slight bicipital tuberosity. The anterior surface distally is marked with two small grooves. The caudal border has a facet for articulation with the ulna.

The ulna is much longer than the radius. At its proximal end is the deep sigmoid cavity for articulation with the trochlea of the humerus. Its lower border is prolonged into a short process, the coronoid process which has a small facet laterally for articulation with the radius. The proximal extremity projects upward behind the humerus to form the olecranon. The proximal border of the sigmoid cavity bears the tricipital process, and above this is the shallow tricipital fossa. The medial surface, towards its proximal end, has a deep fossa. The distal portion of the ulna is narrower than the proximal. The lower epiphysis is united to the shaft, and terminates in a well-marked styloid process.

The bones of the manus could not be examined as it was removed with the skin.

The Pelvic Girdle:

The pelvic girdle consists of the pubis, ischium and ilium. These three bones are indistinguishably fused to form the innominate bone. They concur in the formation of the acetabulum.

The body of the ischium is wide and forms the posterior part of the acetabulum and here, at the caudoventral border of the rim of the acetab-

ulum, is a deep acetabular notch. The dorsal border of the ischium, at about its middle, bears the prominent ischial spine. The ischium is continued posteriorly and terminates in the ischial tuberosity. Between the spine and the tuberosity is the inferior sciatic notch. From the tuberosity, the ischium extends ventrally to meet the pubis.

The pubes meet in a short ventral symphysis forming a flat ventral portion. The pubis is continued laterally and on its anterior border in a line with the upper part of the acetabulum is the prominent ileo - pectineal eminence.

The ilium is the most anterior part of the innominate bone. It extends anteriorly from the acetabulum. The body and the iliac wing make up the ilium, the wing being the greatly expanded portion. The ilium articulates with the sacrum on its medial surface. The cranial and dorsal border of the ilium forms the crest, which is rounded and projects outwards and bears medially the anterior superior spine. The dorsal border bears posteriorly the inferior posterior spine. Between the latter and the ischial spine is the greater sciatic notch.

The Skeleton of the Hindlimb:

The femur is short and stout and has at its proximal end a rounded head and a greater and lesser trochanter. The greater trochanter projects from the outer margin of the bone and is connected by a ridge with the lesser trochanter, which is smaller and conical in shape and projects inwardly from the posterior surface of the femur. The head bears a small pit for the attachment of the ligamentum teres. Posteriorly and on the inner side of the greater trochanter there is a deep fossa the trochanteric fossa.

About one half way up the outer side of the bone there is a small ridge. Distally there are two large external and internal condyles for articulation with the tibia and fibula. These unite anteriorly and form a deep groove, the trochlea. Posteriorly, behind the two condyles, is the deep intercondyloid fossa. The external and internal condyles have slight tuberosities above them.

The patella is very large and considerably elongated. Its inner surface is concave and articulates with the trochlea. Its outer surface is convex.

The tibia is about the same length as the femur. It is wide proximally. Here it bears ventrally a small tuberosity to which the patella is attached, and laterally two projections, the external and internal tuberosities. The external of these is very large, and has its articular surface fused with the fibula. The tibia has a well-marked cnemial crest about one half way up the front of the bone. The lateral surfaces are slightly concave, especially the outer. Distally the outer surface is fused with the distal portion of the fibula. The inner is prolonged to form the internal malleolus. Posteriorly there are two grooves on the internal malleolus, the inner of which is very deep.

The fibula is a thin slender bone and is separated from the tibia by a very wide interosseous space. The proximal portion for about 2 cm. projects anteriorly and thus forms a wide flat portion twice the width of the remainder of the shaft of the fibula. The distal end forms the external malleolus which is grooved posteriorly.

Since the pes was removed with the skin of the animal it was not possible to examine the tarsals, metatarsals and digits.

The Muscular System:

The muscles of the specimen used in the present study are described in the order followed by Howell in the "Anatomy of the Wood Rat." (9)

A short account of some of the chief muscles of Erethizon epixanthus is given by Windle. (22) These muscles were also identified in the present specimen of Erethizon epixanthum epixanthum and only a few variations were observed.

Owing to the fact that the fore and hind feet were removed with the skin of the specimen before it was received by the author, none of the muscles of the fore and hind feet, and only a few of the insertions of the muscles of the forearm and leg could be worked out.

Muscles of the Head:

(1) Superficial Facial Musculature.

The platysma is the facial portion of the superficial panniculus muscle. It is a well-defined sheet of muscle arising by two heads. The wider, more dorsal portion, originates behind the ear, from the ear to the mid-dorsal line, and passes latero-craniad over the side of the neck to join a narrow ventral portion arising from the body of the sternum posterior to the manubrium. The latter portion extends over the ventral portion of the parotid gland. The muscle then passes towards the angle of the mouth, some fibres merging with the orbicularis oris upon the chin, others proceeding towards the mid - ventral line. Although a part of the fascia was torn when the skin was removed, there is some indication that dorsally the fascia extends for a short distance posterior to the ear.

The sternofascialis is a well - developed muscle rising from the

manubrium of the sternum anterior to the platysma. It runs forward and widens to spread over the masseter deep to the platysma. It is attached to the zygomatic arch.

The orbicularis palpebrarum is poorly developed. Its fibres are concentrically arranged and are attached to bone only at the inner margin of the orbit.

The orbicularis oris lies beneath the skin around the mouth and is intimately adherent to the skin.

The occipito-frontalis is a thin flat muscle consisting largely of fascia with a few muscle fibres. It runs upward from the upper border of the orbicularis palpebrarum and is attached to the fascia of the occipital, temporal and frontal regions.

The levator labii superioris alaeque nasi lies directly under the skin and on the lateral surface of the nasal region. It arises from the inner angle of the orbit and frontal bone, and is inserted into the cartilage of the nasal aperture and also blends with the orbicularis oris.

The depressor labii inferioris (quadratus labii inferioris) arises from the lower ventral border of the mandible near the symphysis. Its fibres diverge slightly from the mid-line and are inserted into the lower lip.

The buccinator muscle is well-developed. It arises from the pre-maxilla, the line of origin extending from a point near the alveolus of the incisor to the anterior border of the anterior deep masseter. Its fibres are directed ventrally and pass forward to blend with the orbicularis oris.

(11). Masticatory Musculature:

The masseter muscle is divisible into three parts: the jugo - maxillaris, the mandibularis and the mandibulo - maxillaris.

The jugo-maxillaris is the thick superficial portion arising by a strong tendon from the side of the maxilla, and from the zygomatic arch. It is invested with a tough shiny fascia and is inserted into the lower border of the internal surface of the mandible.

The mandibularis is not as well marked and li es deep to the jugo - maxillaris. It arises from the zygomatic arch, and is inserted into the external surface of the mandible.

The mandibulo - maxillaris is the most anterior portion of the masseter. It arises from the maxilla and posterior part of the pre-maxilla, between the posterior border of the buccinator muscle and the infra-orbital foramen. It passes through the foramen and is inserted on the anterior end of the external border of the mandible by a tendinous portion.

The temporalis is a large thick muscle invested in a tough shiny fascia. It has its origin on the side and dorsal portion of the skull, from the lambdoidal ridge to near the anterior portion of the frontal bone. It is separated from its fellow of the other side by the parietal crest. It fills up the temporal fossa within the zygomatic arch. Its fibres converge to its insertion on the ental and ectal surfaces of the anterior border of the coronoid process of the mandible.

The pterygoid externus rises from the pterygoid plate and is inserted upon the medial face of the mandibular condyle.

The pterygoid internus rises from the pterygoid fossa and is inserted

on the inner surface of the angular part of the mandible.

(111). Interramal Musculature:

The digastric arises from the paroccipital process. There is a slight constriction between the anterior and posterior bellies of the muscle. There is a slight attachment to the hyoid bone, and from here the anterior belly runs forward to be inserted into the ventral surface of the mandible. The two members of the pair are in contact at their insertions and are only slightly separable along the mid-line until the hyoid is reached when they diverge greatly.

The transverse mandibular muscle is absent.

The mylohyoid passes deep to the digastric. It arises from the inside of the mandible and is inserted with its fellow on the median raphe and on the cranial border and process of the hyoid bone.

(1V). Muscles of the Tongue:

The styloglossus arises from the distal end of the anterior cornu. It is inserted on the tongue.

The genio-hyoglossus arises from the mandibular symphysis and is inserted on the proximal portion of the anterior cornu of the hyoid.

Muscles of the Body:

(1). Muscles of the neck.

1. Superficial group

The sternomastoid muscle originates from the anterior portion of the sternum. It diverges from the mid-line and passes forwards and upwards deep to the caudal border of the masseter to be inserted in the region of the mastoid process, lateral to the cleidomastoid muscle.

The cleidomastoid arises from the middle of the clavicle and is inserted on the paramastoid process.

2. Supra-and infrahyoid group:

The omohyoid is a well-developed muscle passing forward from its origin on the scapula, beneath the sternomastoid, to lie superficial to the sternothyroid. It is inserted on the hyoid bone. At its insertion it is closely connected with the digastric muscle.

The sternohyoid lies ventral to the trachea. This muscle and its fellow of the opposite side proceed anteriorly in close contact at the mid-ventral line, from their origin on the dorsal surface of the second sternebra to their insertion on the body of the hyoid.

The sternothyroid lies deep to the sternohyoid on the side of the trachea. It is a narrow muscle having its origin on the sternum and its insertion on the thyroid cartilage.

The thyrohyoid arises from the hyoid and is inserted on the thyroid cartilage immediately anterior to the sternothyroid muscle.

The crico-thyroid muscle is a short muscle on the lateral surface of the cricoid cartilage deep to the sternothyroid. Its fibres are directed dorsally and somewhat anteriorly. It arises from the ventral part of the lateral surface and posterior margin of the cricoid cartilage and is inserted on the posterior border of the ventral and lateral surface of the thyroid cartilage.

The geniohyoid is a narrow muscle lying close to its fellow along the mid-ventral line, deep to the mylohyoid muscle. The origin is from the medial surface of the mandibular ramus close to the symphysis, and the insertion is upon the body of the hyoid and its cranial process.

3. Deep lateral and subvertebral group:

The scalenus consists of only one part, the scalenus anticus being absent. It arises from the atlas and transverse processes of most of the cervical vertebrae, and passes to lie on the ventral surface of the thorax, where a narrow portion passes ventral to the first slip of the obliquus abdominis externus to the fifth rib. Laterally, the remaining part of the muscle proceeds to the fourth rib, and is also attached by delicate tendinous slips to the third, second and first ribs.

The longus colli which is situated on the ventral aspect of the vertebrae arises from the first thoracic vertebra and is inserted on the atlas. At its insertion it lies ventral to the levator claviculae muscle. Parsons (15) gives the origin of this muscle in the hystricomorph rodents as being from the anterior three or four thoracic vertebrae.

The rectus capitis anticus major arises from the thoracic vertebrae, as far back as the sixth dorsal, and also from the cervical vertebrae, and is inserted on the basioccipital. Parsons (15) gives the origin as being from the second or third cervical vertebrae.

(11). Muscles of the Trunk:

A. Muscles of the thorax.

The main portion of the panniculus carnosus is a fleshy sheet of muscle enveloping the back, flanks and abdomen, forming a thick mass over the trunk. It consists in certain places of several layers of fibres running in different directions. The fibres of the dorsal portion run in a longitudinal direction and converge over the shoulder to be attached to the metacromion and spine of the scapula and to the deltoid crest of the humerus and to the fascia on the outer side of the arm in this region.

Posteriorly most of the fibres proceed to the tail to be attached well over the base of the tail; other fibres pass to the hind limbs.

The fibres of the ventral or abdominal portion of the panniculus pass transversely from the mid-ventral line across the abdomen and sides to meet or pass beneath the longitudinal fibres of the back and flanks, the more posterior of these fibres passing to the hind limbs. Some of the more anterior transverse fibres pass beneath the pectoral muscles to the mid-ventral line. The abdominal portion is a much thinner layer and consists largely of fascia, the fibres being scattered in it. Anteriorly the abdominal sheet proceeds cranially to be inserted on the outside of the greater tuberosity of the humerus and on the inside of the deltoid crest for its whole length, deep to the pectoral muscles. In this region it is in close contact with the abdominal portion of the pectoralis muscle but dorsal to it. Posteriorly the fascia of the abdominal panniculus extends to the inguinal region. Over the hind legs there is a narrow well-marked portion of the abdominal panniculus. It is inserted on the fascia on the inner side of the leg, the line of insertion extending from above the knee to three-fourths of the way down the leg along the cnemial crest of the tibia.

The pectoral mass is divisible into three portions.

The pectoralis major is a strong thick muscle having its origin along the greater part of the sternum. The entire muscle converges to an insertion upon the inner surface of the deltoid crest of the humerus.

The pectoralis minor lies dorsal to the preceding muscle and extends slightly further posteriorly. Its origin is along the greater part of the sternum. The fibres run upwards and outwards to be inserted on the

deltoid crest beneath the insertion of the pectoralis major.

The pectoralis abdominis rises from the linea alba immediately posterior to the pectoralis minor. Its fibres pass upwards and outwards deep to the pectoralis minor and more anterior, and converge to a narrow insertion by a tendinous portion on the deltoid crest towards its proximal end. This is a thinner narrow portion of the pectoral mass.

The subclavius is the only part of the sterno-scapularis present. It is a narrow, but thick muscle arising from the cartilage of the first rib close to the mid-ventral line, and is inserted on the outer part of the clavicle, deep and lateral to the origin of the clavodeltoid muscle.

The serratus magnus originates by fleshy digitations from the cranial border of five ribs, the fifth to the ninth inclusive. The attachment to the fifth rib is immediately posterior to the insertion of the scalenus. The muscle is inserted on the caudal portion of the vertebral border of the scapula. The more dorsal fibres pass caudally in a straight line to the ninth rib. The rest of the muscle is inserted on the ventral portion of the ribs.

The levator anguli scapulae is distinct from the serratus magnus. It arises from the first four ribs and the transverse processes of the last five cervical vertebrae. It is inserted on the medio-dorsal border of the scapula between the insertions of the rhomboidei and the serratus magnus.

The external intercostals are dorsally and laterally situated and extend between the ribs. Origin: from the posterior borders of the ribs. Insertion: the anterior borders of the succeeding ribs. The fibres are

directed downwards and backwards.

The internal intercostals lie chiefly deep to the external intercostals and join the ribs, one to the other. ~~They extend ventrally to the other.~~ They extend ventrally to the sternum. Origin: the anterior borders of the ribs. Insertion: the posterior borders of the preceding ribs. The fibres pass obliquely down and forward.

B. Muscles of the Abdomen:

The obliquus abdominis externus is a broad sheet of muscle arising by twelve slips from the fourth to the fifteenth ribs inclusive, and from the lumbar fascia. Its fibres are directed obliquely downwards and backwards. It is composed of a muscular part and an extensive aponeurosis. It is inserted by its aponeuroses on the linea alba, on the median ventral raphe of the thorax and into the crest of the ilium, from which the aponeurosis passes forward to the anterior part of the pubis as Poupart's ligament. The aponeurosis divides to form the external abdominal ring.

The obliquus abdominis internus lies beneath the obliquus abdominis externus and has a much more extensive aponeurosis ventrally. Only the more posterior fibres extend as far ventrally as those of the latter muscle. A white line marking the junction of the fibres with the aponeurosis is curved and extends along the side of the trunk from the ribs to the caudal region. The fibres are directed obliquely downwards, forwards and inwards. Origin: from a large part of Poupart's ligament, lumbar fascia and the crest of the ilium. Insertion: upon the linea alba by an extensive aponeurosis, and thecaudal border of the posterior costal cartilages.

The transversalis is the deepest of the abdominal muscles and is

quite easily separated from the abdominis internus except for its aponeurosis. Its fibres run transversely, slightly downward to the margin of the rectus abdominis where its aponeurosis passes beneath the latter muscle to the linea alba.

Origin: from the inner surface of the posterior ribs, iliac crest and Poupart's ligament.

Insertion: on the linea alba.

The rectus abdominis arises from the ventral surface of the symphysis pubis. It runs forward between the aponeurosis of the obliquus abdominis externus and the transversalis to the ventral surface of the first rib and manubrium. It is also inserted by separate slips into the succeeding four costal cartilages at their sternal ends. The more lateral portion of the muscle, however, extends only to the second rib. Posteriorly, for some distance, the rectus abdominis is almost in contact with its fellow of the opposite side at the mid-ventral line, but as they pass further anteriorly each diverges slightly. The lineae transversae, about seven in number, are very faintly marked and run in a zig-zag manner.

The cremaster muscle is composed of a thin layer of fibres which pass ventrally and slightly caudally from between the layers of the fibres of the obliquus abdominis internus at its posterior border to the scrotum.

C. Lumbar Muscle:

The quadratus lumborum arises from the posterior thoracic vertebrae and from the lumbar vertebrae. It is inserted by a narrow tendon on the ventral surface of the ilium.

D. Muscles of the Back:

1. Superficial, Secondary Back Muscles.

The trapezius muscle is not divided as in the rabbit or the wood rat. The left trapezius muscle is a thin flat sheet consisting mostly of fascia with a few muscle fibres, the right, however, is considerably thicker and well developed. The muscle has origin along the mid-dorsal line from the ligamentum nuchae, from the thoracic spines, except the last five, and from the fascia in this region. The insertion is on the distal end of the clavicle, metacromion and spine of the scapula and fascia over the infraspinatus muscle.

The latissimus dorsi is a thick sheet of muscle covering a large part of the back. It arises from a large number of the posterior thoracic spinous processes by fascia and from the posterior five ribs by separate fleshy slips, and from the lumbar aponeuroses by fascia. Its origin is about 18 cm. in length. It wraps around the border of the teres major coming to lie superficial to it on the medial surface of the humerus. Its fibres converge greatly to a narrow insertion on the inner surface of the humerus close to the deltoid crest. Its more lateral fibres on reaching the back pass caudally to the ribs.

The rhomboideus capitis and the rhomboideus major in Erethizon epixanthus, according to Windle (22), form a single sheet of muscle separated from the rhomboideus minor. In the present specimen, however, the rhomboideus capitis and the rhombordeus major are separate muscles.

The rhomboideus major is the largest of the three muscles and arises from the mid-dorsal line immediately posterior to the skull and from the first five thoracic vertebrae. The muscle converges to its very narrow insertion on the dorsal border of the scapula next to the serratus magnus. The more lateral fibres pass anterio - posteriorly, while the more posterior

fibres pass in a transverse direction.

Lateral to the rhomboideus major is the rhomboideus minor. It has its origin along the lambdoidal ridge and narrows to its insertion on the dorsal border of the scapula, lateral to the insertion of the more cranial fibres of the rhomboideus major, and upon the extreme dorsal portion of the scapular spine. The fibres run in a longitudinal direction.

Lateral to the rhomboideus minor is situated the rhomboideus capitis (occipitoscapularis). It arises from the mastoid region and passes posteriorly to lie with its more dorsal border deep to the rhomboideus minor. It is inserted on the extreme dorsal portion of the scapular spine and on the dorsal border of the scapula partly deep to the rhomboideus minor.

The levator claviculae (atlantoscapularis) is a thick, strong muscle lying partly beneath the posterior portion of the parotid gland where the latter passes over the shoulder, and superficial to the origin of the acromiodeltoid.

Origin: the ventral arch of the atlas.

Insertion: on the metacromion, on the fascia of the shoulder, and by a narrow slip on the humerus, external to the pectoral crest. Some of its fibres at their insertion mingle with those of the panniculus carnosus.

The serratus posterior superior arises by a wide fascia from the ligamentum nuchae and the spines of the anterior thoracic vertebrae. It is inserted on the cranial border of six ribs, the fifth to the tenth. Anteriorly it lies superficial to the posterior portion of the splenius. The fibres are directed backwards and outwards.

The serratus posticus inferior arises from the spines of the posterior thoracic vertebrae. It is inserted on four ribs, the eleventh to the fourteenth. The fibres run forward and outward, the insertional slips passing partly beneath the external intercostals but superficial to the internal intercostals. The anterior and posterior portions of the serratus posticus are separated by the space between the tenth and eleventh ribs.

2. Deep, intrinsic back muscles.

The splenius lies deep to the rhomboideus muscles. It arises from the mid-dorsal line, from the ligamentum nuchae and from the spines of the five anterior thoracic vertebrae. It is inserted on the lateral part of the lambdoidal ridge.

From the crest of the ilium some fibres arise and pass forward to form a muscle similar to the sacrospinalis of the rabbit. The deeper fibres are separated by fascia from the more superficial fibres in this region. The fibres nearest the mid-line continue posteriorly beneath the gluteus muscle to the tail as the extensor caudae lateralis (elevator ~~extensor~~ caudae externus). The most lateral part of the sacrospinalis, a very narrow portion, is inserted on the lumbar vertebrae a short distance posterior to the last rib. The rest of the sacrospinalis muscle passes forward, and laterally a portion is inserted on the ribs by small slips; this lateral portion which is inserted on the ribs, here corresponding to the iliocostalis. In the region of the fourteenth and fifteenth ribs the sacrospinalis separates definitely into two parts, the more lateral portion, the iliocostalis, and the inner, the longissimus dorsi. The sacrospinalis

therefore is really a fusion of the two muscles. The iliocostalis continues forward to the first rib. The fibres of the posterior portion of the iliocostalis proceed anteriorly and end at the eleventh rib, while the fibres of the anterior portion of the muscle arise from the twelfth rib, deep to the fibres which end at the eleventh rib, and continue in an anterior direction.

The longissimus dorsi or inner portion of the sacrospinalis muscle passes anteriorly and is inserted on the transverse process of the sixth cervical vertebra and on the transverse processes of the vertebrae anterior to this and further to the atlas. In this region the longissimus dorsi is known as the longissimus cervicis.

Between the longissimus dorsi and the mid-dorsal line lies the semispinalis dorsi. In the region of the ninth rib and ninth thoracic vertebra the superficial fibres arise from the fascia of the longissimus dorsi. The deeper fibres and the portion near the mid-dorsal line emerge from the longissimus dorsi in the region of the fifteenth rib, and some of the fibres arise from the thirteenth vertebra. The semispinalis is partially fused with the longissimus dorsi for some distance posterior to this point. Still further caudally the muscles separate and the posterior portion of the semispinalis now becomes the multifidus muscle which proceeds to the sacrum and extends into the tail as the extensor caudae medialis (~~extensor~~ levator caudae internus). In the region of the fifteenth thoracic vertebra and posterior to it, the superficial fibres of the longissimus dorsi are inserted on the multifidus. The fibres of the semispinalis anteriorly diverge from the longissimus dorsi at the origin of the biventer

cervicis lateralis and are inserted on the anterior thoracic vertebrae and continue further to the spine of the axis. Lateral to this anterior portion a small muscle lies more or less fused with the semispinalis extending beneath the biventer cervicis from the origin of this muscle to the spine of the axis.

The biventer cervicis arises by two slips from the fifth thoracic vertebra and those anterior to it. Anteriorly the muscle is slightly divided. The superficial portion is fleshy, but there is a deeper portion invested with a shiny fascia. The muscle is inserted on the occipital region deep to the splenius and rhomboideus muscles.

The complexus is narrow and poorly developed. It arises between the biventer cervicis and the longissimus dorsi. It appears to rise from the region of the third thoracic vertebrae and from one or two vertebrae anterior to this, although the origin was discernible with difficulty due to the fact that the muscle was partly decomposed in this region. It is inserted on the paramastoid process deep to the splenius.

The rectus capitis posterior major lies beneath the biventer cervicis. It arises from the spine of the axis and is inserted on the supraoccipital bone.

The rectus capitis posterior minor is situated deep to the rectus capitis posterior major. It arisès from the atlas and is inserted on the supraoccipital.

The oblique capitis inferior lies lateral to the rectus capitis posterior major.

Origin: from the spine of the axis.

Insertion: on the dorsal portion of the transverse process of the atlas.

The transversalis capitis (longus atlantis) arises from the posterior cervical vertebrae and is inserted on the caudal portion of the transverse process of the atlas.

The rectus capitis lateralis and oblique capitis superior muscles are not separable. The combined muscles extend from the transverse process of the atlas to the skull in the region of the exoccipital.

E. Muscles of the tail:

The muscles of the tail are strong and well - developed.

The flexor caudae internus arises from the ventral surface of the sacrum and anterior caudal vertebrae. It is inserted by numerous tendons on the ventral surface of the succeeding caudal vertebrae. The most internal of the superficial tendons are inserted first, the deeper tendons coming to the surface round the outer side of these.

The flexor caudae externus arises from the lateral part of the ventral surface of the sacrum. It is inserted on the ventral surface of the caudal vertebrae. The external tendons are inserted first, the deeper one reaching the surface round the inner side of these.

The coccygeus arises from the caudal border of the ischium. It is inserted on the lateral surface of the sacrum and the transverse processes of three caudal vertebrae.

The levator caudae externus is dorsally situated. It is a continuation of the longissimus dorsi. The insertion is on the sacral and each succeeding caudal vertebrae.

The levator caudae internus is a continuation of the multifidus muscle. It arises from the sacral and anterior caudal vertebrae. It is inserted on the dorsal surface of the caudal vertebrae.

There is a very large muscle on the dorsal surface lateral to the levator caudae externus. It apparently corresponds to the inter-transversarii caudae of the cat. It arises from the transverse process

of an anterior caudal vertebrae and is inserted on the transverse processes of the caudal vertebrae posterior to the origin of the muscle. It extends to the tip of the tail.

There is a narrow muscle arising from the ilium and from the deep fascia of the gluteus medius, muscle, and more caudally from the fascia of the gluteus maximus. It lies lateral to the anterior portion of the inter-transversarii caudae. The origin of the latter muscle is deep to it. It is inserted on the anterior caudal vertebrae.

F. Perineal Musculature:

The sphincter ani externus is a broad ring of muscle fibres around the anus. It is inserted upon the body of the urethra.

The ischiocavernosus arises from the caudal border of the ischium and is inserted on the body of the urethra.

Muscles of the Anterior Limb:

A. Muscles of the shoulder girdle.

The supraspinatus occupies the supraspinous fossa, arising from the entire dorsal border of the spine of the scapula, and from the supraspinous fossa. It is inserted on the greater tuberosity of the humerus passing dorsal to the clavicle.

The infraspinatus arises from the infraspinal surface of the scapula and the posterior surface of the scapular spine. It is inserted on the greater tuberosity of the humerus.

The acromiodeltoid is a thick triangular - shaped muscle arising from the acromion and metacromion and from the acromial end of the elavicle. The insertion is very narrow and is on the outside of the deltoid crest.

The clavodeltoid has its origin from the ventral surface of the

clavicle. Its insertion is on the inside of the posterior portion of the deltoid crest.

The spinodeltoid arises from the spine of the scapula and from the fascia over the infraspinatus muscle. The muscle is inserted upon the deltoid ridge of the humerus. It is covered by the superficial panniculus.

The teres minor is a small muscle arising from the lateral axillary border of the scapula. The insertion is on the greater tuberosity of the humerus.

The teres major arises from the posterior quarter of the axillary border of the scapula. It is inserted deep to the latissimus dorsi muscle and extends beyond it anteriorly. It is inserted on the medial ridge of the humerus.

The subscapularis occupies the inner surface of the scapula. It is inserted on the lesser tuberosity of the humerus deep to the proximal portion of the biceps brachii muscle.

B. Muscles of the upper arm:

The biceps brachii arises by two heads. The shorter head has its origin from the coracoid process of the scapula. The longer head arises from the superior margin of the glenoid cavity. The muscle is inserted on the ulnar border of the radius, close to the head of the latter.

The coracobrachialis arises from the coracoid process of the scapula deep to the short head of the biceps brachii muscle. It is inserted on the middle and lower portion of the humerus on the inner side.

The brachialis anticus arises outside the deltoid ridge as high as the head of the humerus, from the dorsal portion of its neck. It passes deep to the biceps brachii near the insertion of the latter and is in-

serted on the proximal portion of the radial side of the ulna deep to the biceps brachii. This point of insertion differs from that noted by Windle(22), who states that the insertion is on the antero-external surface of the humerus as far down as the external condyle. These are the three flexor muscles of the upper arm.

The following muscles are the extensors of the upper arm.

The dorso - epitrochlear is a large muscle arising from the ventro-distal portion of the latissimus dorsi muscle. It is inserted on the olecranon.

The triceps longus is a large thick muscle having its origin at the humeral end of the axillary border of the scapula, and its insertion on the proximal end of the olecranon.

The triceps lateralis is equally large and arises from the greater tuberosity of the humerus and is inserted on the olecranon.

The triceps medialis is medially situated and originates along the posterior border of the shaft of the humerus. Its insertion is on the dorsal surface of the olecranon. The anconeus is continuous with the triceps medialis.

The epitrochleo - anconeus is a small fleshy muscle rising from the internal condyle of the humerus. It is attached to the inner side of the olecranon.

C. Muscles of the forearm:

Flexor Muscles: The palmaris longus arises from the internal condyle of the humerus. It is a bipennated muscle closely adherent to the first part of the flexor profundus digitorum. Its tendon of insertion is broad.

The pronator radii teres has origin from the internal condyle of the humerus. Its insertion is along the middle half of the medial border of

the radius extending for a considerable distance towards its distal end.

The flexor digitorum sublimis is small and arises from the internal condyle of the humerus. It lies deep to the palmaris longus and the second part of the flexor digitorum profundus, and is also closely connected with the first part of the latter.

The flexor digitorum profundus consists of two parts. The first part has origin from the internal condyle and is extremely large. It passes to the radial side of the forearm and its lower tendinous part is joined by the flexor longus pollicis, which arises from the distal portion of the flexor aspect of the radius. It is closely connected with the flexor carpi radialis proximally. The ~~second~~ first part of the flexor profundus digitorum is a bipennated muscle. ~~It~~ The second part arises from the ulna and has a small slip coming from the internal condyle.

The flexor carpi radialis is a large muscle arising from the internal condyle. It lies between the pronator teres and the first part of the flexor profundus digitorum.

The pronator quadratus lies deep to the flexors. It arises from the distal half of the ulna. Its fibres pass in an oblique direction to be inserted on the radius.

The flexor carpi ulnaris arises from the olecranon, the proximal part of the medio - caudal border of the ulna and the internal condyle of the humerus.

Extensor Muscles:

The extensor digitorum communis has its origin from the external condyle. It is a large muscle closely connected with the extensor carpi radialis brevis and the extensor minimi digiti muscles near its origin.

The extensor metacarpi pollicis arises from the greater portion of the radial surface of the ulnar and the interosseus ligament.

The extensor indicis is a small muscle which lies surperficial to the above muscle. Its origin is from the dorsal surface of the ulna about one half way up the bone.

The extensor digiti quinti (extensor minimi digiti) arises from the external condyle in common with the extensor communis digitorum. It is a small narrow muscle.

The extensor carpi ulnaris arises from the external condyle of the humerus and adjacent part of the ulna. Cranially there is a slight division of the muscle and the anterior part so formed passes to the ulna.

The extensor carpi radialis brevis is a large muscle arising from the external condyle of the humerus close to the extensor digitorum communis, between it and the carpi radialis longus. Its tendon of insertion is broad.

The extensor carpi radialis longus has an extensive origin from the external epicondyloid ridge of the humerus. Its origin is distinct from that of the external carpi radialis brevis.

The supinator longus is a thin muscle arising from the external epicondyloid ridge beneath the origin of the extensor carpi radialis longus.

The supinator brevis is a very small muscle arising from the annular ligament and shaft of the radius. It extends halfway down the radius.

Muscles of the Posterior Limb:

A. Muscles of the Hip.

1. Iliopsoas group.

The psoas minor arises from the majority of the lumbar vertebrae. It narrows posteriorly and is inserted on the ilio-pectineal eminence. It partly overlies the psoas magnus.

The psoas magnus arises deep to the psoas minor from all the thoracic vertebrae and is inserted on the lesser trochanter of the femur.

The iliacus rises from the crest of the ilium and is inserted on the lesser trochanter of the femur.

2. Gluteal group.

According to Parsons (15), in rodents the gluteus maximus, tensor fascial femoris and sartorius are closely united to form one muscle sheet. Windle (22) similarly describes these muscles in Erethizon epixanthus. Howell (9), however, emphatically disagrees with Parsons and does not consider the gluteus maximus in rodents to form a part of the tensor latae or gluteus superficialis sheet, and states that when not distinct it should be considered as having fused with the gluteus medius. These muscles in Erethizon epixanthum epixanthum, however, are more in agreement with Parson's and Windle's descriptions, although some variations are apparent.

According to Windle the maximus arises by a lumbar aponeurosis from all the sacral vertebrae and from the crest of the ilium as far forward as its anterior superior spine. Such a muscle was found in Erethizon epixanthum epixanthum, but its divisions differ slightly from those given by Windle.

The muscle descends in a broad sheet over the thigh. The anterior

portion is separable from the rest of the muscle and has a narrow origin from the lateral part of the crest of the ilium. This widens and passes to the inner side of the knee and is connected in this region with the fascia over the joint but not to any bone; and its more posterior border is inserted over the fascia of the thigh. This anterior portion corresponds to the sartorius muscle.

The posterior portion of the muscle sheet is divisible into two parts, where the fibres begin. The anterior part is wide and is inserted into the femur about one half of the way down and probably corresponds to the tensor vaginae femoris. The posterior part is narrower and is inserted into the lower portion of the femur and is probably the gluteus maximus proper.

Windle divides the whole sheet into two portions, anterior and posterior, the posterior being inserted into the femur; and again divides the anterior into two; the most anterior being the sartorius, and the posterior part being the tensor vaginae femoris. Windle finds another muscle arising by a lumbar aponeurosis from the spines of the caudal vertebrae and closely connected with the gluteus maximus as far as its insertion, which is on the anterior aspect of the tibia. No such muscle was found in the specimen dissected.

The gluteus medius is a wide sheet of muscle lying deep to the above sheet. Its origin is from the crest of the ilium and dorsal fascia. Its insertion is on the great trochanter of the femur. There is very little indication, if any, of a portion corresponding to the gluteus ~~maximus~~ minimus. It is closely fused with the gluteus medius.

Beneath the gluteus medius but closely connected with it there is a layer of muscle fibres representing the scansorius. It arises from the ilium and is inserted deep to the anterior margin of the gluteus medius on the great trochanter.

3. Obturator group.

The pyriformis lies deep to the last mentioned layer, and superficial to the obturator internus and gemellus superior. It is a comparatively large muscle. It arises from the sacrum and is inserted on the top of the great trochanter.

The gemellus inferior is separable with difficulty from the obturator internus. It arises immediately craniad to the ischial tuberosity and is inserted on the great trochanteric fossa.

The obturator internus arises from the medial surface of the ischium caudad and craniad of the obturator foramen. It passes over the dorsal border of the ischium between its tuberosity and the acetabulum. It is inserted on the trochanteric fossa.

The gemellus superior is a large flat muscle. It arises from the caudal part of the dorsal border of the ilium. It is inserted into the great trochanter at its summit. Its posterior border is connected with the obturator internus.

The quadratus femoris arises from the tuberosity of the ischium and is inserted between the great and small trochanter.

B. Muscles of the thigh:

Flexor Muscles.

The semitendinosus arises by strong fascia from the sacral and caudal vertebrae. It is inserted on the cnemial crest of the tibia.

Towards its origin the fibres of the semitendinosus are separable only with difficulty from the fascia of the gluteus maximus. The muscle is wide, flat and well - defined and arises by one head, not two as in some rodents. Wendle (22) gives the origin of the muscle as from the tuber ischii in Erethizon epixanthus, but in this specimen this was not found to be the case.

The semimembranosus consists of two parts. The first portion is very slender and arises by fascia from the transverse processes of the vertebrae immediately caudal caudal to the bicipitis accessorius. Near its origin it lies superficial to the chief part of the biceps, but deep to the bicipitis accessorius; it passes over the adductor magnus and brevis muscles, in part, and extends to the bend of the knee, towards the inner side of the leg. It is inserted above the inner condyle of the femur by tendon. This portion corresponds in part to the adjutator caudae mentioned by Windle (22), but that muscle is inserted on the patella.

The main part of the semimembranosus is a long thick muscle arising from the tuberosity of the ischium caudad to the biceps femoris. It passes to the medial side of the lower leg and is inserted on the proximal end of the tibia anterior to the gracilis. Windle (22) found its insertion to be on the femur.

The biceps femoris is divisible into two parts. The chief part arises by a distinct tendon from the outer part of the tuberosity of the ischium. It is inserted by fascia on the outer side of the patella, by tendon on the projection of the head of the fibula and on the fascia on the front of the tibia, extending almost to the distal end. It is a

thick muscle narrow at its origin, but having its fibres diverging to a wide insertion.

The bicipitis accessorius arises by tendon from the transverse process of one of the upper caudal vertebrae. It is inserted by fascia into the posterior part of the os calcis and the tibia. This part of the biceps is long and slender. Near its origin it lies deep to the chief part of the biceps. It passes over the anterior part of the semimembranosus and under the main part of the biceps again, and from thence it lies posterior to the biceps on the tibia.

Extensor Muscles:

The quadriceps extensor cruri is composed of four muscles which are as follows:

The rectus femoris is a thick strong muscle which arises from the ilium and is inserted on the proximal border of the patella. It is situated between the vastus externus and vastus internus.

The vastus externus is very large and thick. At its origin it extends to the summit of the trochanter. It is inserted on the patella.

The vastus internus is closely connected with the vastus externus. It arises from the proximal part of the femur and is inserted on the patella.

The crureus lies beneath the above muscle and has a similar origin and insertion.

Adductor muscles:

The pectineus arises from the ilio - pectineal eminence dorsal to the origin of the third part of the adductor muscle. It is inserted on the femur below the lesser trochanter. It lies on the medial surface of

the leg.

The gracilis is a wide muscle situated on the ventral surface of the leg. It is divided towards its origin into three parts. The anterior part arises from the ilio - pectineal eminence and pubic symphysis. A small medial slip arises between the sphincter ani externus and the ischiocavernosus muscles. The posterior portion arises from the ramus of the ischium. The insertion is on the front of the tibia from the patella to below the summit of the insertion of the semitendinosus, along the inner side of the cnemial crest of the tibia.

The adductor mass is divisible into six portions.

The first part is a thin, flat, narrow muscle arising from the brim of the pelvis beneath the gracilis and ventral to the origin of the pectineus, and from the anterior portion of the pubic symphysis. The insertion is on the distal end of the femur and medial portion of the patella.

The second part lies beneath the first and is not easily separable from it at the origin. It is inserted on the femur between the insertions of the pectineus and the adductor magnus.

The third part or adductor magnus is a thick muscle arising from the symphysis pubis and adjacent ramus of the ischium. It is covered by the gracilis. It is inserted on the back of the femur distal to the insertion of the adductor brevis, on the caudal lateral border of the shaft of the femur.

The fourth part is very thin and lies superficial to the posterior portion of the third part. It arises superficial to the latter and is inserted on the distal part of the femur and the medial portion of the patella beneath the first part, and craniad of the semimembranosus.

The fifth part or adductor brevis arises from the pubic symphysis beneath the first, second and third portions. It is inserted along the back of the femur, extending as far anteriorly as the outer side of the great trochanter immediately posterior to the quadratus femoris.

The sixth part arises beneath the pectineus from the brim of the pelvis. It is inserted on the femur close to the insertion of the pectineus.

C. Muscles of the leg.

Flexor group:

The gastrocnemius rises by two heads from the upper and back part of the two condyles of the femur. The two portions unite with the soleus and form the tendo calcaneus distally.

The plantaris is a large muscle lying beneath the gastrocnemius and having its origin on the external condyle of the femur beneath the external lateral ligament. Its narrow tendon of insertion passes around the inner side of the tendo calcaneus.

The soleus is a fleshy muscle lateral to the flexor longus hallucis. It arises by tendon from the caudal portion of the head of the fibula, and joins the outer head of the gastrocnemius to help form the tendo calcaneus.

The popliteus arises from the lateral condyle of the femur, and is inserted on the upper third of the medial shaft of the tibia.

The flexor digitorum longus is a very large muscle and is ventrally situated. It arises from the tibia beneath the popliteus. It has a large tendon for insertion.

The flexor longus hallucis (flexor fibularis) lies beneath the tibialis posticus. Its origin is from three fourths of the fibula. Its

tendon distally is large. It is an extremely large muscle filling the space between the fibula and tibia.

The tibialis posticus is a large muscle lying beneath the flexor digitorum longus. It arises from the head of the fibula and caudal aspect of the proximal third of the tibia. The fibres are pennated upon its tendon which passes deep to that of the flexor digitorum longus. The muscle is closely connected with the flexor longus hallucis.

Extensor group:

The tibialis anticus is a large muscle having its origin from the fibula and upper portion of the tibia. It has a tendinous insertion. Its fibres are pennated upon the deep surface of the tendon which develops within the muscle.

The extensor longus digitorum arises from the front of the external condyle of the femur just outside the patellar surface lateral to the tibialis anticus.

The extensor hallucis is small and slender and lies between the tibialis anticus and the extensor longus digitorum. It has a narrow origin along the lower part of the shaft of the fibula. Its slender tendon passes, close to the tibialis anticus, to the foot.

Peroneal group:

The peroneus longus arises from the head of the fibula and the lateral ligament of the knee. It passes to the foot.

The peroneus brevis lies deep to the above muscle. It has its origin from the outer surface of the lower part of the fibula below that of the peroneus quinti digiti. Its tendon passes behind the external malleolus in a deep groove. At its ventral border there is a portion of the brevis

muscle which is distinct anteriorly from the rest of the muscle. It partly folds around the peroneus longus and arises by thin fascia from the fibula, anterior to the main part.

The peroneus quarti digiti is not present.

The peroneus quinti digiti is very slender and lies lateral to the peroneus brevis. It arises from the outer surface of the fibula behind the peroneus brevis muscle.

The Diaphragm, the Body Cavities, and Membranes.

The Diaphragm:

The diaphragm is a broad muscle separating the thoracic cavity from the abdominal cavity. It is attached ventrally to the sternum and sixth rib, laterally and dorsally to the posterior ribs and the lumbar vertebrae. It is pierced by three foramina, the hiatus aorticus, the hiatus oesophageus, and the foramen venae cavae.

The Pleural Cavities:

The pleural cavities are lined by the pleura. Ventrally, the two median walls of the pleural sacs join to form the mediastinal septum extending from the heart to the sternum.

The Pericardial Sac:

The pericardial sac is tough and is attached to the anterior end of the heart where the vessels enter and leave.

The Peritoneal Cavity

The peritoneal cavity is lined by the peritoneum. A portion of this, the mesogaster, extends from the dorsal wall to the greater curvature of the stomach and is also prolonged posteriorly to form a sac, the greater omentum, which is not very extensive. Ventrally, the portion passing from the left part of the greater curvature of the stomach to the hilus of the spleen is the gastrosplenic ligament. The mesogaster passes over the stomach and at the lesser curvature continues as a strong ligament, the lesser omentum, to the liver. The lesser omemtum consists of the gastrohepatic ligament, passing from the lesser curvature of the stomach to the liver, and the hepatoduodenal ligament from the liver to the first part of the small intestine, in which portion runs the bile duct and hepatic portal vein. The falciform and coronary ligaments are described with the liver.

The Digestive System:

The entrance to the oral cavity is broad. The hard palate forming the anterior part of the roof of the mouth is narrow and ends near the third molar. It has its mucous membrane thrown up into a number of transverse ridges. Posterior to this is the soft palate.

The dental formula is i 1/1, c o/o, pm 1/1, m 3/3. The incisors are long and chisel - like, and grow from persistent pulps. The upper incisors protrude over the lower. The outer surface of the incisors is orange - yellow in color. The teeth of the upper and lower jaw are similar in size. The premolars, however, are slightly larger than the molars.

On the grinding surface of the premolar and molars are several grooves or reentrant angles of enamel which form an enamel pattern. The reentrant angles become isolated rings of dentine surrounded by enamel where the teeth are much worn. The reentrant angles are so deep on each side of the teeth that the enamel spaces are infinitely small. The enamel pattern is as follows:

Upper Teeth:

Premolar: One medial outer reentrant angle, one outer anterior and one outer posterior ring, one inner reentrant angle.

First Molar: Antero - external enamel face indented by one groove, one anterior outer reentrant angle, and two outer posterior rings, one inner reentrant angle.

Second Molar: One outer anterior and one outer posterior ring, one medial outer reentrant angle, one inner reentrant angle.

The third molar is the same as the premolar.

Lower Teeth:

Premolar: One outer reentrant angle, one inner anterior ring and two posterior inner reentrant angles.

First and Second Molar: One outer reentrant angle, one inner anterior and one inner posterior ring, one medial inner reentrant angle.

The third molar is the same as the premolar.

The tongue is long and narrow. It is 8.5 cm. long, and its greatest width is at its posterior end where it measures 1.7 cm, anteriorly it narrows considerably and at its tip measures only .7 cm in width. The free end of the tongue is attached to the floor of the mouth by a fold, the frenulum. The root of the tongue is attached to the hyoid bone and its cranial process and to the soft palate. There is no median furrow present. The anterior half of the dorsum of the tongue is covered with very small soft conical papillae which are directed backward. These are also present further posteriorly but to a less extent. Scattered amongst them are a few fungiform papillae which are much more prominent and more numerous posteriorly. There are a number of fungiform papillae at the tip and on the underside of the tongue in this region. Near the root of the tongue are two circumvallate papillae.

The pharynx extends from the soft palate to the origin of the oesophagus and has the openings of the posterior nares and eustachian

tubes. Posteriorly, the pharynx opens into the oesophagus and anterior to this is the entrance to the larynx, the glottis. The cartilaginous valve, the epiglottis, at the entrance to the glottis, is broad.

The oesophagus passes through the diaphragm by way of the hiatus oesophageus and 3cm. posterior to it enters the stomach. It is a straight tube 11mm. in diameter, with a narrow lumen of about 3 mm. in diameter.

The stomach is elongated and where the oesophagus enters is the cardia. To the left of this the stomach bulges to form the fundus. The stomach is bent sharply on itself towards the pyloric end. The pyloric extremity, near the duodenum, is much smaller and the pylorus is marked externally by a slight constriction. Internally, there is a circular ridge, the pyloric valve. The parietal and visceral surfaces of the stomach are convex, the former is related to the diaphragm and liver, the latter to the intestines and pancreas. There are no well - marked ridges or folds internally.

The duodenum leaves the pyloric end of the stomach and passes to the right. It shortly receives the bile duct, and 15 mm. further on, the pancreatic duct. On reaching the right side it turns caudally for 5 cm, then to the left. The diameter of the duodenum is about 3 cm. The small intestine is continued as the jejunum and the ileum, and is a convoluted tube. No dividing line between the different portions can be seen externally. The diameter varies from 2.5 - 3.5 cm.

The large intestine extends from the termination of the ileum to the anus, and consists of the colon and the rectum. At the junction of the two portions there is a large, blind, curved sac, the caecum which is about 28 cm. long. The terminal 3 cm. of the caecum narrows to form the ver-

miform appendix. There is no sacculus rotundus. There is a circular constriction at the entrance of the ileum into the caecum and the margins of the ileum are prolonged within for 8 mm. The ileo-caecal orifice is small, while the caeco-colic orifice is much larger. These orifices are about 3 cm. apart. The caecum has a dorsal and a ventral longitudinal muscular band which causes two rows of sacculations. The colon is smooth, not sacculated. It is large proximally but gradually becomes smaller. It is coiled greatly, and, for a considerable distance, two portions are in contact, being connected by mesentery. The colon passes posteriorly to join the rectum which is a wider tube and which terminates at the anus.

Glands:

Digestive Glands:

The Salivary Glands:

In the region of the neck there are three pairs of salivary glands, the parotid, the submaxillary, and the sublingual glands.

The parotid gland is extremely large, extending over the whole side of the neck and dipping into a triangular cavity above the cleido - mastoid muscle, between the latter and the levator claviculae and passing beneath the trapezius muscle. The gland extends beyond the clavicle. It is 18.2 cm. long, 3.7 cm. wide and about 3.5 cm. thick. Its posterior border is strongly concave and is loosely attached to the underlying muscles. The superficial surface is covered by the parotid fascia and part of the facial portion of the panniculus carnosus. The anterior border partly overlies the masseter muscle. The gland is composed of a large number of lobules. Its duct passes across the surface of the masseter muscle and opens beside the anterior molar.

The submaxillary gland lies on the front of the neck beside the inner border of the masseter muscle. The right and left glands are separated by a small portion of the sternohyoid muscle. Both consist of a large posterior lobe and three small anterior lobes in close proximity to one another and invested with a delicate fascia. The outer of the three smaller, anterior lobes is separated from the remainder by the external maxillary vein, while the inner overlies the middle. These three lobes are somewhat triangular in shape and are separated from the rounded posterior lobe by the transverse vein. The duct passes from the deep surface of the gland deep to the digastric muscle and proceeds forward to a point near the

mandibular symphysis where it pierces the lining of the mouth.

The sublingual gland is situated deep to the posterior lobe of the submaxillary gland. It is small and oval in shape and is related to the submaxillary duct. Its duct passes forward with the latter.

The Liver:

The liver is large and is divided by deep fissures into three principal lobes, the left lateral, the right lateral and the central. There is also a small caudal and a spigelian lobe. The central lobe is divided into a right and a left portion. The right and left lateral lobes are of a similar size. The left lobe is somewhat oval in outline and is cleft slightly at its inner border. The more dorsal, posterior portion, so formed, bears on its inner border the oesophageal notch. The central lobe is very irregular in shape. The left central portion is cleft at its inner border to form a small inner lobe lying next to the fissure. The right central lobe has its more posterior portion bent under to lie dorsal to the anterior part. The posterior portion is directed to the right and caudally and extends beyond the anterior part for a considerable distance. The falciform ligament extends into the fissure between the left and right central lobes and is also attached along the ventral surface of the right central lobe from its posterior to its anterior border. The gastro - hepatic ligament is attached to the right central lobe, and the hepatoduodenal ligament extends from this portion of the liver to the first part of the small intestine, and the bile duct and portal vein run through the ligament. The right lateral lobe is directed dorso-ventrally. On its inner border lies the caudal lobe, which is clearly marked off by a fissure.

The caudal lobe has on its ventral surface a deep impression, the renal impression. It is roughly triangular in shape and is notched on its inner border.

Appearing as a continuation of the caudal lobe is the small, narrow elongated spigelian lobe. It passes cranially from the base of the caudal lobe and then bends posteriorly.

The gastro - hepatic ligament is attached to the left inner border of the left lobe, as well as to the dorsal surface of the central lobe. The coronary ligament is also attached to the anterior surface of the more dorsal portion of the left lateral lobe and to the right lateral and right central lobes.

The bile ducts from the lobes of the liver enter the common bile duct which empties into the duodenum about 3.5 cm. from the pylorus.

The anterior or parietal surface of the liver is convex and lies against the diaphragm. The visceral surface is concave and is related to the stomach and the right kidney.

There is no gall bladder present.

The Pancreas:

The pancreas is a large lobulated gland not very compact. It extends from the right border of the spleen to the first part of the duodenum. It lies dorsal to the stomach and ventral to the anterior border of the left kidney. Its greatest portion lies to the left of the median line. Its cranial portion extends to the anterior border of the stomach. It is attached by mesentery to the liver near the portal fissure and to the crura of the diaphragm.

The pancreatic duct passes into the duodenum about 5 cm. from the pylorus. The above glands are associated with the digestive tract.

Lymph Gland:

The Spleen.

The spleen is situated on the left side lying along the left border of the stomach but dorsal to it. It is large, somewhat oval in shape. Its long axis is directed antero - posteriorly, its short axis almost dorso-ventrally. The anterior portion of the spleen is curved ventrally so that the visceral surface is concave. This surface is divided by a ridge, in which there is a slight depression anteriorly forming the hilus, which extends further posteriorly than the ridge. The area to the left of the ridge is slightly larger than that to the right. The parietal surface is smooth and concave and lies against the diaphragm. The posterior portion of the spleen extends almost to the left kidney.

Endocrine Glands:

The Thyroid.

The thyroid gland consists of two long and very narrow portions occurring on either side of the trachea and larynx. They extend from the middle of the thyroid cartilage caudally for 25 mm. There is no median connecting portion. It is a ductless gland.

The Thymus: The thymus is a ductless gland and is situated in the mediastinum in the median line, ventral to the anterior part of the heart. It extends forward on the trachea for a short distance. It is composed of a number of lobules.

The Adrenal Glands.

The adrenal glands are small and are situated close to the inner

borders of the kidneys. These glands are also ductless.

The Respiratory System:

The larynx, which connects the pharynx and trachea, consists of the thyroid, cricoid, epiglottis, and the two small arytenoid cartilages. The thyroid cartilage is the most anteriorly placed. It is not very large and consists of two lateral laminae which are separated dorsally but which unite ventrally. The ventral median portion is very short. The dorsal border of each lamina projects cranially to form a short blunt process, the superior cornu, which articulates with the posterior cornu of the hyoid bone. There is a similar but larger projection posteriorly to form the inferior cornu of the thyroid cartilage. The inferior cornu articulates with the outside of the cricoid cartilage. The posterior margin of the thyroid cartilage is concave mid-ventrally, the anterior margin convex. Below the superior cornu is a small foramen through which passes the laryngeal nerve. The anterior margin of the thyroid cartilage is attached to the body of the hyoid and its posterior cornua, by the thyro - hyoid membrane, and the posterior border to the cricoid cartilage by the crico - thyroid membrane.

The cricoid cartilage is comparatively large, is situated at the caudal end of the larynx, and forms a complete ring. The posterior border is concave ventrally, the anterior border convex.

The epiglottis is broad and short and has its apex rounded. Its more dorsal surface is concave from side to side, but bears a slight ridge medially.

The arytenoid cartilages are small, pyramidal in shape, having their bases resting on the sides of the cricoid cartilage.

A pair of folds, the true vocal cords, are situated at the side and extend ventrally and anteriorly towards the middle of the epiglottis. There was no indication of false vocal cords.

The trachea is long and is supported by a series of cartilaginous rings. Terminally it divides into the right and left bronchi which lead to the right and left lungs.

Each bronchus divides into branches which pass into the lobes of the lungs.

The right lung is divided into three lobes by two deep fissures. The posterior lobe is the largest, the medial the smallest. The latter is narrow and long and projects into the caval fold of the mediastinal septum. The anterior lobe is incompletely divided again at its ventral margin. The posterior lobe has on its ventral surface anteriorly a deep groove. To the left of this a small caudal lobe projects posteriorly over the left portion of the posterior lobe. The left lung is divided into two lobes, the posterior of which is the larger. The anterior lobe is further divided to form a small anterior and a slightly larger posterior lobe.

The Urogenital System:

The Urinary System.

The two kidneys are situated in a similar position against the dorsal wall of the abdominal cavity. They are large bean - shaped bodies encased in a fibrous capsule. The anterior lateral extremity of the right kidney fits into the renal impression of the caudal lobe of the liver. The kidneys are slightly wider anteriorly than posteriorly and the right kidney is longer than the left. The left kidney is 5.5 cm. long, the

right 6 cm. Both are 3.5 cm. wide at the hilus.

From the hilus of each kidney the ureter passes posteriorly to the base of the urinary bladder and enters it on either side and somewhat dorsally. The ureters are 16 cm. long.

The bladder is a large sac 6 cm. long and 5 cm. wide having its blind end rounded. Posteriorly it narrows to form the fundus and this empties into the urethra. The urethra proceeds posteriorly and receives in its dorsal wall the ducts from the seminal vesicles and the vasa deferentia. Beyond this point the common tube is known as the urogenital sinus which terminates in the penis, at the end of which is the urogenital orifice.

The Reproductive System:

The scrotal sacs, a pair of tough - walled outpouchings of the abdominal cavity are situated ventral to the pelvis on either side of the mid - line. The left pouch is much longer than the right, the left being about 6 cm. long, the right 2 cm. This difference in size is due to the fact that the left testis has descended entirely into the left scrotal sac, while the right has only partly descended. According to Pocock (18) the testes never pass into a scrotum in the Hystricomorpha, but it will be noted from the above description that this is evidently not always the case. Of the right testis only 2 cm. is contained within the scrotalsac, 3 cm. remaining in the abdominal cavity. Each testis is inclosed in a sac, the parietal portion of the tunica vaginalis. It is continuous with the parietal peritoneum of the abdomen at the inguinal ring. The parietal layer is reflected from the posterior wall of the inguinal canal around

the structures of the spermatic cord and forms the mesorchium, a fold of mesentery between the sac and testis. The lining of the sac is the visceral portion of the tunica vaginalis.

The left testis is elongated and somewhat oval and is attached at its inner dorsal border by the mesorchium. It is to this border that the epididymis is attached. The testis measures 5.5 cm. X 2 cm. X 1 cm. The epididymis, a mass of coiled tubes, is situated along the inner edge of each testis. The portion lying anterior to the testis is known as the head or caput epididymis. The corpus epididymis is a narrow band which extends back from this along the edge of the testis. The cauda epididymis is large and is found at the posterior end of the testis. Continuing from the cauda epididymis the vas deferens, which is not convoluted, passes anteriorly along the side of the testis through the inguinal ring into the abdominal cavity.

The right testis is the same length as the left. It is bent slightly to the right beyond the scrotal sac. It is similar in shape to the left testis except for a constriction at the portion immediately anterior to the scrotal sac.

The two vasa deferentia loop over the ureters and pass posteriorly dorsal to the urethra and ventral to the seminal vesicles and enter the urethra separately alongside the ducts of the seminal vesicles.

The penis is cylindrical in form and extends 6 cm. from the abdominal wall. It is enclosed in a cutaneous sac, the prepuce, which extends, in the quiescent state, about 2 mm. beyond the penis. The orifice of the penis reveals within, two apertures, a small upper opening, the

urogenital aperture, and a lower long slit. The latter opens into a small sac with corrugated walls. This is characteristic of the Hystricomorpha (18).

The seminal vesicles are two elongated, glandular bodies situated dorsal to the posterior part of the bladder and ventral to the prostate gland and rectum. From each seminal vesicle a duct passes posteriorly to enter the urethra at the same level as the vasa deferentia. The seminal vesicles are 4.5 cm. long and 1.8 cm. at their greatest width.

The prostate gland is large and lies in the region of the neck of the bladder but dorsal to the seminal vesicles, and ventral to the rectum. It consists of two large lateral lobes which can be seen at the side of the bladder, connected by a short isthmus. The lobes are directed somewhat ventrally to partly surround the seminal vesicles.

The bulbourethral glands or Cowper's glands are two small oval - shaped bodies situated shortly posterior to the prostate gland on either side of the pelvic part of the urethra. They are partly covered by the the urethral muscle. Their ducts are very short and open into the urethra.

The Circulatory System:

The Heart.

The heart occupies a median position in the thoracic cavity. Posteriorly, it extends to the anterior surface of the diaphragm. Its apex is much rounded. Externally, the division between the right and left ventricles is marked only by indistinct furrows running from near the base of the pulmonary artery to the right of the apex, and from above the apex to the base of the posteaval. The right auricle is a little larger than the left.

The structure of the heart is similar to that of other mammals. The walls of the auricles are thin and the right and left auricles are separated by the interauricular septum. The right auriculo - ventricular opening is guarded by the tricuspid valve. This consists of three membranous flaps attached to the papillary muscles, which project from the wall of the ventricle, by short, slender chordae tendinae. The left auricular - ventricular opening is guarded by the bicuspid or mitral valve, consisting of only two membranous flaps. The chordae tendinae of the mitral valve are better developed than those of the tricuspid valve.

The two ventricles are separated by the interventricular septum. The wall of the left ventricle is thicker than that of the right. The entrance to the aorta in the left ventricle is guarded by three semilunar valves. The opening of the pulmonary artery in the right ventricle is similarly guarded.

The Arteries:

The pulmonary artery passes obliquely forward and to the left from

the base of the right ventricle. It bifurcates posterior to the aortic arch into right and left branches which lead to the right and left lungs. Near the bifurcation, the pulmonary artery is connected to the aortic arch by a short arterial ligament. The right pulmonary artery passes dorsal to the heart and at the root of the right lung lies dorsal to the pulmonary vein, but ventral to the bronchus. It passes into the substance of the right lung posterior to the entrance of the bronchus and pulmonary vein. The left pulmonary artery is short and enters the left lung anterior to the pulmonary vein and bronchus.

The aorta arises from the base of the left ventricle dorsal to the pulmonary artery; it passes forward and curves backward and dorsally somewhat to the left forming the aortic arch. From the aortic arch two arteries are given off, the large innominate or brachiocephalic artery on the right and the left, subclavian on the left. The innominate artery bifurcates a short distance from the heart to form the left carotid artery and a branch which divides immediately to form the right carotid artery and the right subclavian artery which passes laterally to the arm. The left subclavian artery and its branches are similar to the right subclavian artery and its branches, hence only the left will be described.

The left subclavian artery passes forward and then curves to the left. At this point, it gives off from its posterior border the internal mammary artery which passes along the inner surface of the sternum and branches to the pleura, the pericardium and to the muscles on the chest wall. It passes between the cartilage of the last sternal rib and the xiphoid cartilage and proceeds posteriorly along the rectus abdominis muscle as the superior epigastric artery. Immediately lateral to the origin of the

internal mammary artery the supreme intercostal artery is given off and runs posteriorly along the dorsal wall of the thorax and receives the intercostal arteries. From the anterior surface of the subclavian artery the vertebral artery is given off and passes dorsally. The subclavian artery crosses the first rib and passes into the axilla dorsal to the corresponding vein as the axillary artery and from here it is continued as the brachial artery to the upper arm and proceeds along the inner surface of the limb in company with the axillary vein and nerves.

The first branch to be given off from the axillary artery is the long thoratic artery which passes posteriorly dorsal to the corresponding vein into the abdominal portion of the panniculus carnosus and branches in this region. It is continued along the lateral abdominal wall as the external abdominal artery. Small branches are next given off to the pectoral muscles. From the dorsal border of the axillary artery the subscapular artery arises and accompanies the subscapular vein which is situated anterior to it. The thoracodorsal artery arises from the subscapular artery.

The brachial artery divides at the elbow and a branch, the radial artery continues posteriorly, lying deep to the pronator teres muscle and lateral to the median nerve and gives branches to the muscles in this region; anteriorly a branch is given to the biceps brevis muscle. a large branch from the brachial artery passes over the biceps muscle and proceeds superficially down the arm above the supinator longus muscle; at the elbow a branch from it passes down over the flexor carpi radialis, and a second branch passes to the flexor profundus digitorum muscle.

Another branch passes to lie on the posterior part of the medial epicondyle close to the ulnar nerve and gives several branches to the muscles.

The right and left carotid arteries pass forward on either side of the trachea. As they are similar, only the left will be described. The left carotid gives off the small superior thyroid artery to the thyroid gland, as well as branches to the larynx. The artery then passes to the dorsal surface of the shining ligament of the digastric muscle. As it emerges posterior to the anterior cornu of the hyoid, it gives off the lingual artery to the tongue. Beyond this the carotid artery bifurcates to form the external maxillary which passes to the jaw and a branch which passes dorsally and slightly caudally to the region of the ear. A small branch is given off to the parotid gland and at the base of the ear the transverse facial artery is given off and an auricular and a temporal branch. The external maxillary gives off a small branch which passes superficial to the masseter muscle and ramifies in it.

The external maxillary artery passes along the ventral border of the masseter muscle and ascends along its anterior border; at the bend it lies deep and anterior to the facial vein and passes forward beneath the platysma muscle. In this region it is called the facial artery and is continued upward as the superior labial artery. The superior labial artery passes over the buccinator muscle to the region of the upper lip. The facial artery gives off an inferior labial artery deep to the corresponding vein and from it a branch is given off to the cutaneous muscle and two smaller branches which pass into the orbicularis oris in the region of the lower lip. The facial artery gives off another branch to the

cutaneous muscle, opposite to where the inferior labial leaves the facial artery. Parallel to the angular vein of the eye, but more anterior to it, the infraorbital artery runs across the infraorbital portion of the masseter and gives off a branch to the levator labii muscle in the lateral nasal region and disappears through the infraorbital foramen.

In its descending course along the dorsal body wall, the aorta gives off small branches to the intercostal spaces. As the aorta enters the hiatus aorticus it gives off small inferior phrenic arteries to the diaphragm. Slightly posterior to the latter arteries, the short unpaired coeliac artery arises from the ventral surface of the aorta. It gives off the large splenic artery and small branches to the oesophagus.

The splenic artery passes to the left in the mesogaster to the anterior end of the apleen and supplies small branches to the pancreas. It runs along the hilus of the spleen giving off small splenic branches which go into the substance of the spleen, and in this region short gastric branches proceed to the greater curvature of the stomach. Near the posterior end of the spleen, the splenic artery passes to the right and somewhat ventrally in the omentum and gives off the large, left gastro - epiploic artery to the greater curvature of the stomach, branches to the omentum, and a large branch to the pancreas. Close to the origin of the splenic artery, a group of vessels arise from the coeliac artery, the gastric arteries, two of which pass to the visceral surface of the stomach, the third to the parietal surface in the region of the lesser curvature. One branch to the visceral surface is very large and rebranches to a considerable extent.

The coeliac artery is continued asthe hepatic artery and lies somewhat dorsal to the gastric branches. The hepatic artery passes towards the pyloric region of the stomach along the right end of the lesser curvature and here gives off the gastroduodenal artery. The hepatic artery continues along the hepatoduodenal ligament to the liver.

The superior mesenteric artery arises a short distance behind the coeliac and is also unpaired. It divides into three branches. The first, the pancreatico - duodenal artery passes to the ~~left~~ *right* to supply the pancreas and duodenum. The ~~right~~ *left* branch divides to form the ileocaecolic artery to the caecum, and numerous small branches to the small intestine. The third and middle branch arising from the superior mesenteric is small and bifurcates; one branch, corresponding to the middle colic artery of the rabbit, passes to the transverse colon and to the proximal portion of the descending colon.

A short distance posterior to the superior mesenteric artery the renal arteries arise from the dorsal aorta, the right, anterior to the left. The arteries are dorsal to the renal veins.

The right and left spermatic arteries are given off from the posterior borders of the right and left renal arteries. They pass posteriorly, in close contact with the ureters, to the testes.

Posterior to the renal arteries, the unpaired inferior mesenteric artery arises from the ventral surface of the aorta and passes to the descending colon and rectum. It divides into the left colic artery, which passes cranially along the descending colon giving off branches to it, and into the superior hemorrhoidal artery which passes posteriorly to the

caudal portion of the descending colon and rectum.

Paired lumbar arteries arise from the dorsal surface of the aorta and supply the muscles of the back.

In the posterior region of the abdominal cavity the aorta forks to form two common iliac arteries, which bifurcate again, shortly, into the internal iliac gives off the caudal artery and passes to the region of the bladder. The external iliac gives off a small branch to the region of the tail, a branch to the internal abdominal wall and the external spermatic artery. On passing through the body wall, a deep branch is given off from the external iliac artery to the muscles, and further posteriorly the inferior epigastric artery is given off. The latter ascends in the abdominal wall to anastomose with the superior epigastric artery. The external iliac is continued in the leg as the femoral artery which proceeds along the medial surface of the thigh, supplying the muscles of the leg.

The Veins:

The pulmonary veins from the lungs unite to form two chief trunks which enter the left auricle.

The azygos vein is large and receives branches from the intercostal spaces. It empties into the precaval just before the entrance of the latter into the right auricle.

There is only one precaval vein; it is formed by the union of the right and left innominate veins. The innominate veins receive the internal mammary veins, and the supreme intercostal veins which correspond to the arteries of the same name.

The left innominate vein is formed by the union of the left internal and external jugular and left subclavian veins. The right innominate vein is formed in a similar way.

The internal jugular, on each side, accompanies the carotid artery and vagus nerve and arises in the region of the brain.

The right and left external jugular veins receive tributaries from the head and neck. Each external jugular arises behind the ramus of the mandible by the union of the posterior facial vein and the external maxillary vein.

The external maxillary vein arises as the anterior facial vein which is formed by the union of the large angular vein, from the inner canthus of the eye, and a dorsal nasal vein from the levator labii nasae muscle. The latter two veins lie deep to this muscle. The angular vein receives small veins from the mandibular portion of the masseter muscle.

At the anterior upper border of the jugo - maxillaris part of the masseter muscle, the anterior facial vein receives the transverse facial vein which lies along the dorsal border of the masseter muscle.

The superior labial vein from the region of the upper lip enters the anterior facial vein. The former is connected, by a short branch, with the inferior labial vein which comes from the substance of the orbicularis oris in the region of the lower lip and enters the anterior facial vein. Shortly posterior to the small connecting branch, the inferior labial receives a small branch from the platysma. Along the anterior border of the masseter muscle, the anterior facial vein is covered by the superficial platysma.

As it proceeds posteriorly, the anterior facial vein receives a short branch from the masseter muscle and another from the mandible. It continues between the outer and middle lobes of the submaxillary gland, receiving here the lingual vein from the tongue.

The anterior facial vein now becomes the external maxillary vein which passes along the ventral border of the masseter muscle and partly deep to the submaxillary gland. In this region the left external maxillary vein is connected with the right external maxillary vein by the transverse vein, which runs from the left vein between the posterior and anterior lobes of the submaxillary gland, to the right side where it passes beneath the anterior inner lobe of the right submaxillary gland, then between the posterior and anterior lobes of the gland to the right vein.

A considerable distance posterior to the transverse vein, the external maxillary meets the posterior facial vein to from the external jugular.

The superficial temporal vein from the region anterior to the ear, the auricular vein from the ear and a vein from the region posterior to the ear are tributaries of the posterior facial vein. The transverse facial vein is received just anterior to the superficial temporal.

As the posterior facial vein passes ventrally along the posterior border of the masseter muscle, it receives a branch from the parotid gland, and continues to the external jugular. At the junction of the posterior facial and the external maxillary, a branch coming from the parotid gland enters the external jugular. Posterior to this the latter vein receives small branches from the muscles in this region, passes deep to the clavicle and receives the transverse scapular vein from the shoulder, from the clavodeltoid and supraspinatous muscles. A small branch from the

parotid gland enters the transverse scapular vein.

The external jugular then continues its course to meet the subclavian vein.

The subclavian vein, on each side of the body, is a continuation of the axillary vein which arises as the brachial vein from the forelimb.

Distally two veins, one of which passes along the posterior border of the pronator teres muscle, and the other between the extensor carpi ulnaris and the extensor minimi digiti muscles, unite to form the radial vein which joins the brachial vein. The latter vein receives other branches but these were not followed.

The brachial vein continues in the axilla as the axillary vein. The latter receives the long thoracic vein which lies embedded in the abdominal portion of the panniculus carnosus muscle and branches in it. The axillary vein next receives, on its dorsal surface, the subscapular vein which is formed by the union of two branches, one of which comes from the trapezius, cutaneous maximus, triceps and teres major muscles; the other branch passes from the antibrachium and proceeds along the posterior border of the brachialis anticus in company with the musculospiral nerve.

The subscapular vein then passes between the subscapular and the teres major muscles to the medial surface of the brachium and receives a branch from the subscapular muscle, and the thoracodorsal vein from the latissimus dorsi. It continues deep to the nerves and muscles in this region and enters the axillary vein. The latter next receives small branches from the pectoral muscles and continues as the subclavian vein.

The postcaval vein is formed in the posterior part of the abdominal cavity dorsal to the terminal part of the aorta by the union of the right and left common iliac veins. Each of these results from the union of the internal and external iliac veins. The external iliac veins receive branches corresponding to those of the arteries.

The external iliac is the continuation of the femoral vein from the leg.

At the junction of the two external iliac veins the postcaval vein receives the caudal vein. As the postcaval vein proceeds anteriorly, small paired lumbar veins from the dorsal body wall empty into it. The right and left spermatic veins enter the postcaval at the same level.

The renal veins are large and the left enters the postcaval posterior to the right renal vein. In this region the postcaval vein lies ventral to, but slightly to the right of the aorta.

The postcaval vein now passes dorsally and lies along the dorsal surface of the liver. It receives large hepatic veins from the liver, and small phrenic veins from the diaphragm. The postcaval vein passes through the diaphragm by way of the foramen venae cavae and proceeds anteriorly on the right of the median line and terminates in the right auricle.

The portal vein is a large trunk which receives blood from the viscera. It lies in the portal fissure of the liver and divides into a right and left portion which ramify in the substance of the liver, and break up into capillaries which unite again to form the hepatic veins which empty into the postcaval vein.

Just as the portal vein enters the liver it receives the coronary

vein from the lesser curvature of the stomach. Posterior to the coronary vein the anterior pancreatic - duodenal vein enters, from the region of the pancreas and duodenum. On the right, shortly posterior to this, the portal vein receives a branch from the region of the duodenum and the gastrosplenic vein from the spleen and the left gastro - epiploic vein from the stomach.

The posterior portion of the portal vein is known as the superior mesenteric vein which collects blood from all parts of the intestine, and which receives the inferior mesenteric vein from the descending colon and rectum.

The Nervous System:

The Brain and its Membranes.

The brain is broad and rounded anteriorly. It is enveloped by membranes, the meninges, of which the outermost, the dura mater, is exceedingly tough. The dura mater dips down between the larger divisions of the brain. A thinner, vascular membrane, the pia mater, closely adheres to the brain. Between the two is the delicate arachnoid membrane.

The brain corresponds to that of other mammals and consists of three main divisions, the forebrain or prosencephalon, the midbrain or mesencephalon, and the hindbrain or rhombencephalon.

The prosencephalon is comprised of the telencephalon and diencephalon. The telencephalon consists of the olfactory lobes and the cerebrum.

The cerebral hemispheres are large and are rounded anteriorly. Each is 37 mm. long and 22 mm. wide. They are separated from each other by a deep median fissure. The separation is complete anteriorly and posteriorly; but in the middle the two hemispheres are connected by a band of white fibres, the corpus callosum, as in other mammals. The surface of the cerebrum is not thrown up into folds.

The olfactory lobes are small and project forward from the anterior portion of each cerebral hemisphere. Posterior to these on the ventral surface are the short olfactory tracts. Lateral to the optic chiasma are the two pyriform lobes forming the posteroventral part of the cerebral hemispheres, and separated from the rest of the cerebral hemispheres by the rhinal fissures.

In the diencephalon, the optic chiasma, a transverse band of nerve fibres, is situated behind the ventral termination of the longitudinal

fissure. Posterior to this is a rounded prominence, the tuber cinereum, to which is attached, by a narrow stalk, the pituitary body. This is widely ovoid in shape and very large. The pineal body is small and is situated at the base of the transverse fissure which separates the cerebrum and cerebellum.

The mesencephalon is completely hidden, dorsally, by the cerebral hemispheres and the anterior lobe of the cerebellum. The mesencephalon consists of the corpora quadrigemina and the cerebral peduncles. The corpora quadrigemina is made up of four small lobes; the anterior pair are the superior colliculi, the posterior, the inferior colliculi. The cerebral peduncles are two thick bundles of fibres coming from beneath the pyriform lobes and passing obliquely backward.

The rhombencephalon consists of the metencephalon and the medulla oblongata. The metencephalon comprises the pons **Varolii** and the cerebellum. The pons is situated posterior to the cerebral peduncles and consists of a band of transverse fibres. The cerebellum consists of a median lobe, the vermis, and two lateral lobes, the hemispheres. The anterior part of the vermis projects up between the diversion of the two cerebral hemispheres. The dorsal surface presents numerous transverse folds.

The medulla oblongata is partly overlapped by the vermis. From beneath the pons Varolii ventrally, on either side the mid-line, the anterior **pyramids**, narrow but prominent bundles of fibres, emerge and proceed posteriorly. Behind the pons is the trapezoid body, a band of transverse fibres; this is not very prominent.

A sagittal section of the brain reveals that the internal structure is similar to that of other mammals; it will therefore not be described in

detail, except to record that the ventricles are very large and that the aqueduct of Sylvius is characteristically funnel - shaped (16).

The Cranial Nerves:

Of the twelve pairs of cranial nerves, the origins of the first nine were located.

The olfactory nerves, the first pair, arise from the under surface of the olfactory bulbs.

The optic nerves, the second pair, are given off from the optic chiasma.

The oculo - motor nerves, the third pair arise posterior to the tuber cinereum.

The trochlear nerves, the fourth pair, are small and arise from the side of the brain, at the anterior margin of the pons Varolii.

The trigeminal nerves, the fifth pair, are very large and arise from the lateral part of the pons Varolii. These nerves have three main branches, the opthalmic to the eye, the maxillary, and the mandibular. The maxillary passes through the infra - orbital foramen and divides and goes to the adjacent parts and to the teeth. A branch from the mandibular nerve, the mylohyoid, passes from the ventral border of the masseter muscle, across the mylohyoid muscle, to the mid - line to supply the mylohyoid and digastric muscles and the superficial fascia.

The abducens nerves, the sixth pair, arise posterior to the pons Varolii.

The facial nerves, the seventh pair, arise from the trapezoid body. They emerge at the stylo - mastoid foramen. Near the base of the ear, a

temporal branch is given off. The main portion of the facial nerve passes over the external surface of the masseter muscle along with the transverse facial vein. At the more dorsal border of the masseter, branches are given off to the lips and to the eyes.

The auditory nerves, the eighth pair, have their origin posterior to that of the facial nerves.

The glossopharyngeal nerves, the ninth pair, arise from the lateral surface of the medulla oblongata.

The origins of the tenth pair or vagus, the eleventh pair, or spinal accessory, and the twelfth pair or hypoglossal nerves could not be made out, but during the dissection of the muscles, the terminal portions were followed in part.

The vagus nerve descends in the neck between the internal jugular vein and the carotid artery to the thorax, passing dorsal to the innominate vein, but ventral to the subclavian artery, to the region of the heart where it gives off branches to the heart and lungs. It continues further to the stomach. Anteriorly it gives off branches to the pharynx and larynx, one branch, the superior laryngeal nerve, passing through the thyroid foramen.

The spinal accessory nerve lies close to the vagus nerve, anteriorly. It passes back towards the ear and gives off a branch to the sternomastoid muscle.

The hypoglossal nerve passes from the region of the ear beneath the masseter muscle and proceeds deep to the digastric muscle, crossing the common carotid artery ventrally. It crosses the geniohyoglossus muscle and divides into two, one branch going towards the mid-ventral line to

the deep muscles in this region, the other passes up near the ventral edge of the masseter muscle to the tongue.

The Spinal Nerves:

Of the spinal nerves only the ventral rami were followed.

There are seven pairs of cervical nerves some of which supply the muscles in the region of the neck, others go to forming the brachial plexus.

The Brachial plexus:

The brachial plexus is composed of the fifth, sixth, and seventh cervical nerves and the first dorsal (thoracic) nerve.

The median nerve is formed chiefly from the seventh cervical and first dorsal nerve and at the junction, the ulnar nerve comes off.

The musculo - spiral nerve is large and is formed mainly from the seventh cervical nerve.

The circumflex nerve originates from the sixth and seventh cervical nerves.

The nerve to the subscapularis muscle comes from the sixth cervical nerve.

The musculo - cutaneous nerve arises from the fifth and sixth cervical nerves.

The internal cutaneous nerve springs from a branch of the first dorsal nerve which receives a branch from the seventh cervical nerve.

The anterior thoracic nerve arises from the same source.

The median nerve passes along the medial side of the forelimb and at the elbow is situated anterior to the brachial artery. It passes down

the forearm deep to the flexor carpi radialis muscle.

The musculo - spiral nerve on the upper arm lies deep to the median nerve. It passes to the dorsal side of the arm between the head of the inner triceps muscle and the latissimus dorsi muscle and proceeds to the elbow where it divides between the supinator and brachialis anticus muscles into the radial and posterior interosseous nerves. The radial portion passes deep to the supinator longus muscle above the radial artery, and supplies the extensor carpi radialis longior and brevis muscles. The posterior inter - osseous nerve passes deep to the supinator brevis muscle and supplies the extensor muscles.

The musculo - cutaneous nerve descends to the outer side of the forearm, passing down the humerus beneath the long head of the biceps brachii muscle and at its anterior border lies on the ventral surface of the brachialis anticus muscle at the elbow. It gives branches to the biceps brachii muscle.

The circumflex nerve passes to the dorsal surface of the arm between the teres major and the subscapularis muscles together with the subscapular artery and vein. It supplies the deltoid and teres minor muscles.

The anterior thoracic nerve supplies the pectoral and ventro - lateral part of the panniculus carnosus muscle and gives off intercostal branches.

The nerve to the subscapularis lies between the axillary and the musculo - spiral nerves.

The internal cutaneous nerve passes to the inner side of the arm.

The ulnar nerve passes along the anterior border of the triceps medialis muscle and runs down behind the internal condyle, beneath the

epitrochleo - anconeus muscle, between the second part of the flexor profundus digitorum and the palmaris longus muscles. It supplies the palmaris longus and the flexor carpi ulnaris muscles.

The Thoracic Spinal Nerves:

The first thoracic nerve contributes to the brachial plexus. The ventral divisions of the remaining thoracic nerves pass along the border of the ribs as the intercostal nerves.

The Lumbar and Sacral Spinal Nerves:

There are six pairs of lumbar nerves. The first and second pass to the muscles and skin of the abdominal wall. The last four lumbar nerves, together with the first two sacral nerves, form the lumbosacral plexus.

The Lumbosacral Plexus:

The anterior crural nerve is formed by the first two lumbar nerves of the above group, the third and fourth lumbar nerves. The last two lumbar nerves, the fifth and sixth, form the great sciatic nerve. The small sciatic nerve arises from the junction of the first two sacral nerves.

The anterior crural nerve is very large, and emerges between the psoas major and minor muscles and passes to the front of the thigh, where it branches to the skin and muscles in this region.

The obturator nerve is also large and passes along the side of the pelvis and through the obturator foramen. It branches to the gracilis, adductor and other muscles in this region.

The great sciatic nerve turns dorsally passing between the ilium and vertebral column. It passes down the back of the thigh and divides into

the external and internal popliteal nerves. The external popliteal nerve is continued as the peroneal nerve and passes between the two heads of the gastrocnemius muscle and branches, a part passing down the outside of the gastrocnemius muscle, the remainder passing along the side of the tibialis posticus to the foot.

The internal popliteal nerve passes beneath the peroneus longus muscle and divides, one branch going to this muscle, the other passing between the peroneus brevis and the extensor longus digitorum muscles.

The small sciatic nerve passes close to the first part of the great sciatic nerve and gives branches to the gluteus maximus muscle.

The Sense Organs:

The eye and the ear are similar to those of other mammals. In the ear the external auditory meatus extends from the pinna to the tympanic membrane. The bones of the middle ear, the malleus, incus, and stapes are all present. These extend across the tympanic cavity from the tympanic membrane to the fenestra ovalis, which is the opening of the inner ear. The inner ear is very small and is enclosed in an extremely hard bony capsule.

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PLATE I.

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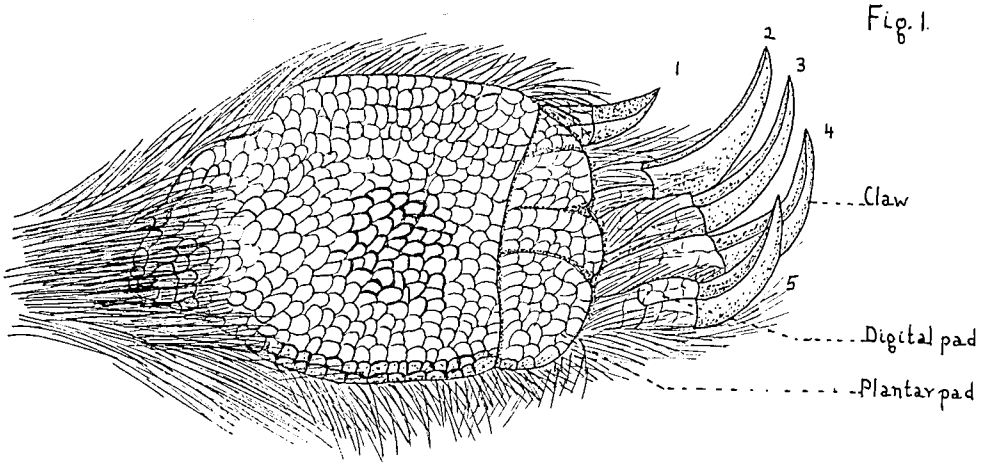

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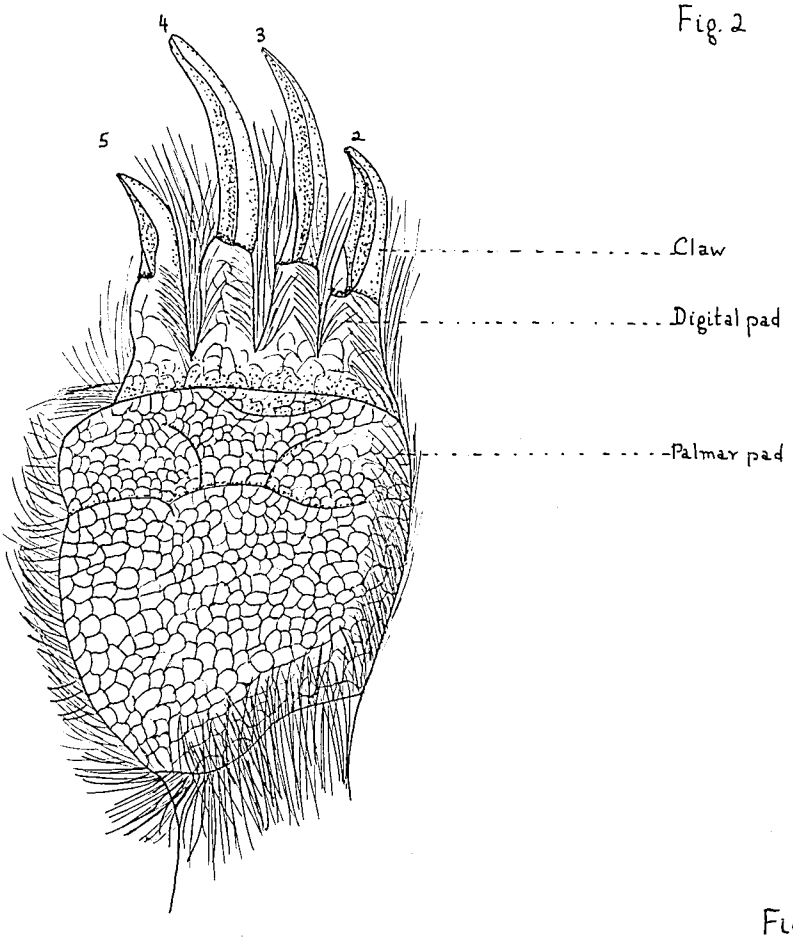

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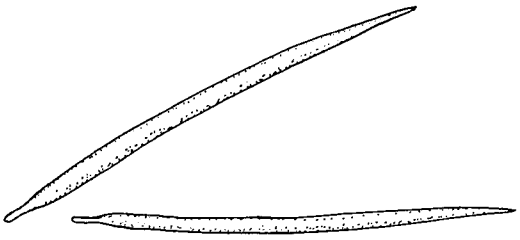

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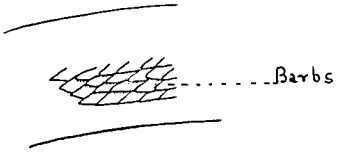

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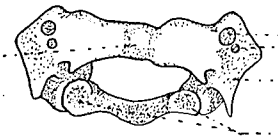

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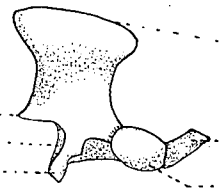

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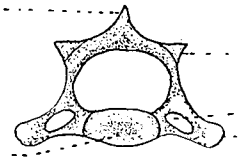

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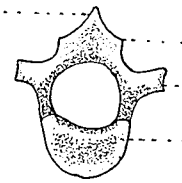

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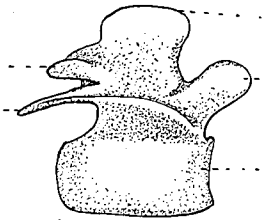

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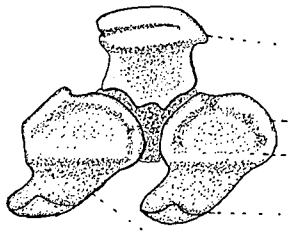

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Fig. 1

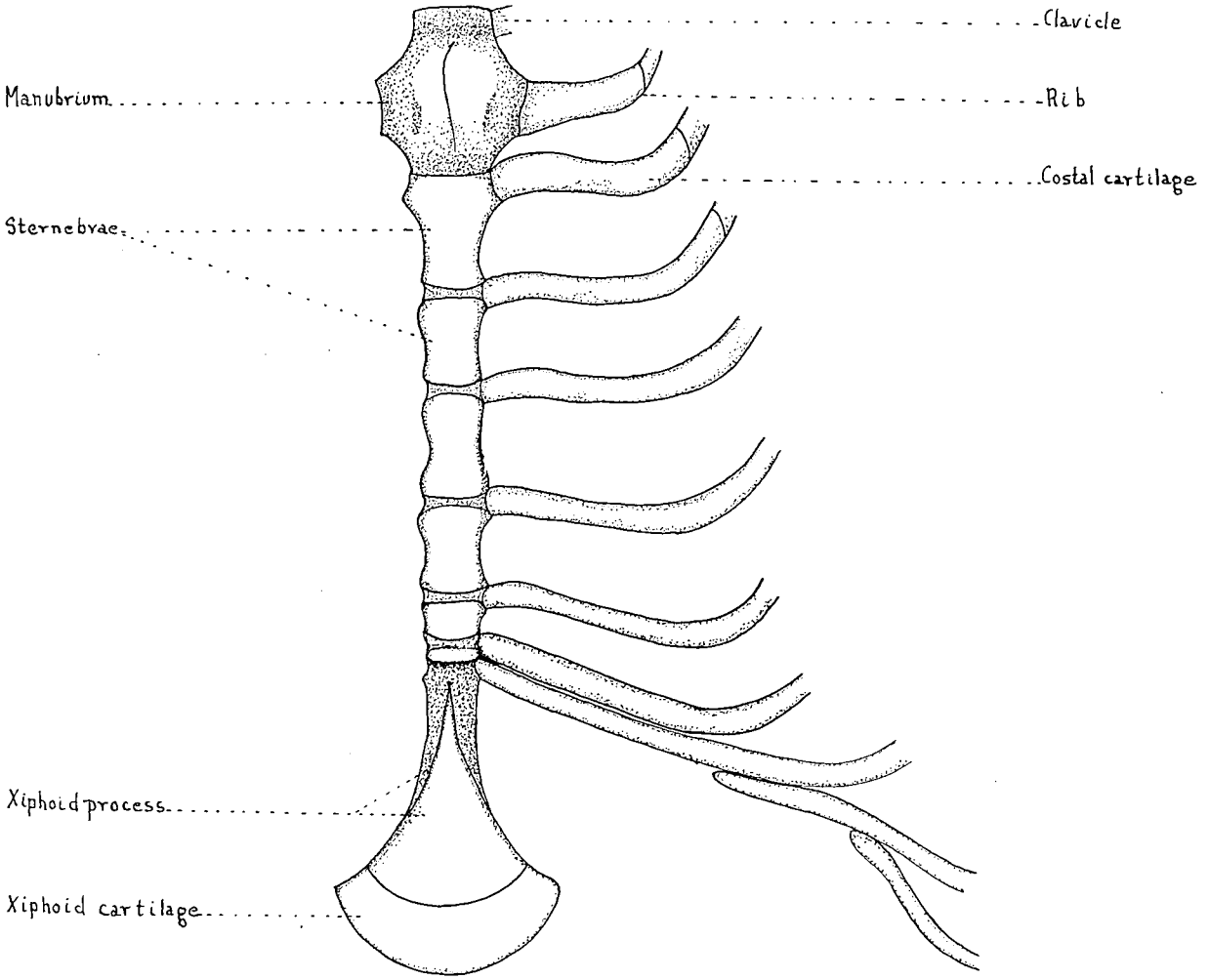

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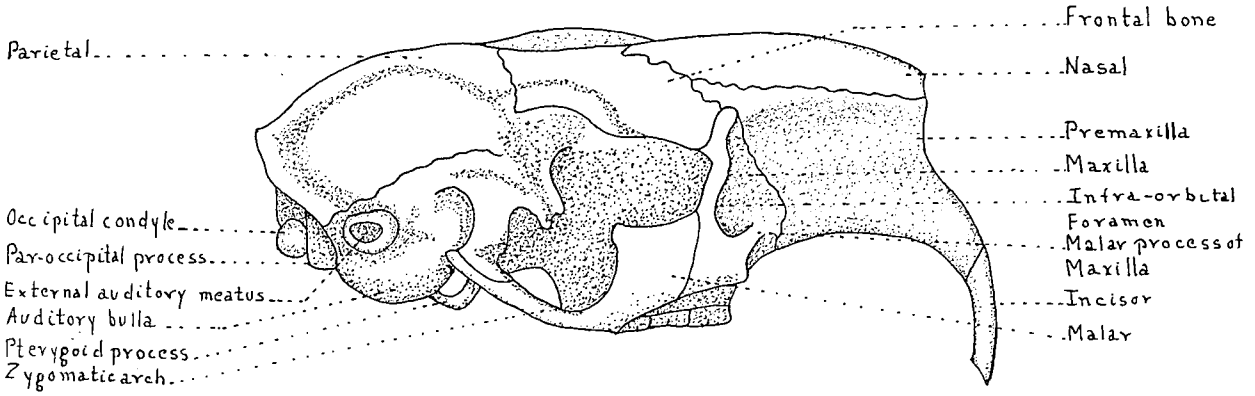
Fig. 1



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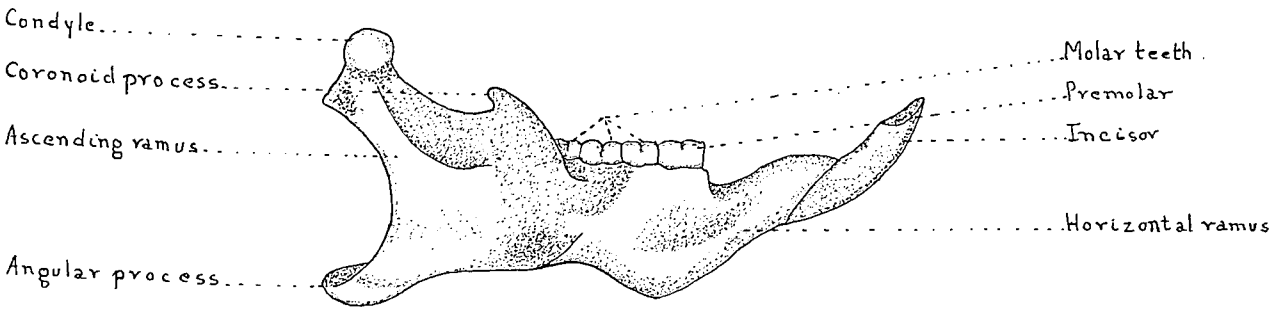

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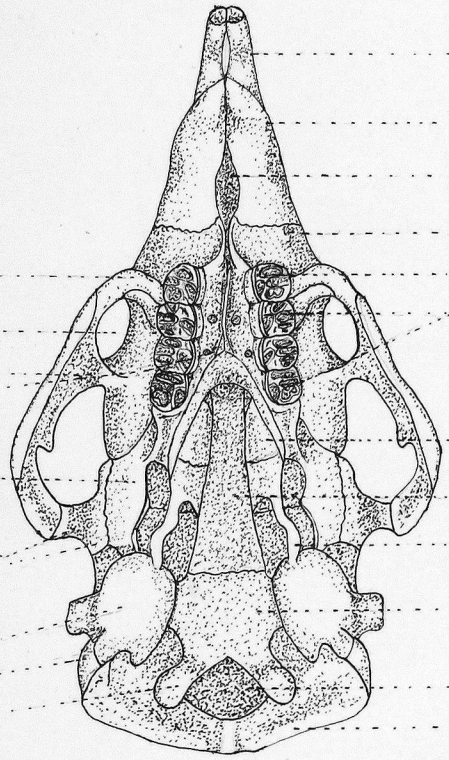
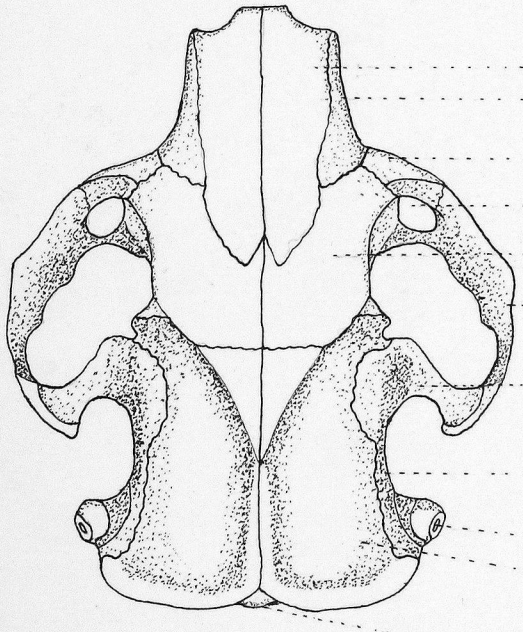
Fig. 1.



Incisor
Premaxilla
Incisive foramen
Maxilla
Premolar
Molar teeth
Palatine
Sphenoid
Pterygoid process
Basi-occipital
Foramen magnum
Supra-occipital
Malar process of maxilla
Infra-orbital foramen
Malar
Palatine process of maxilla
Alisphenoid
Glenoid surface
Zygomatic process of the squamosal
Auditory bulla
Mastoid process
Occipital condyle

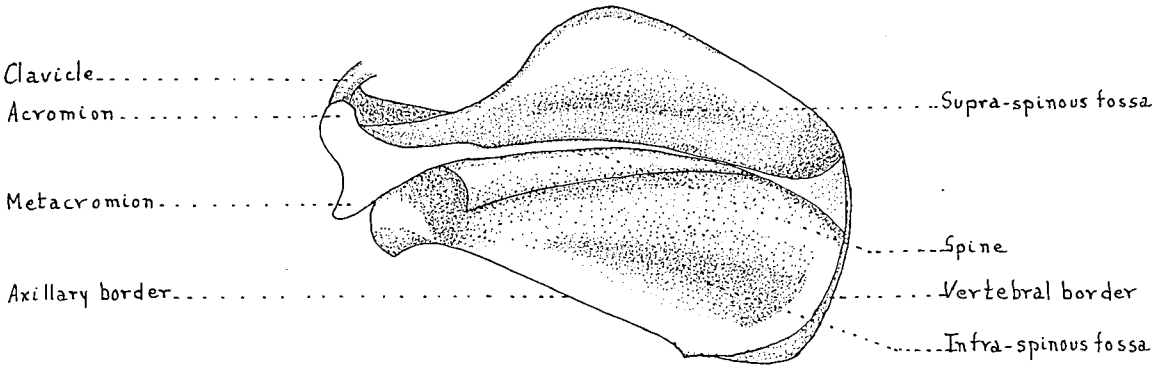
Fig. 2



Nasal
Premaxilla
Maxilla
Infra-orbital foramen
Frontal bone
Malar
Zygomatic process of the Squamosal
Squamosal part of Temporal bone
External auditory meatus
Parietal
Nuchal crest

PLATE VI.

Fig. 1



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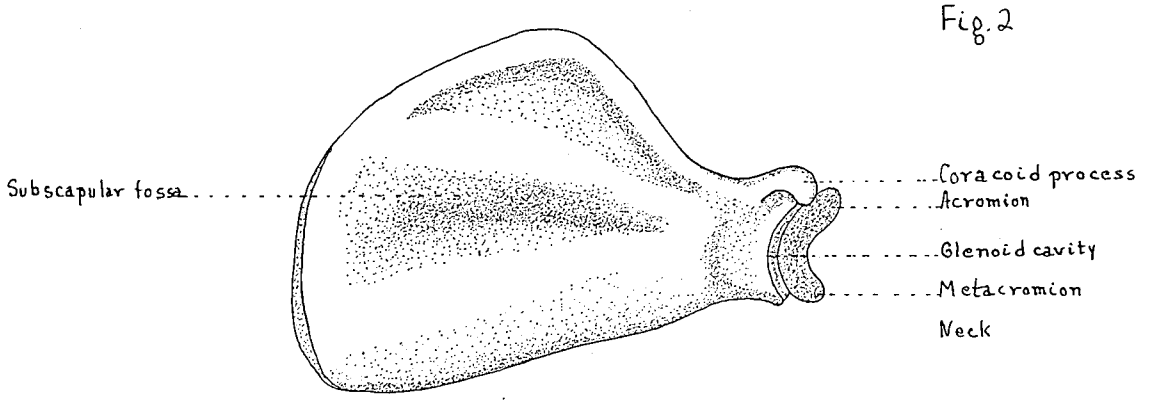

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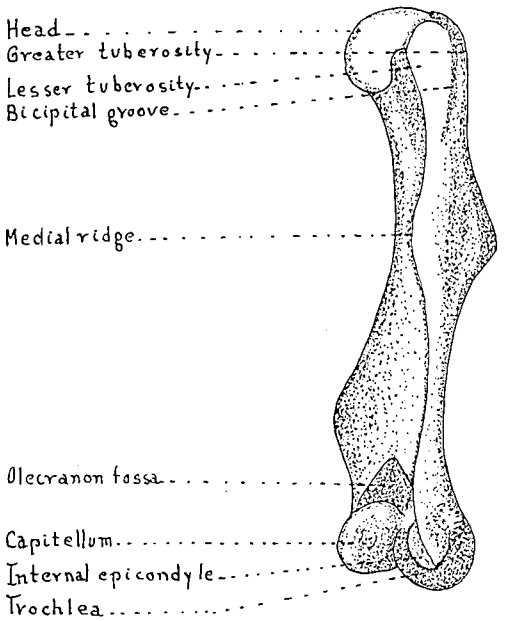

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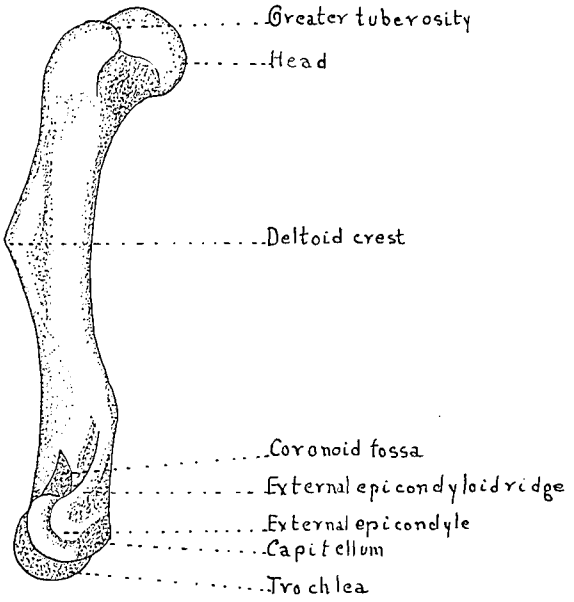

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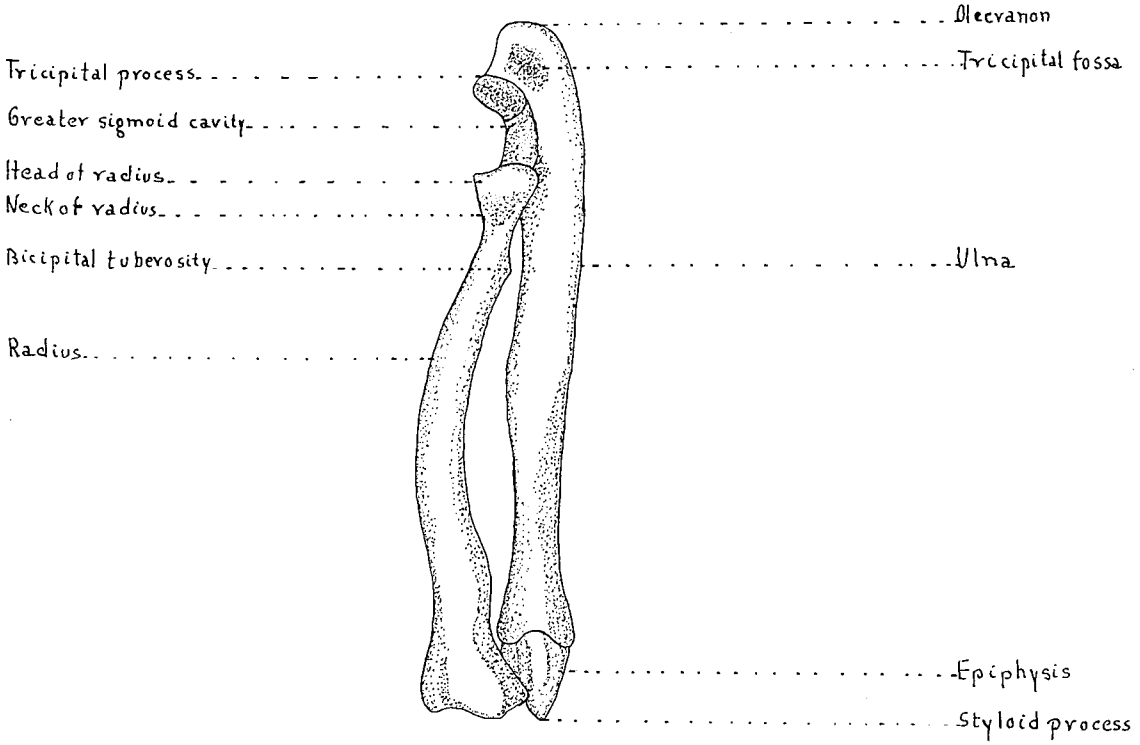
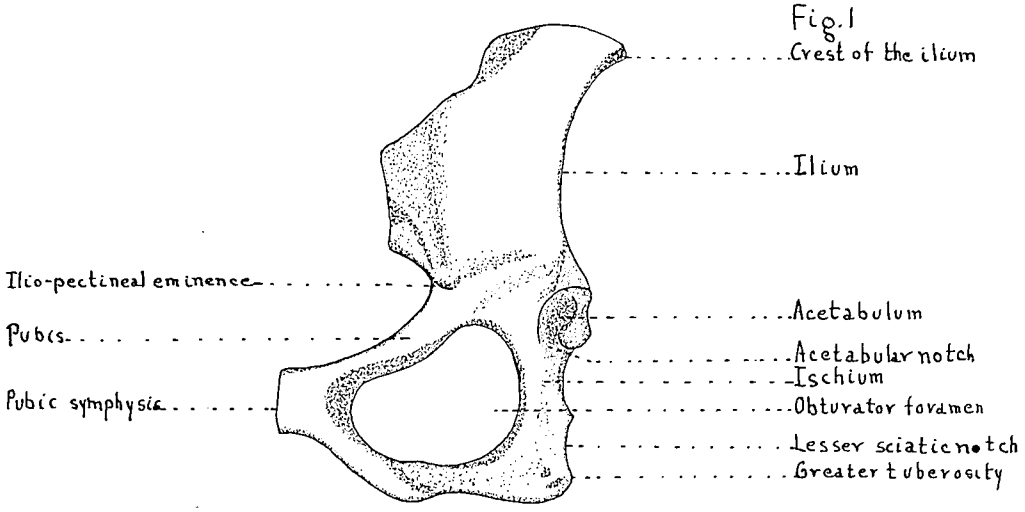


PLATE VIII.

Fig. 1



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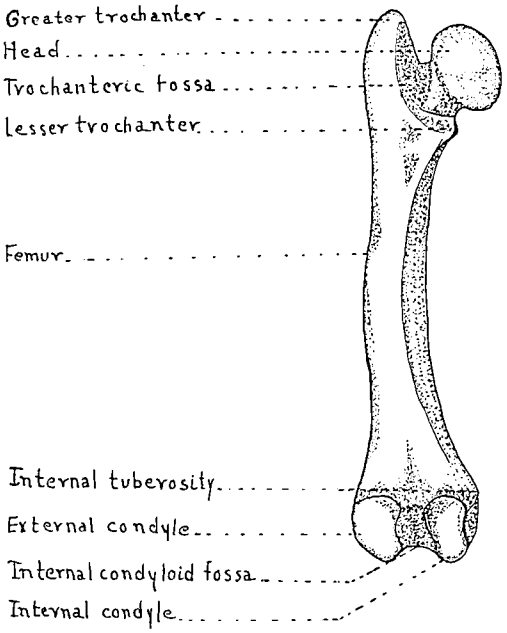

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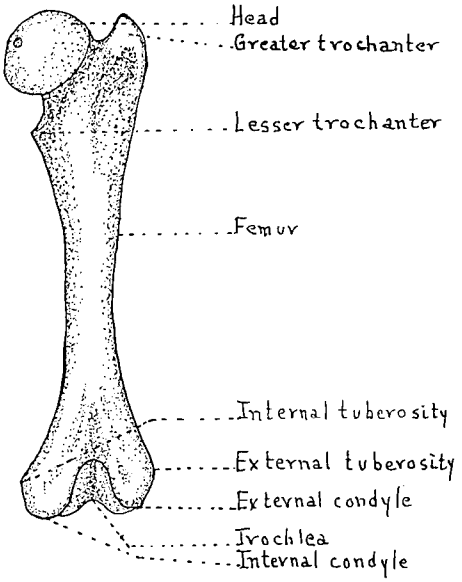

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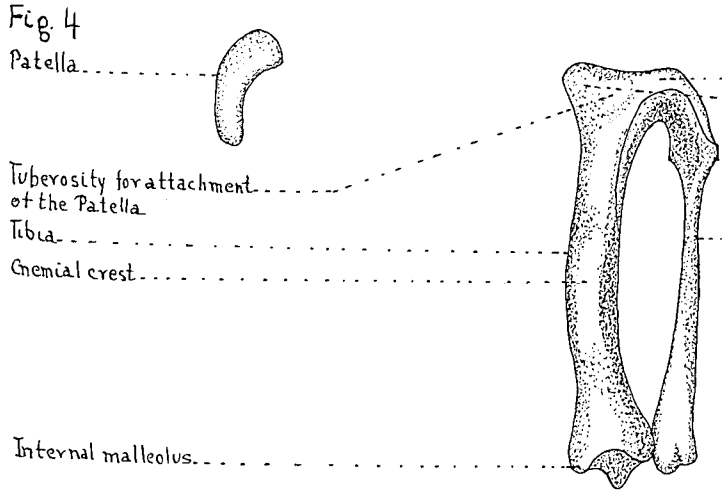

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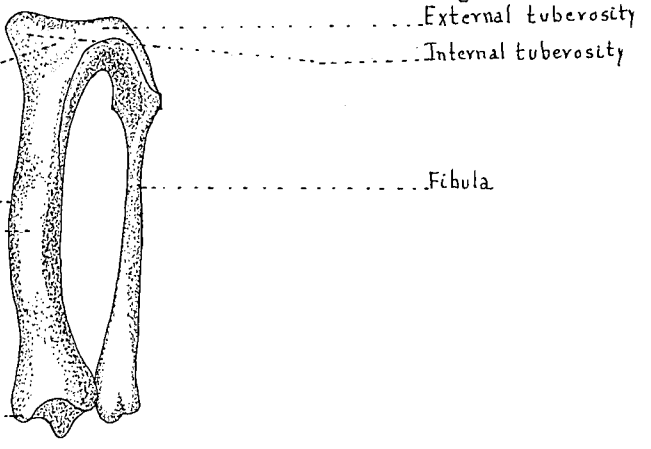

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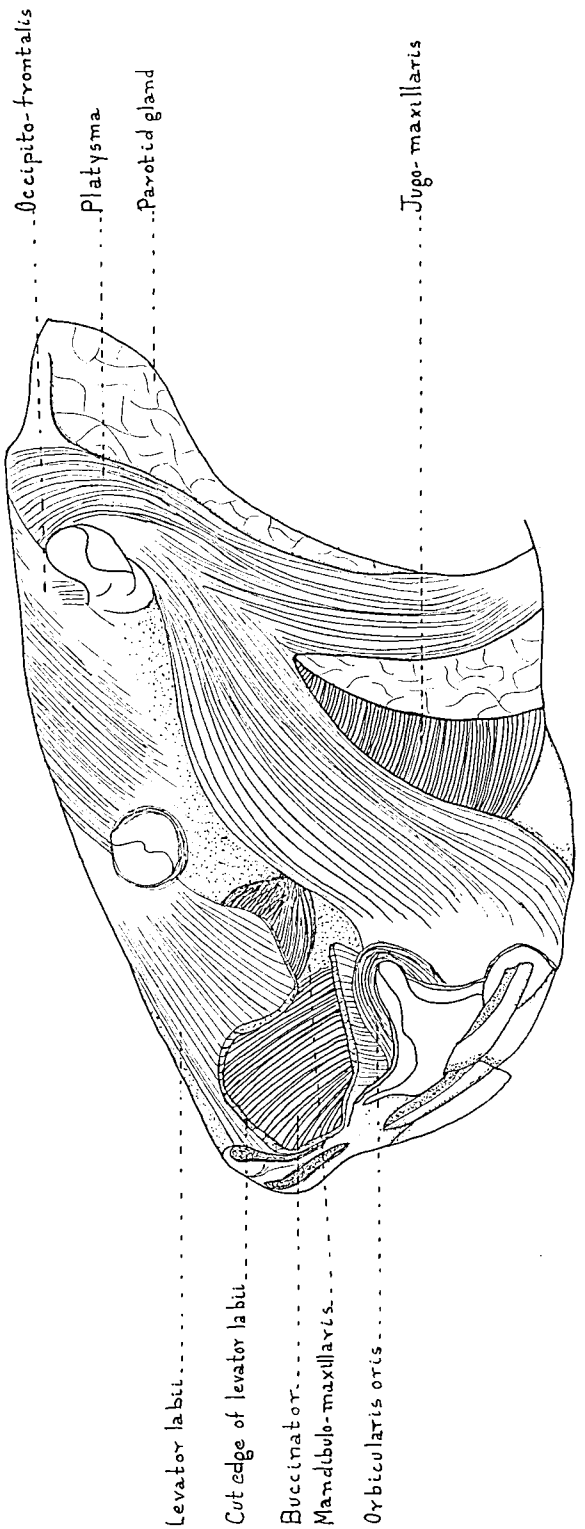

Occipito-frontalis
Platysma
Parotid gland
Jugo-maxillaris
Levator labii
Cut edge of levator labii
Buccinator
Mandibulo-maxillaris
Orbicularis oris

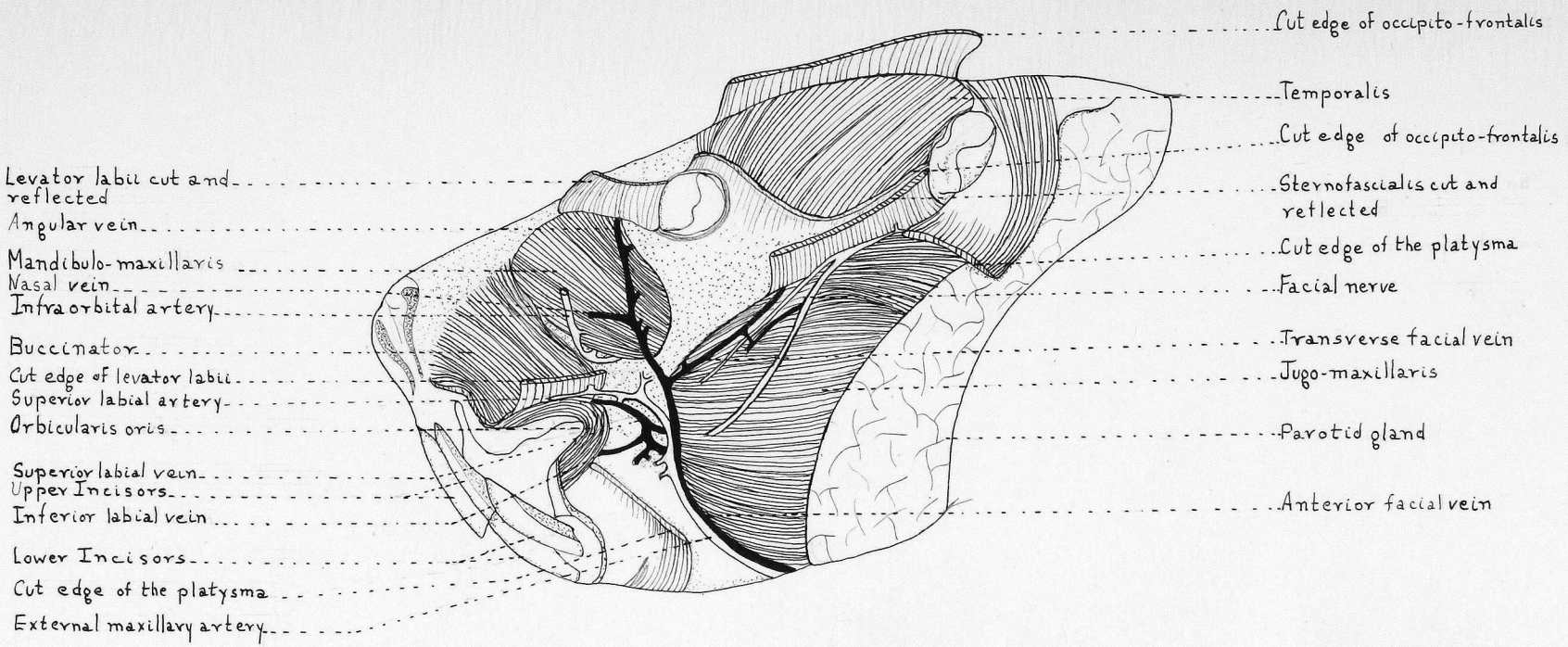
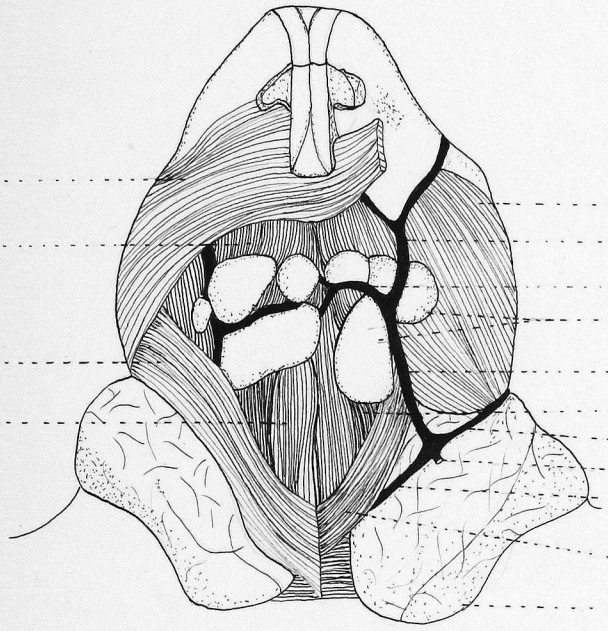

Cut edge of occipito-frontalis
Temporalis
Cut edge of occipito-frontalis
Sternofascialis cut and reflected
Cut edge of the platysma
Facial nerve
Transverse facial vein
Jugo-maxillaris
Parotid gland
Anterior facial vein
Levator labii cut and reflected
Angular vein
Mandibulo-maxillaris
Nasal vein
Infra orbital artery
Buccinator
Cut edge of levator labii
Superior labial artery
Orbicularis oris
Superior labial vein
Upper Incisors
Inferior labial vein
Lower Incisors
Cut edge of the platysma
External maxillary artery

PLATE X

PLATE XI

Fig 1



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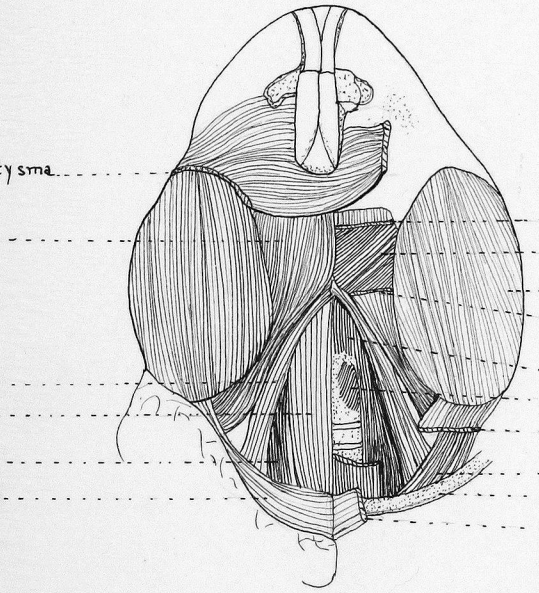

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Fig. 1

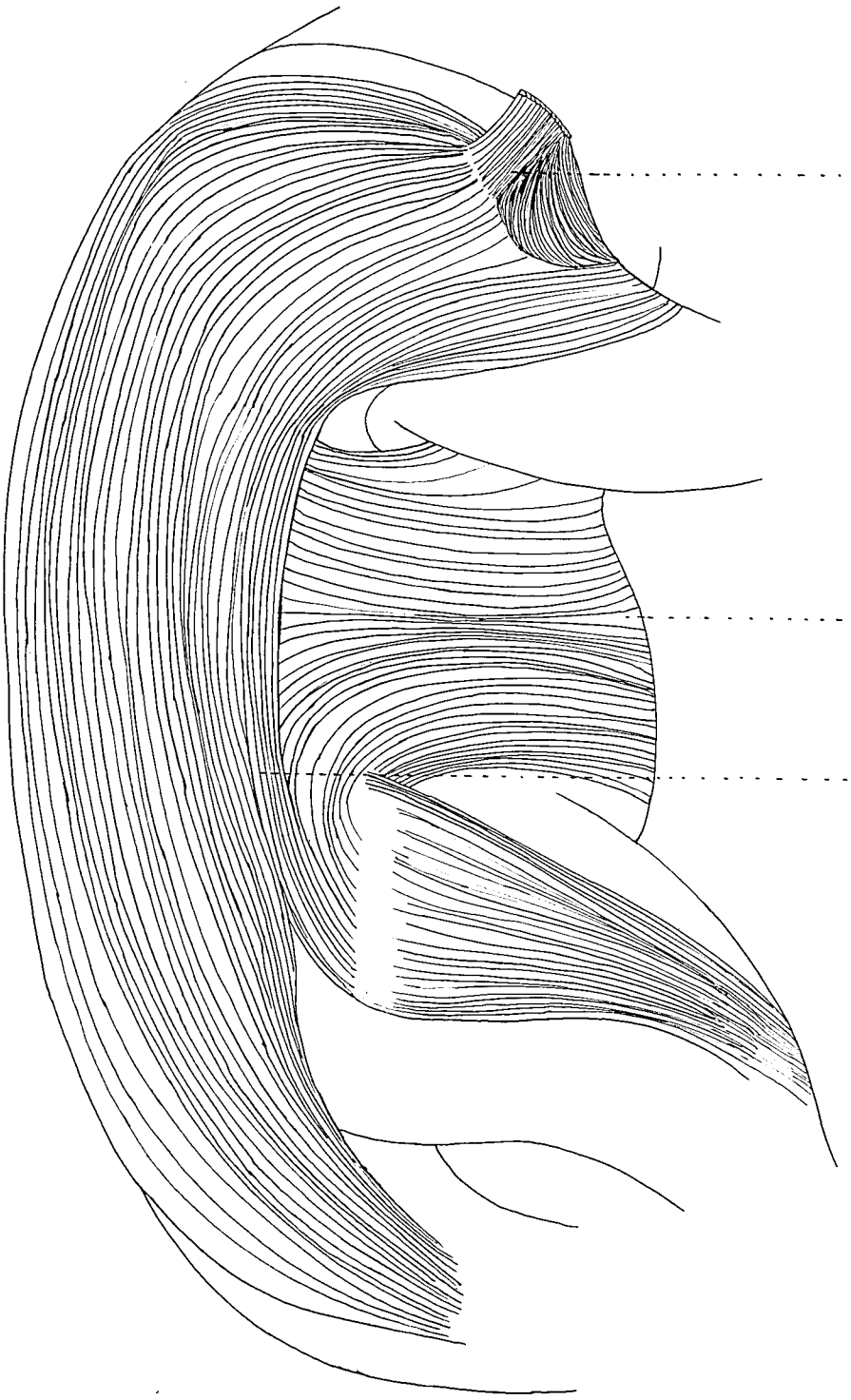

PLATE XIII

Fig. 1

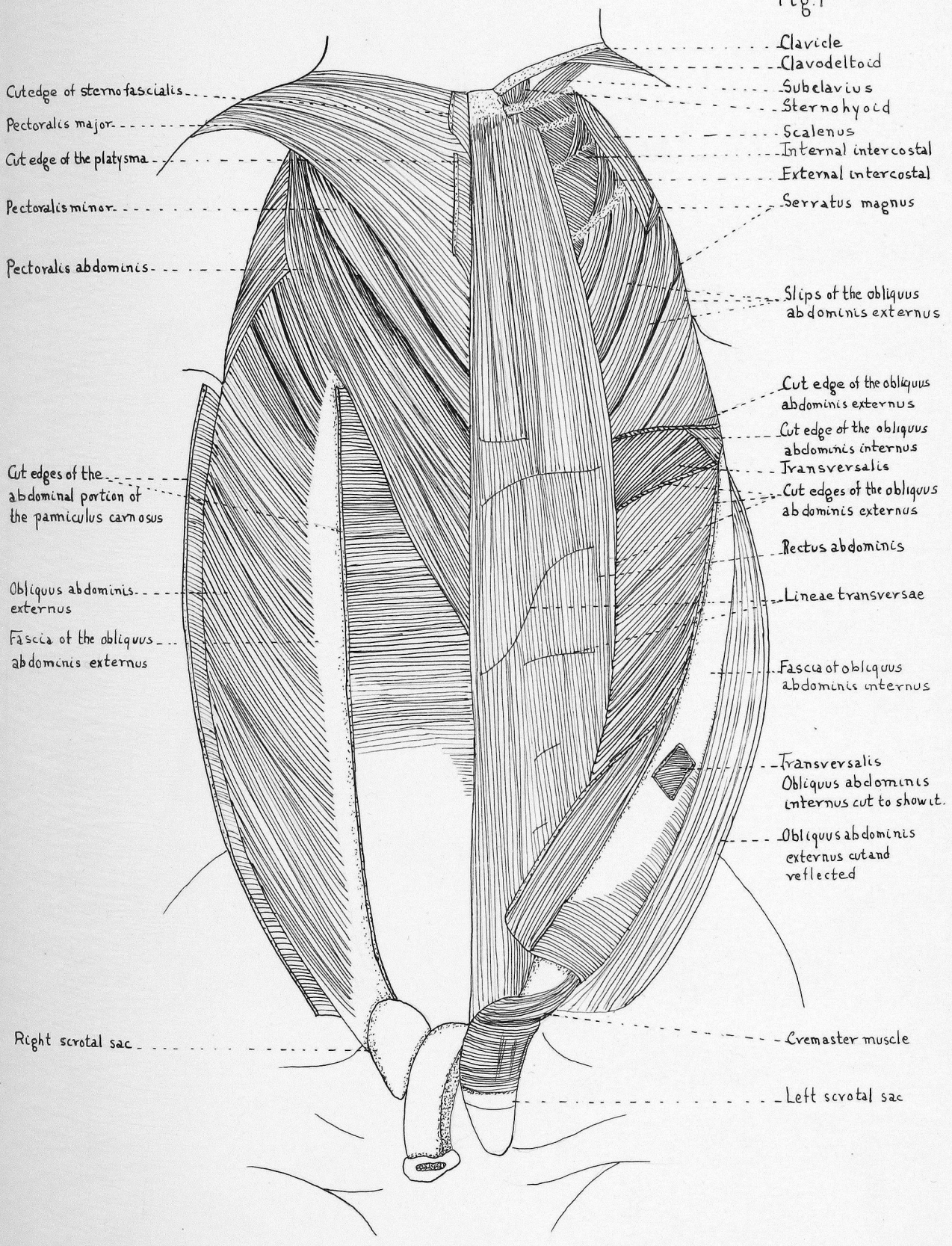

PLATE XIV

Fig. 1

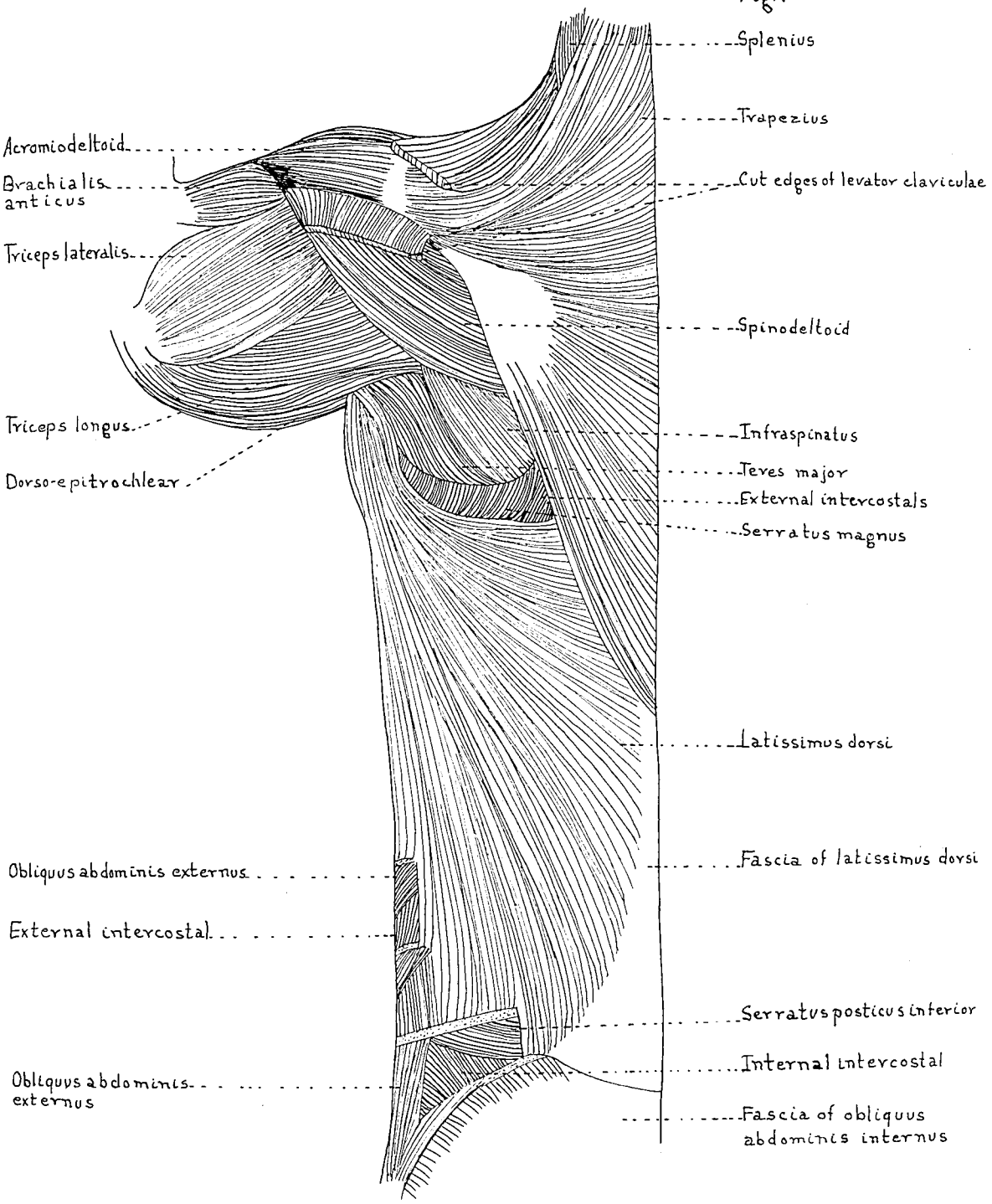

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Fig. 1

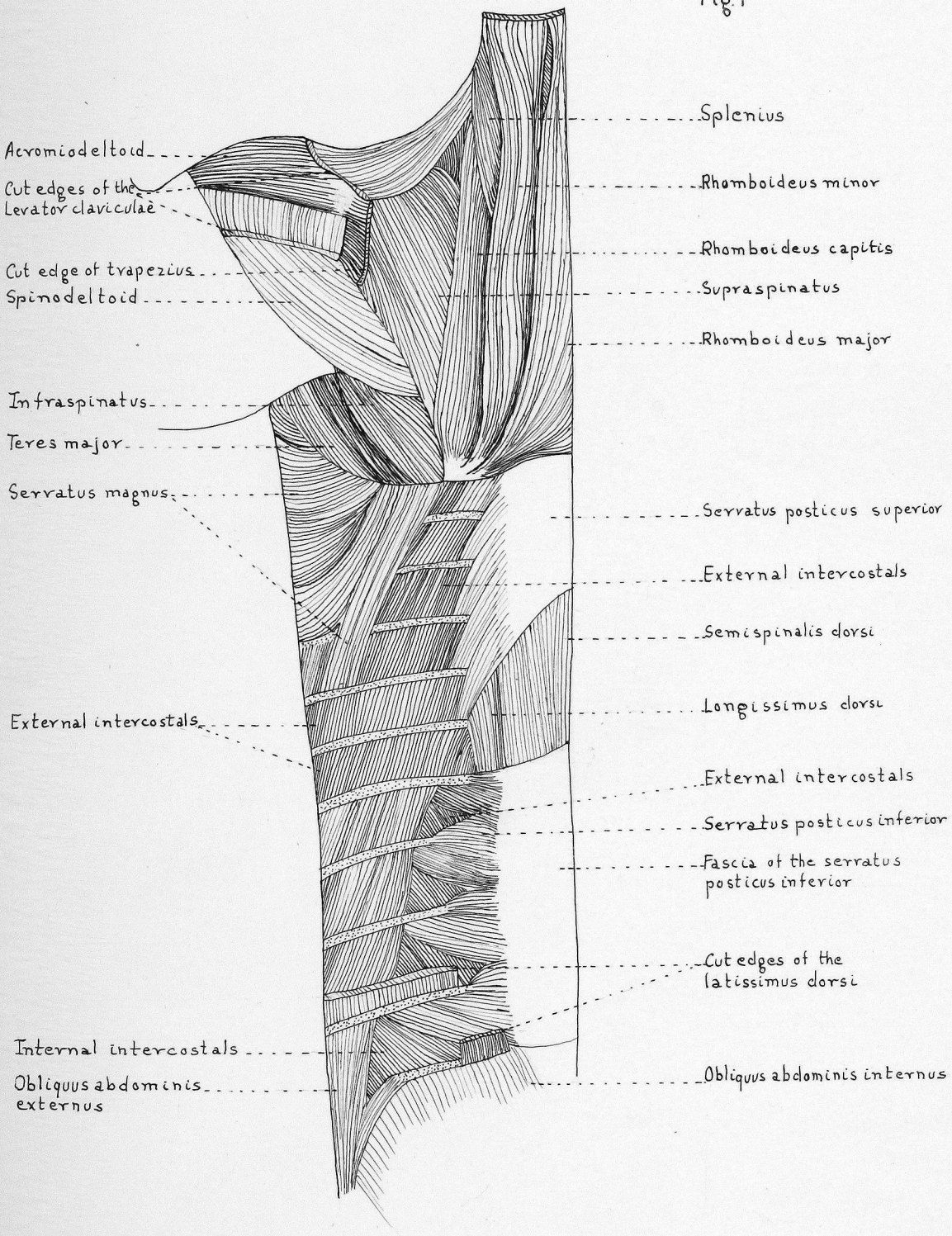

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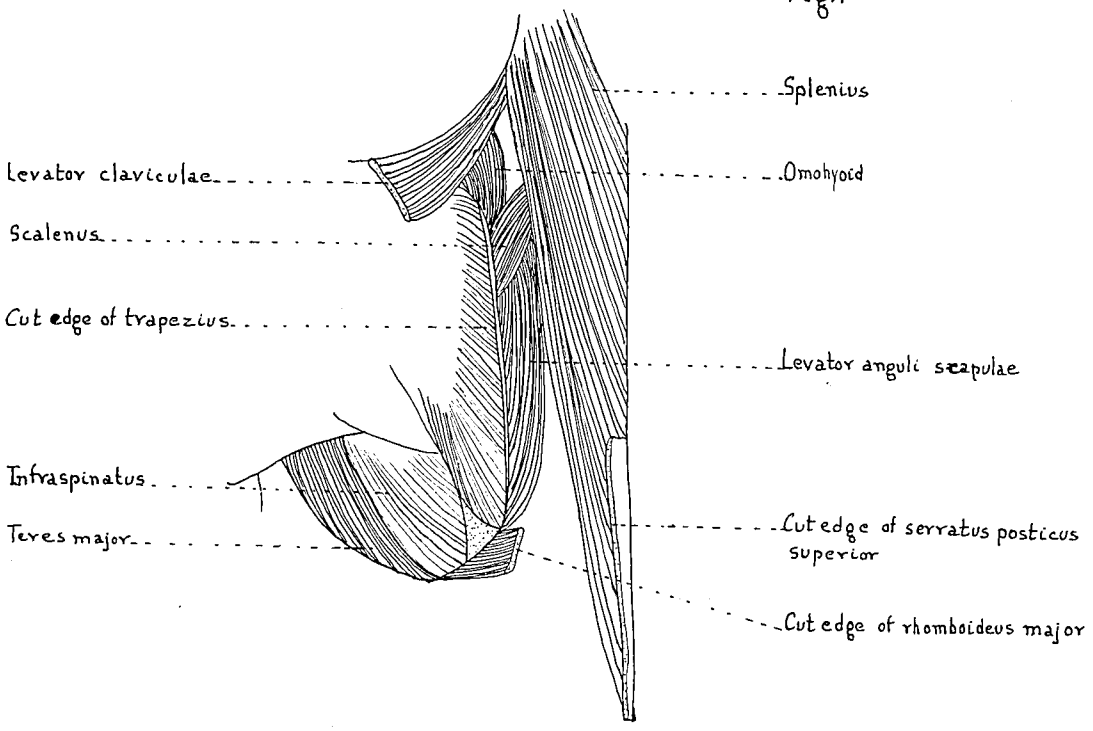
Fig. 1



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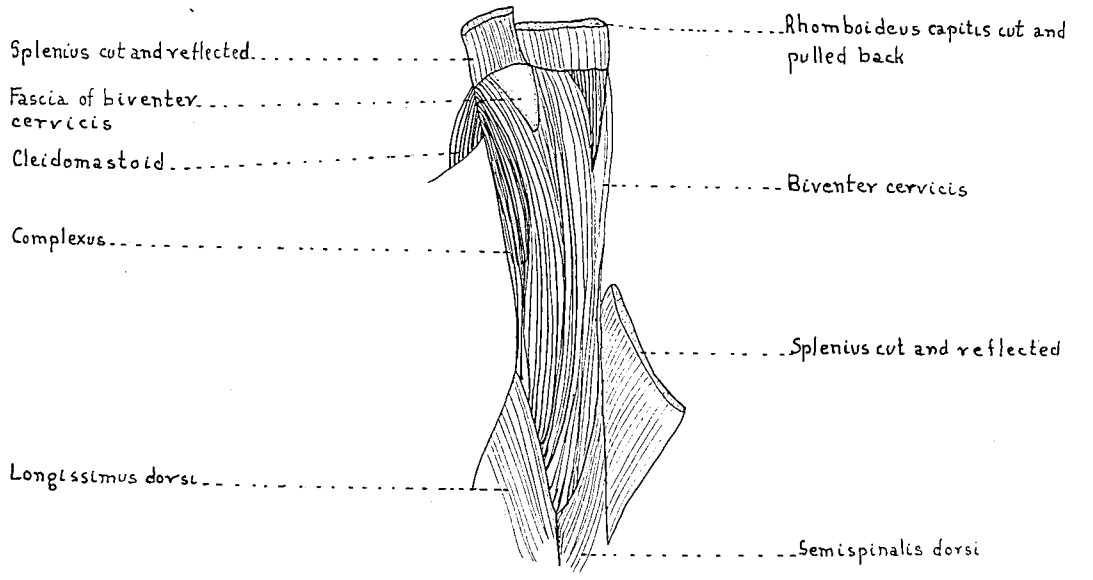

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Fig. 1

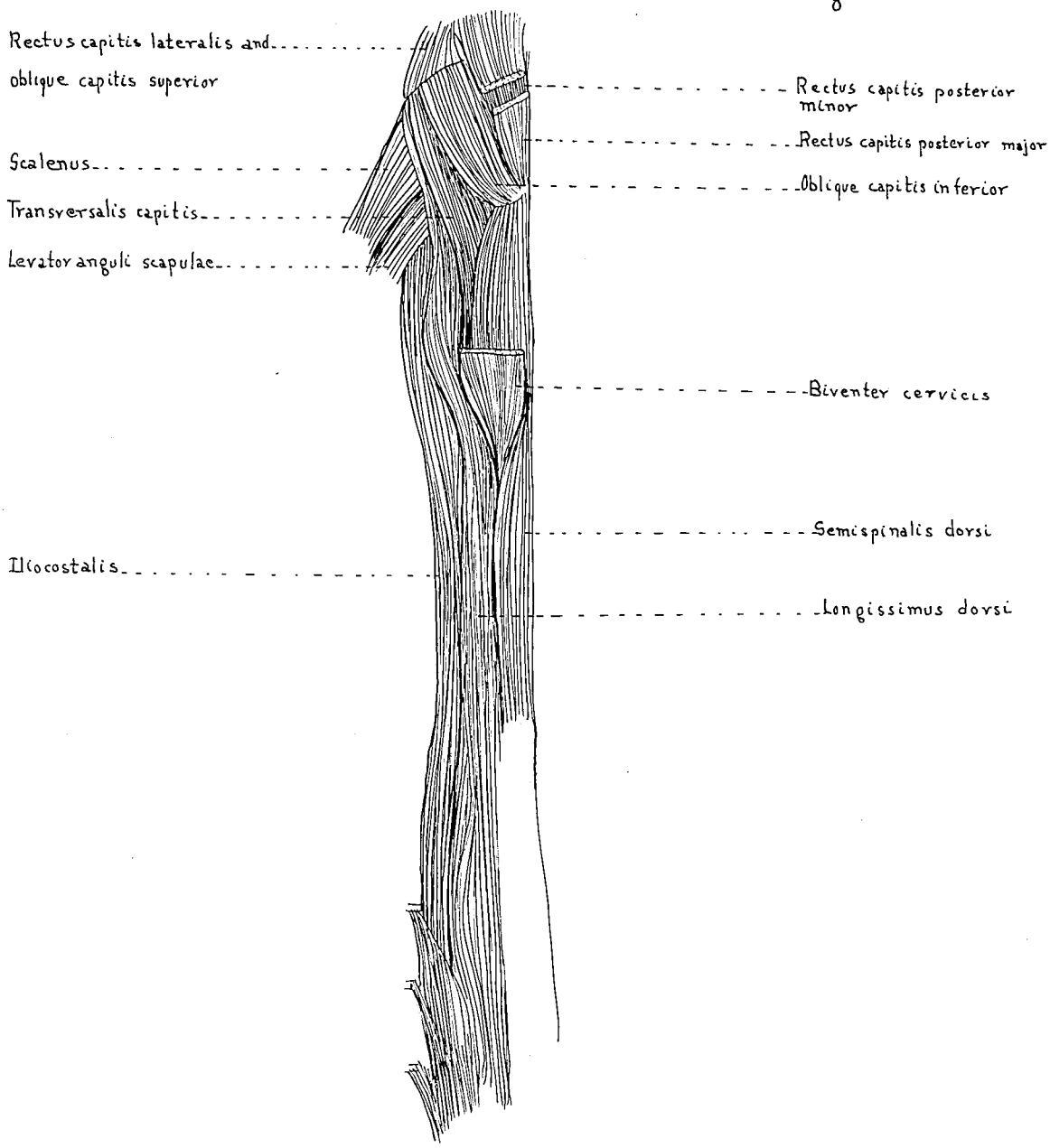

PLATE XVIII.

Fig. 1

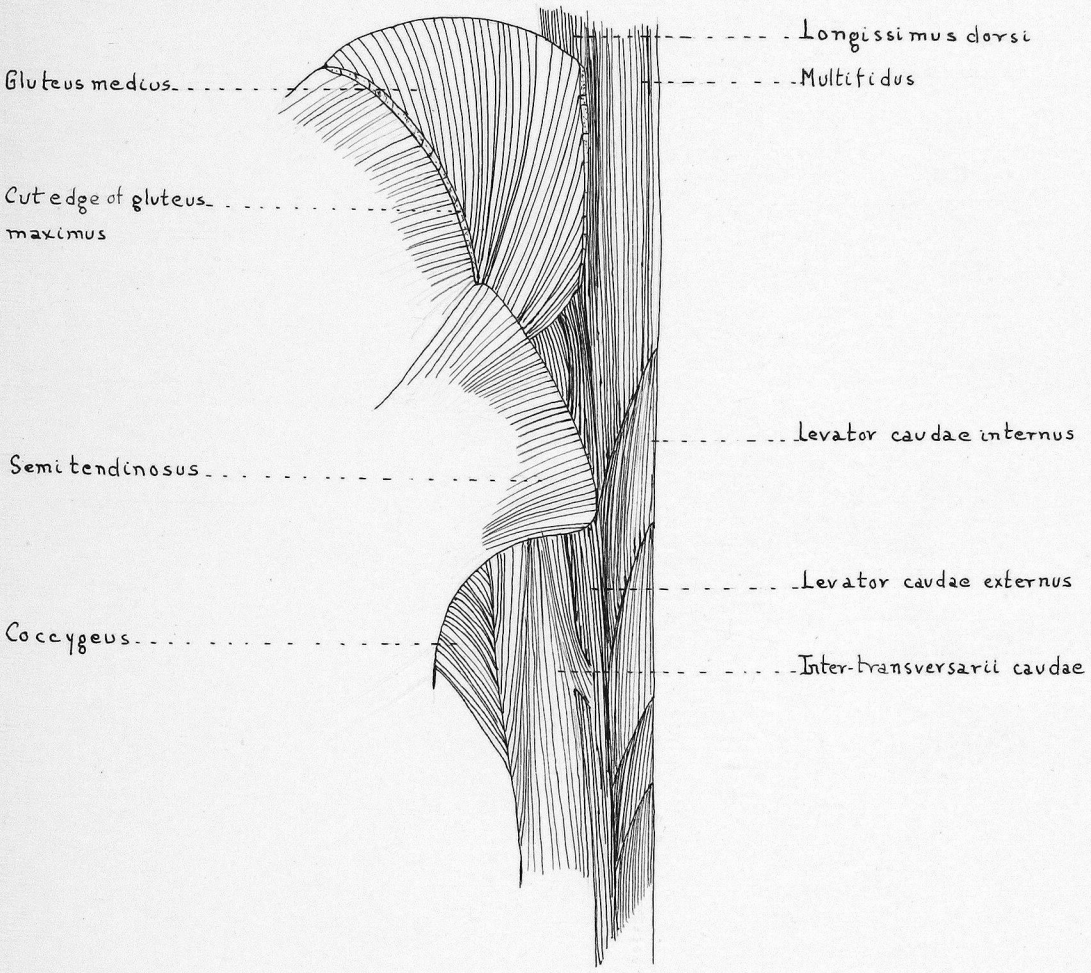

PLATE XIX

Fig. 1

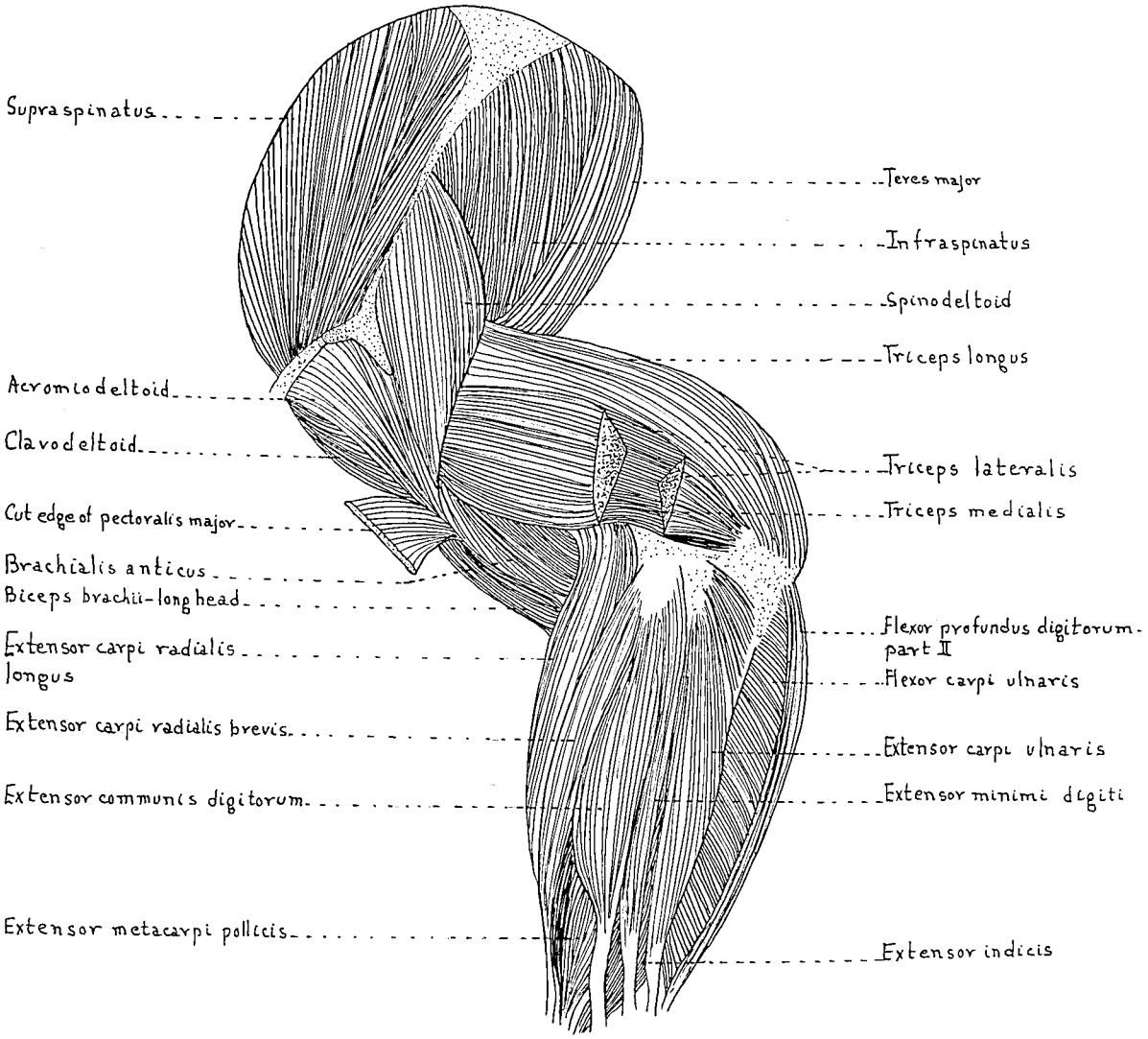

PLATE XX

Fig. 1

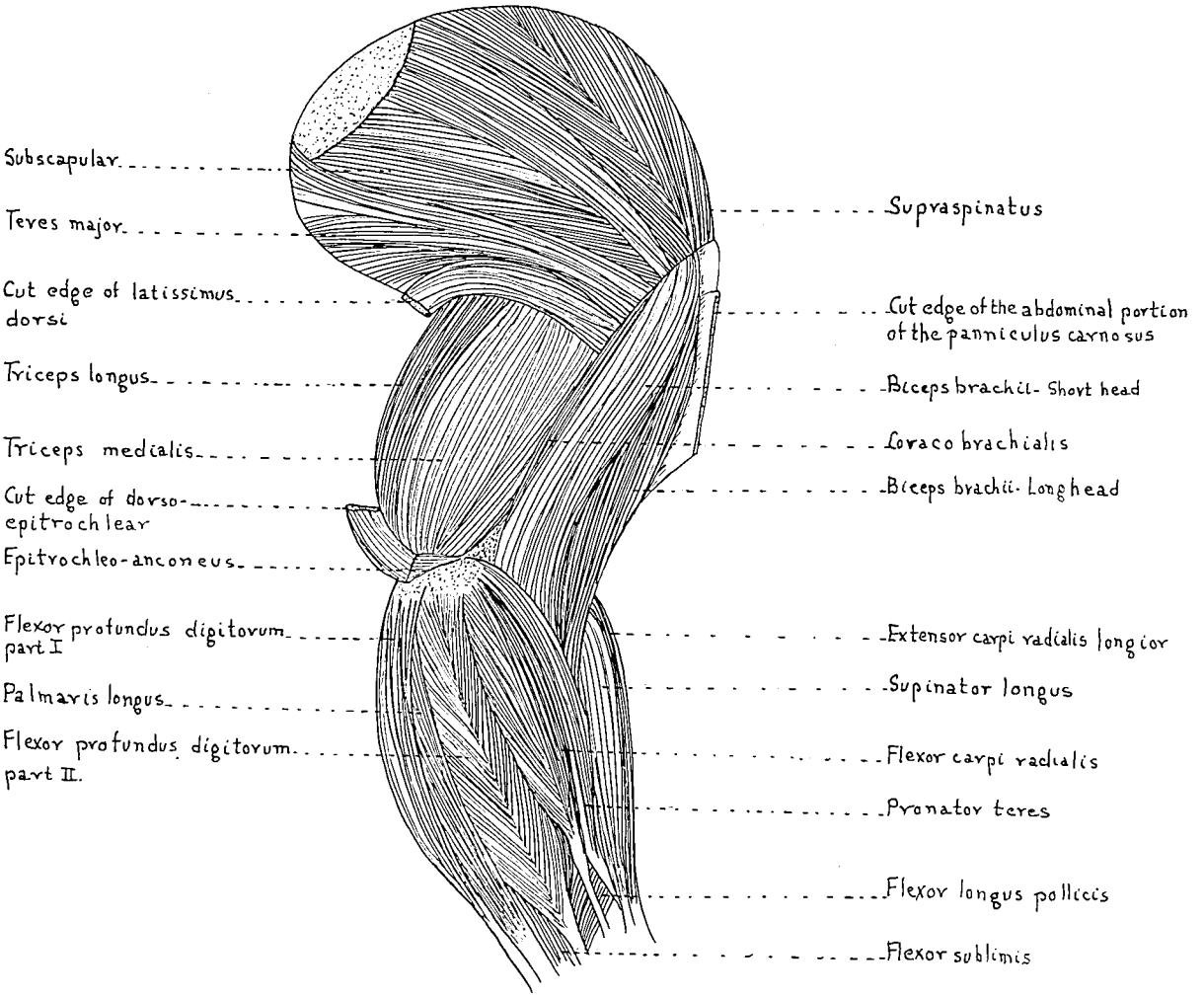

PLATE XXI

Fig. 1

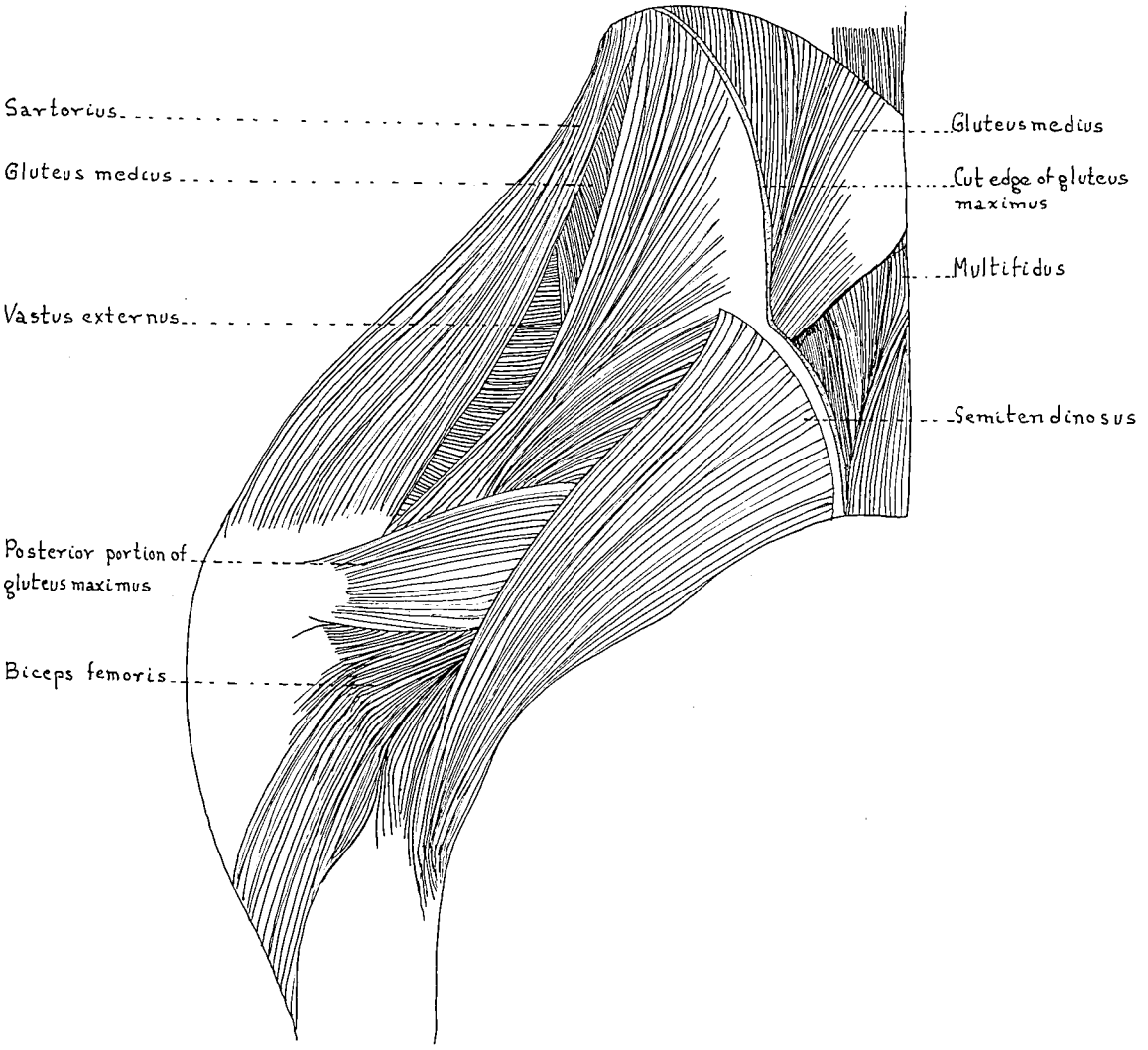

PLATE XXII.

Fig. 1

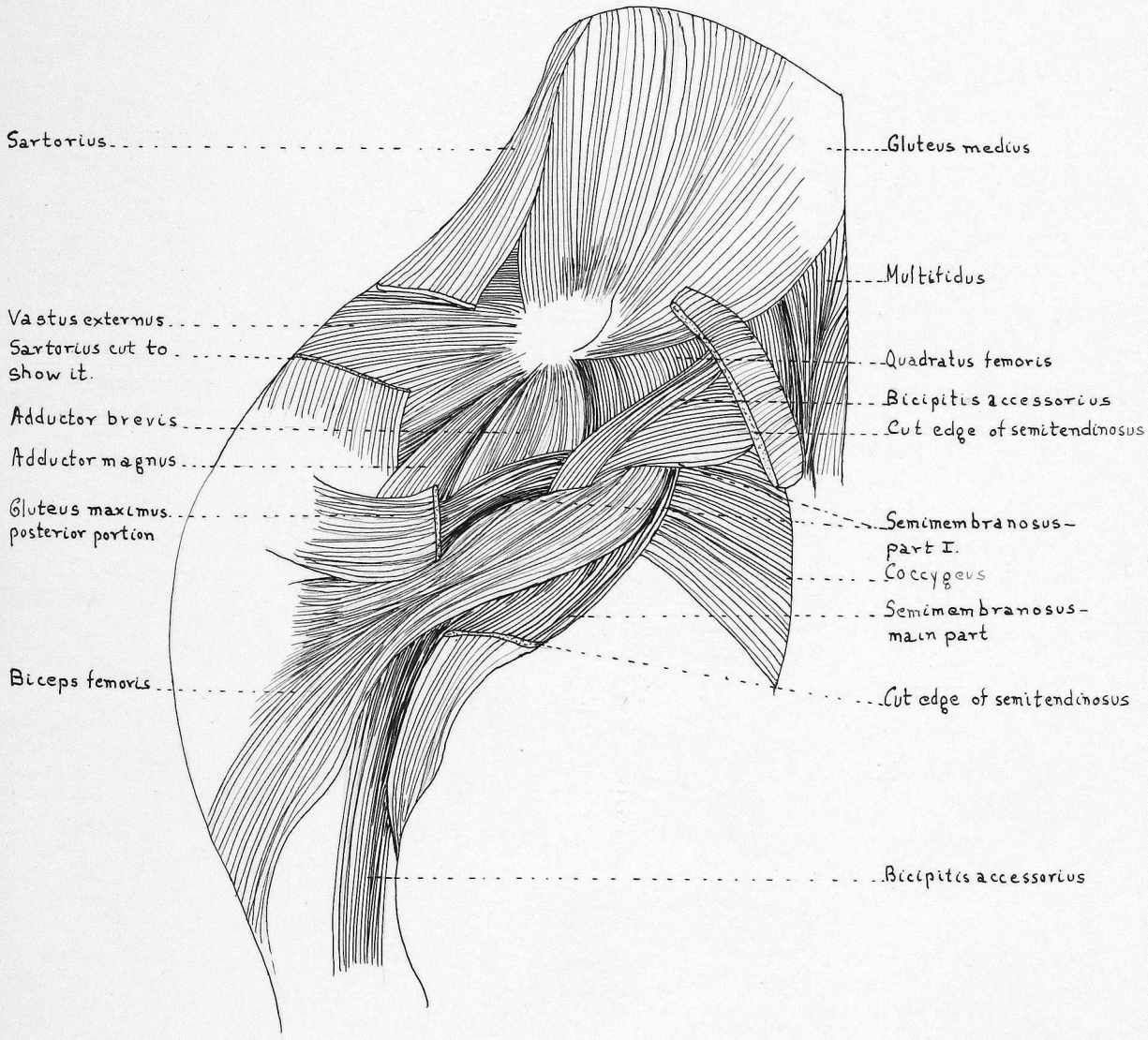

PLATE XXIII

Fig. 1

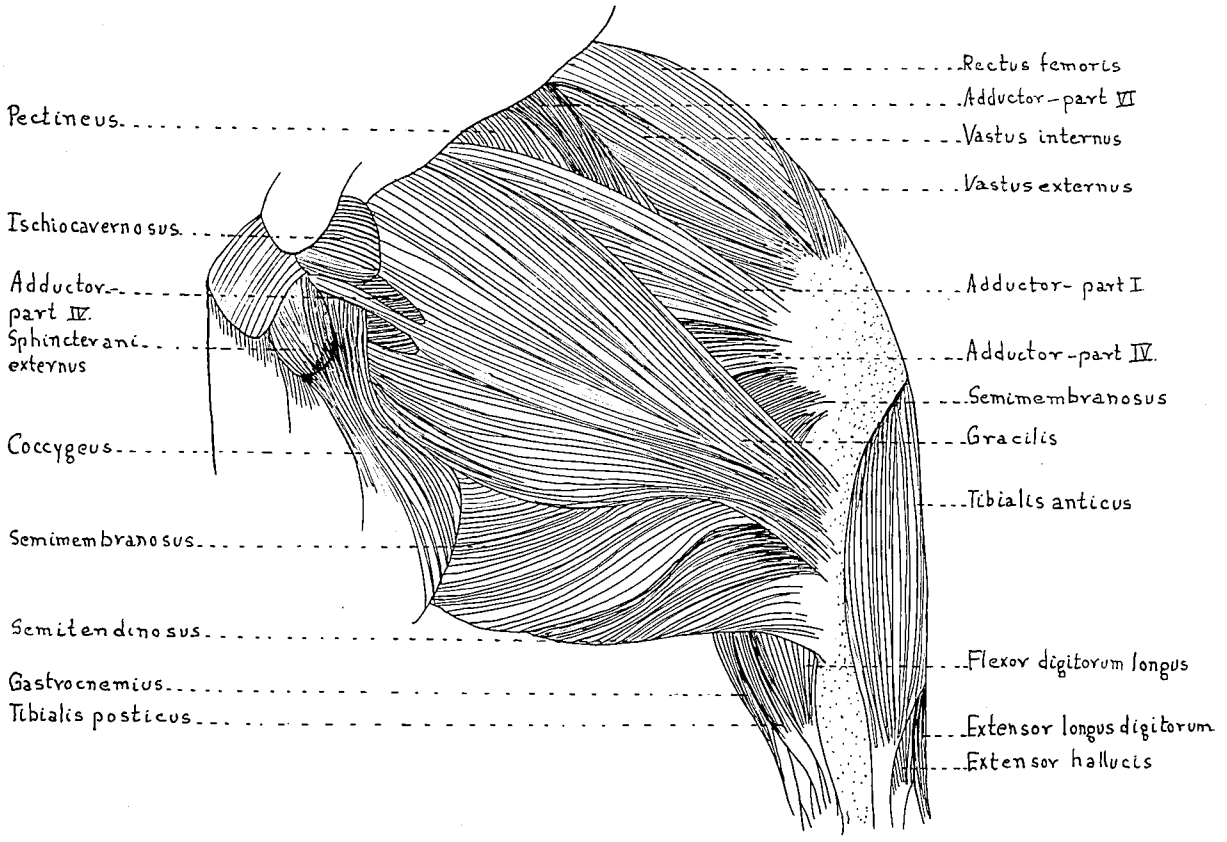

PLATE XXIV

Fig 1

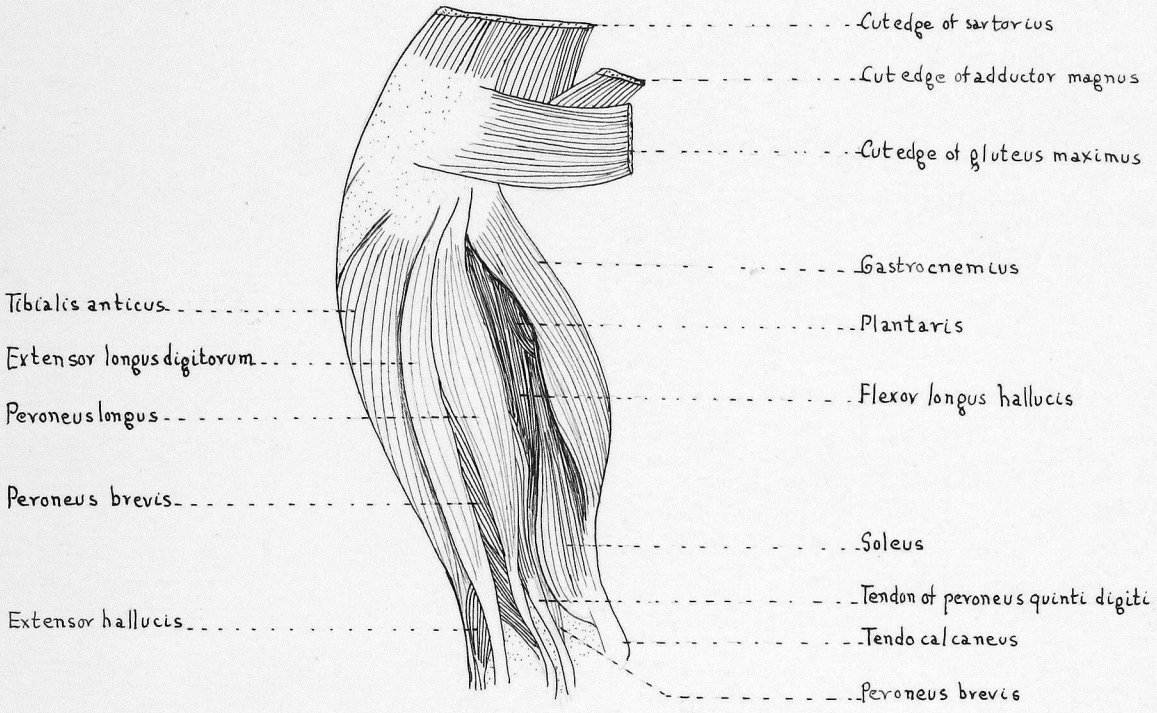

Fig. 2

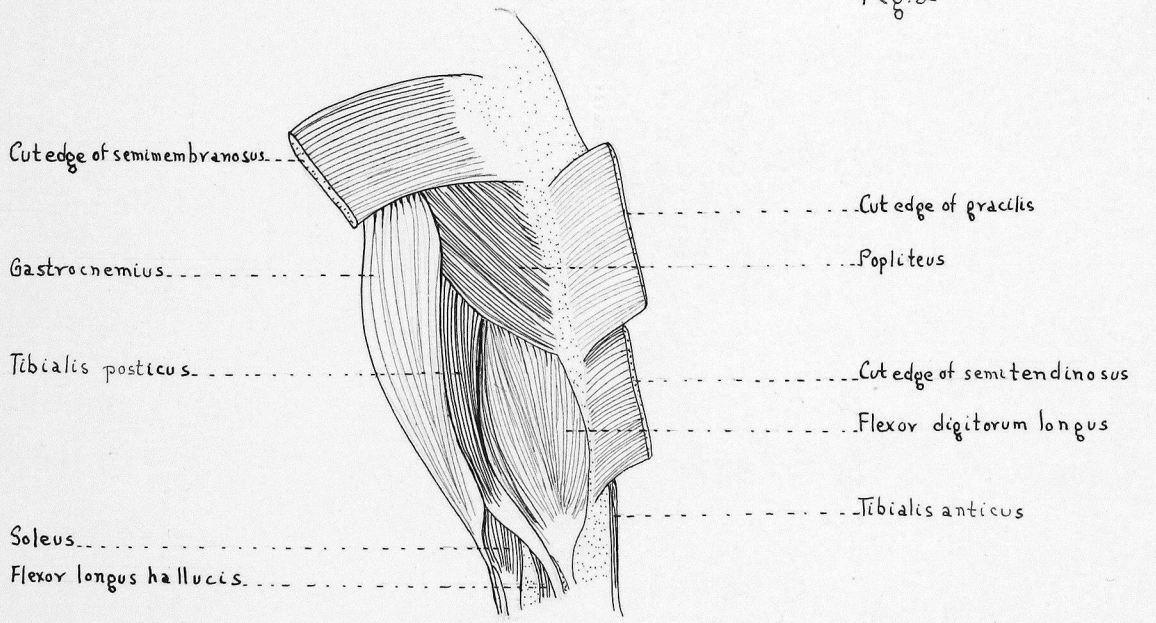

PLATE XXV.

Fig. 1

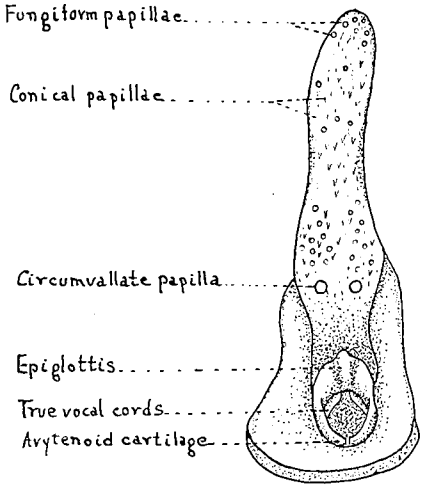

Fig. 2

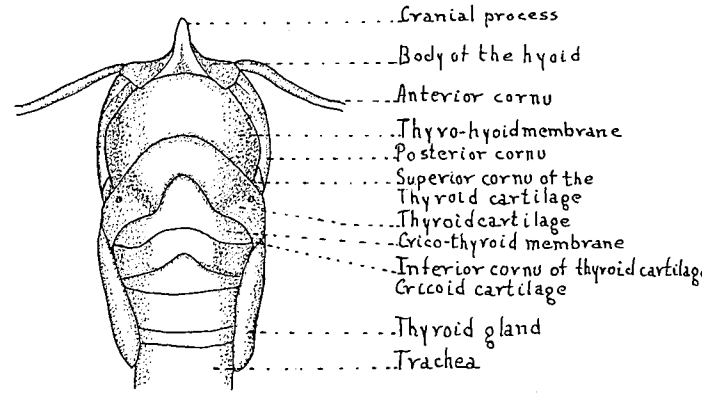

Fig. 3

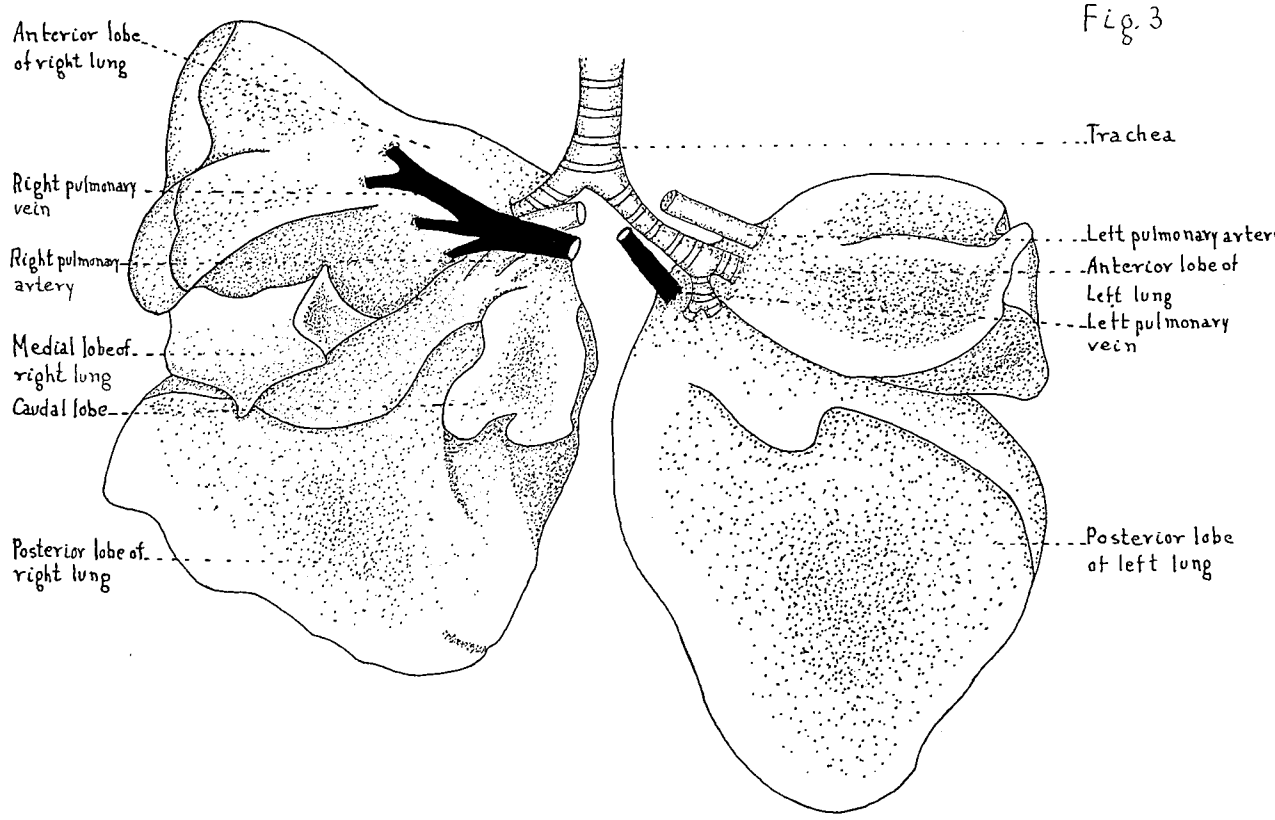

PLATE XXVI

Fig. 1

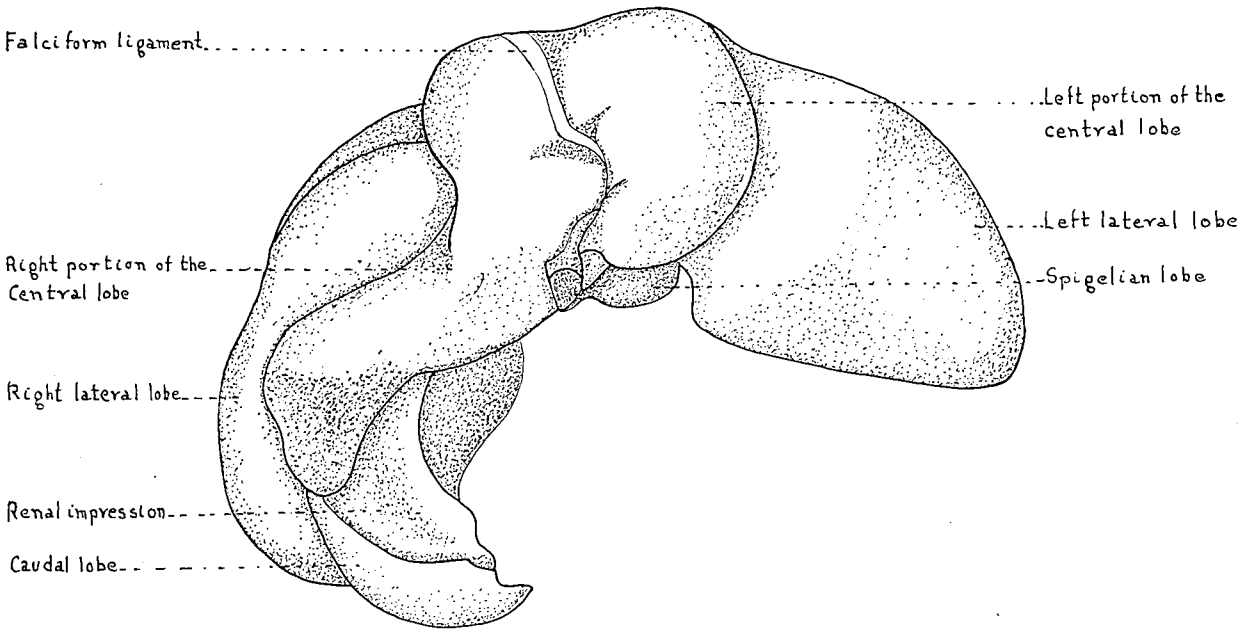

Fig. 2

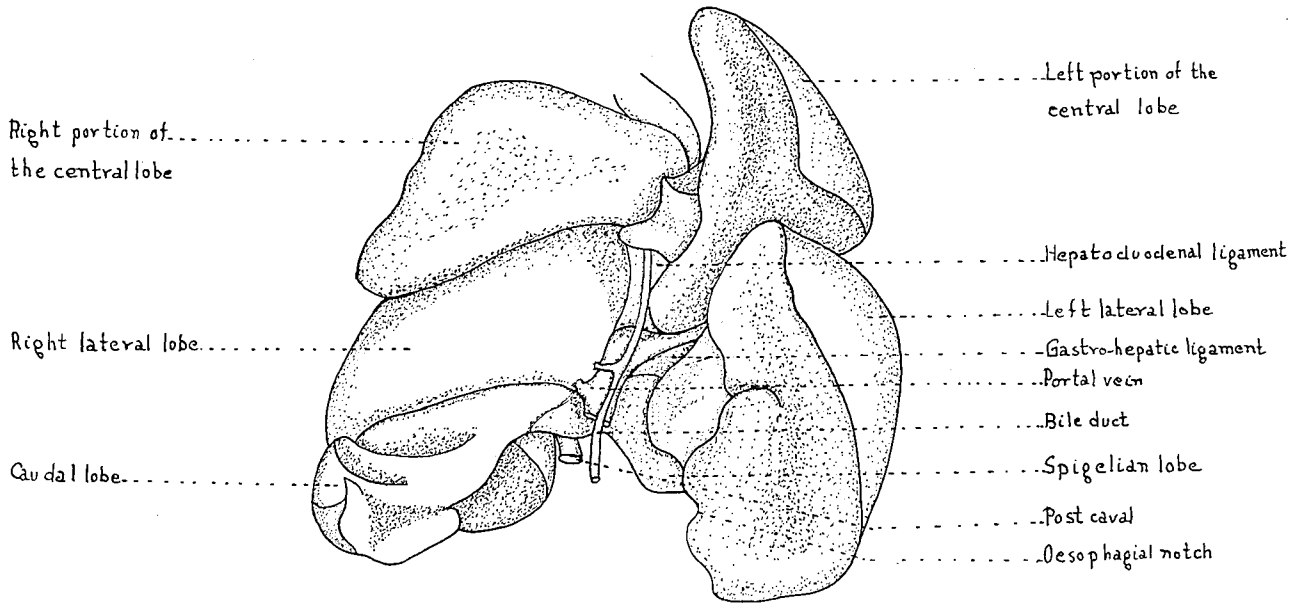

PLATE XXVII.

Fig. 1

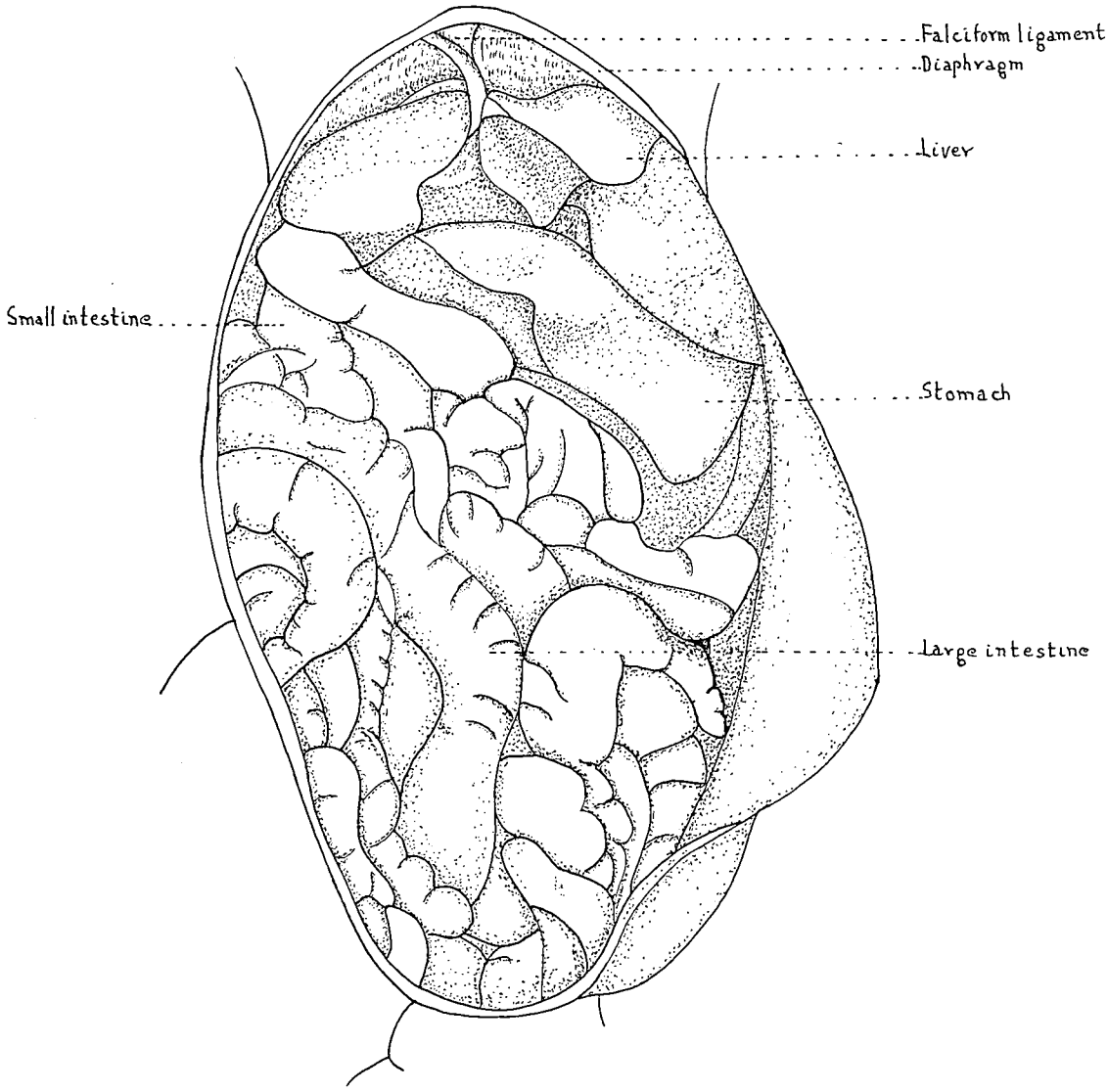

PLATE XXVIII

Fig. 1

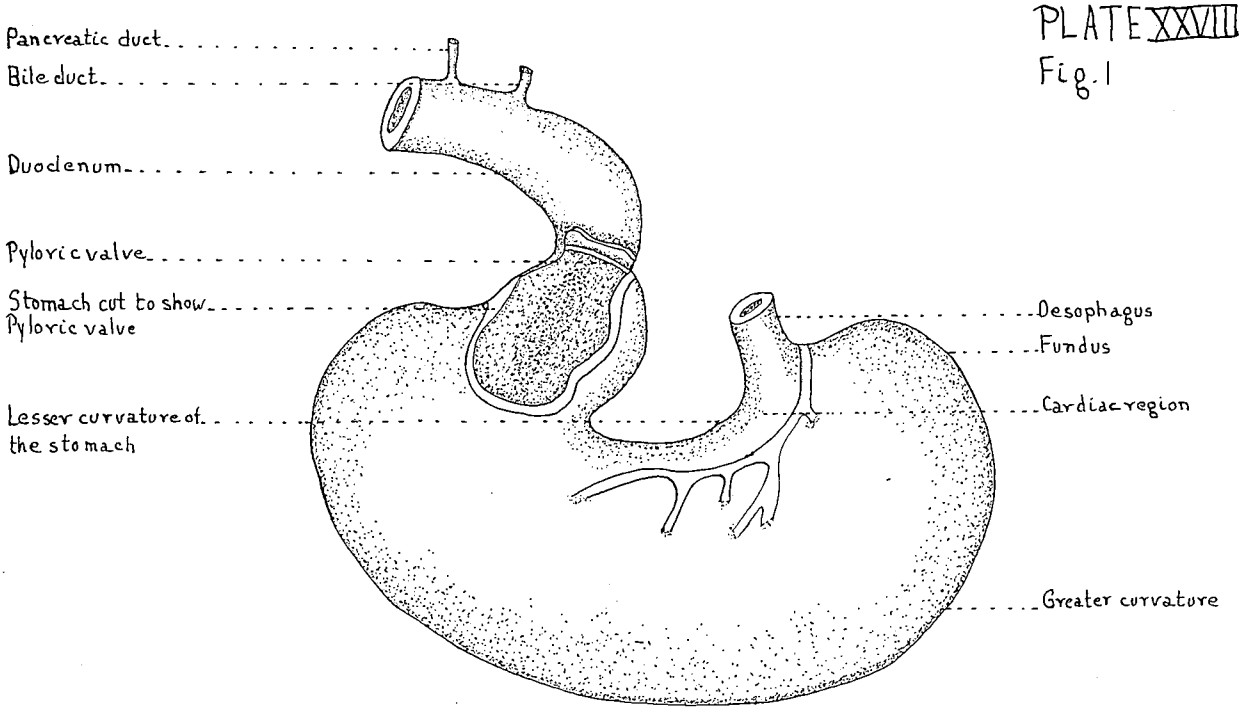

Fig. 2

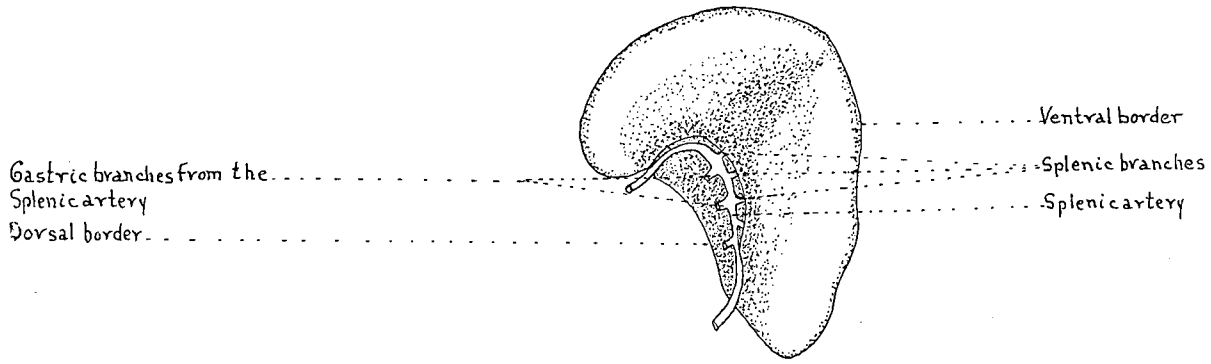

Fig. 3

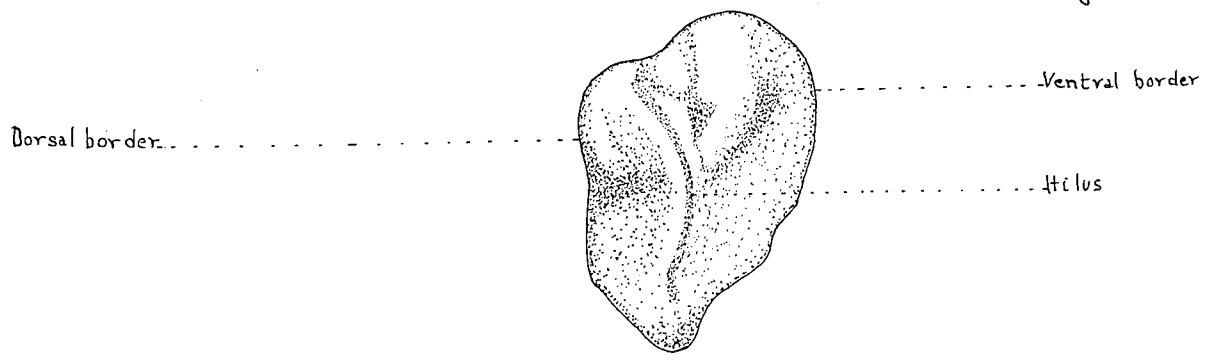

PLATE XXIX.

Fig. 1

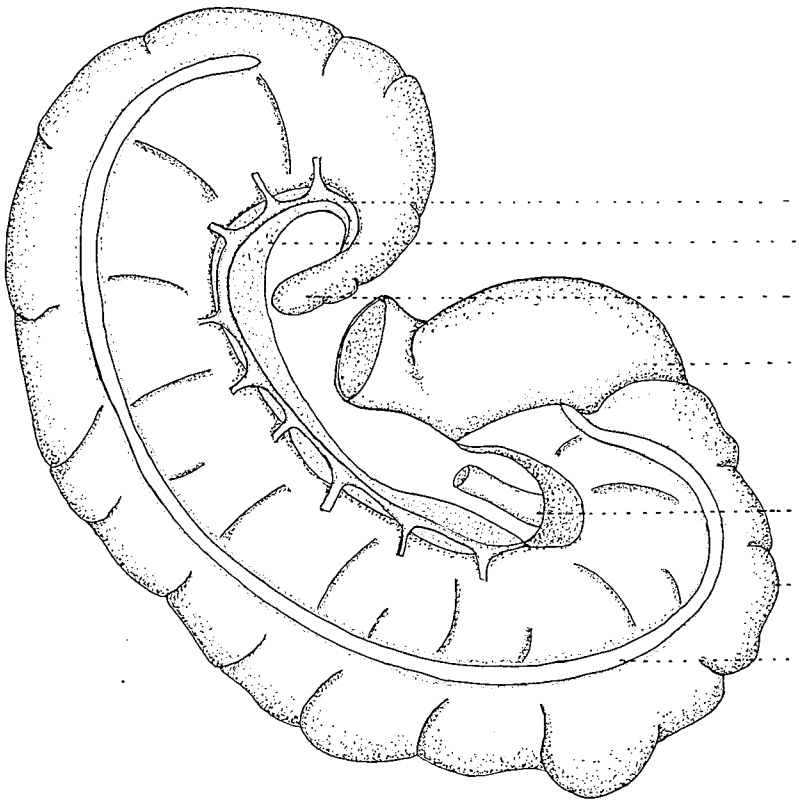

Fig. 2

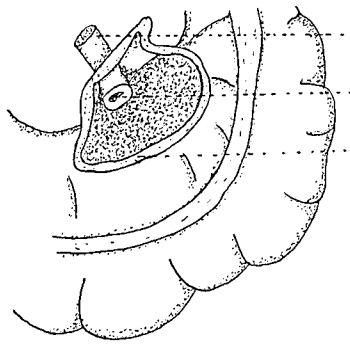

PLATE XXX

Fig. 1

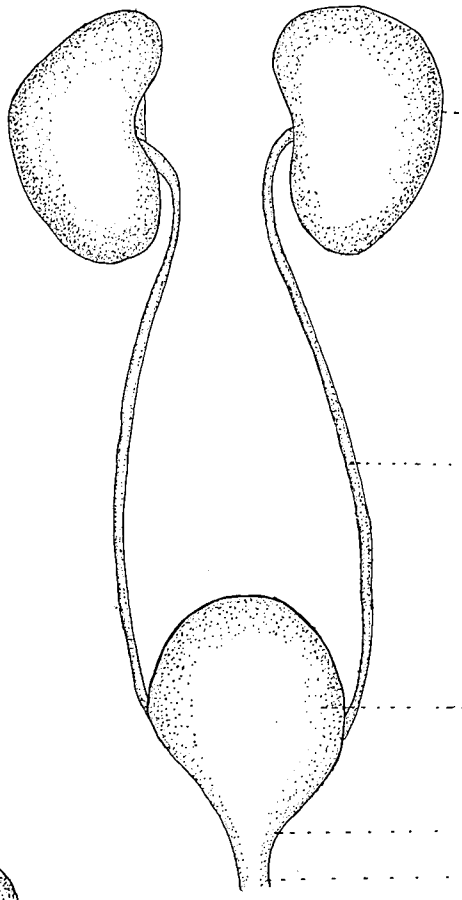

Fig. 2

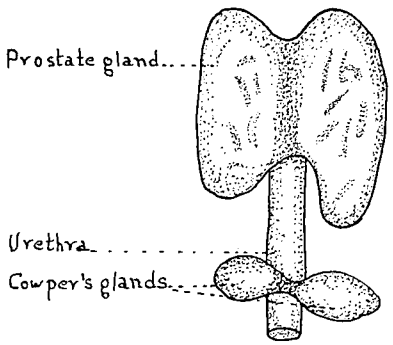

Fig. 3

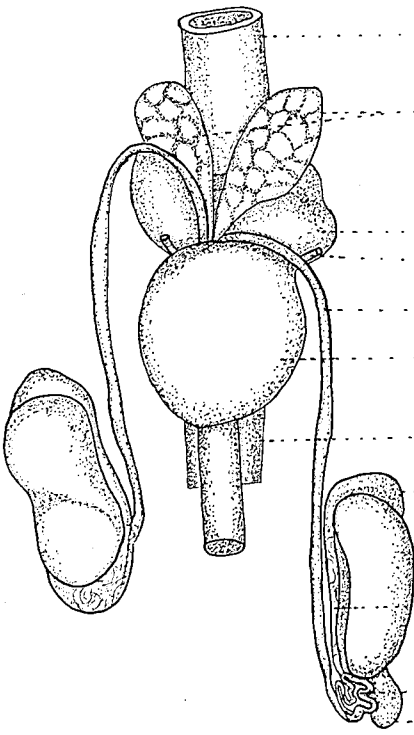

PLATE XXXI

Fig.1

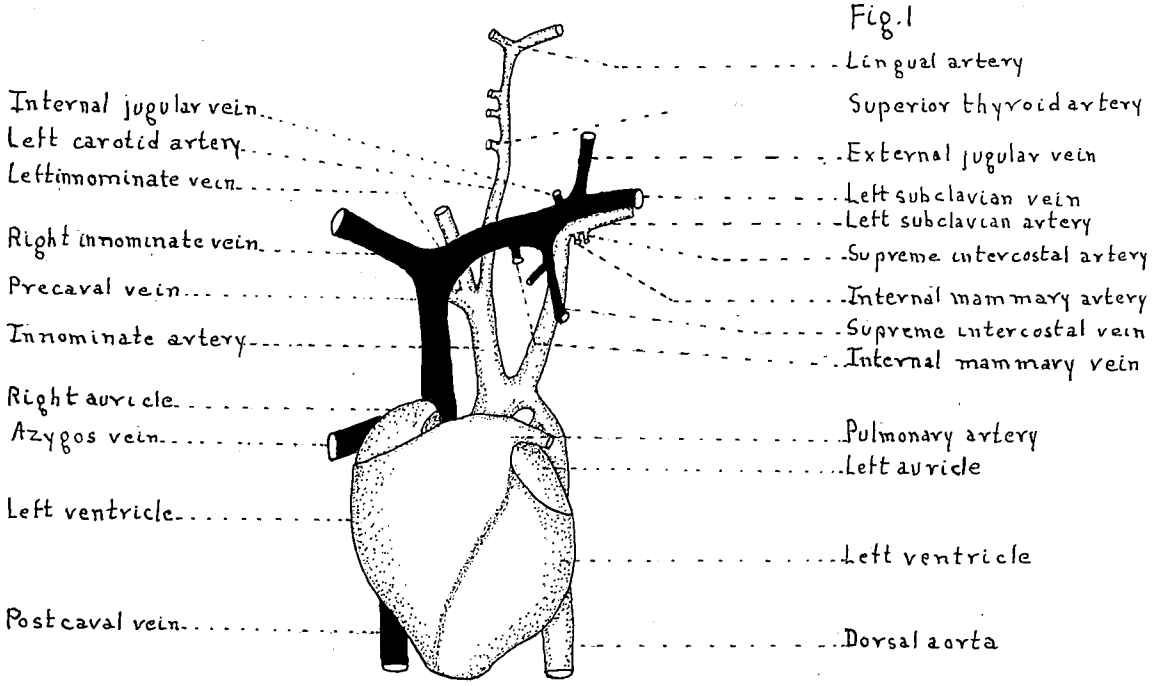

Fig.2

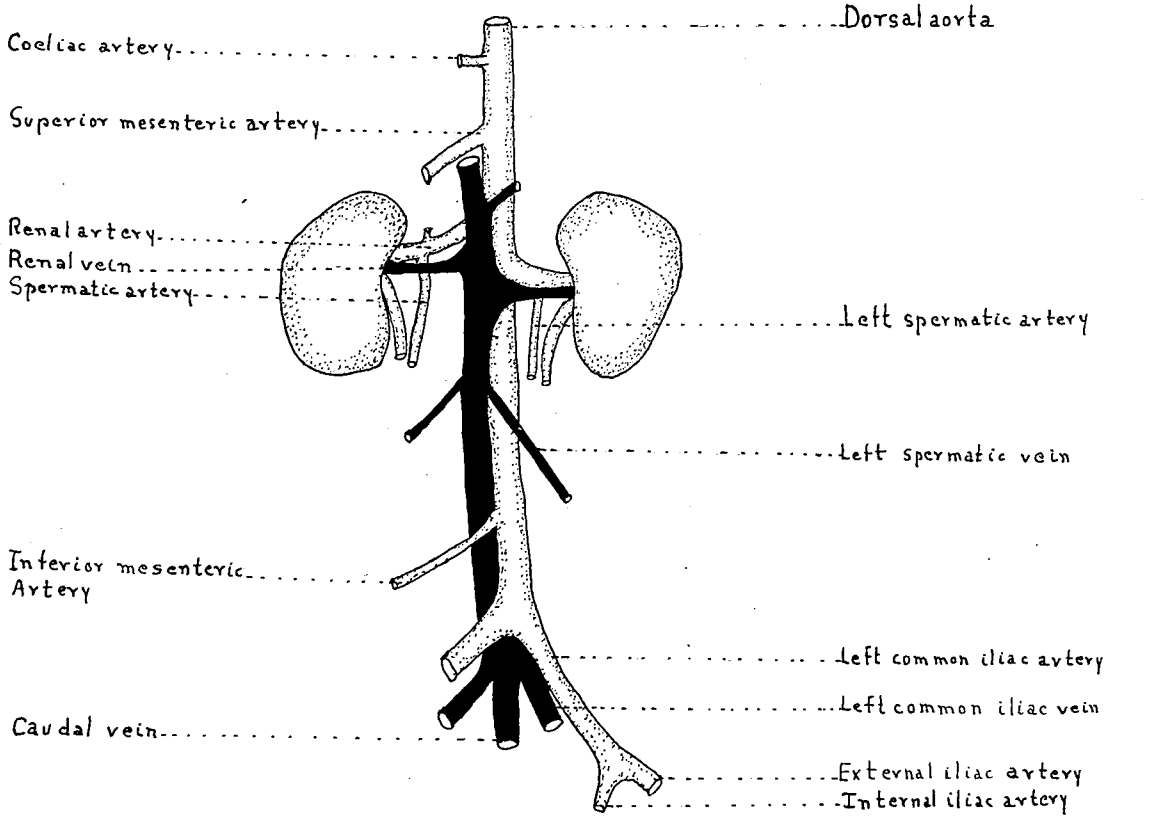

PLATE XXXII.

Fig. 1

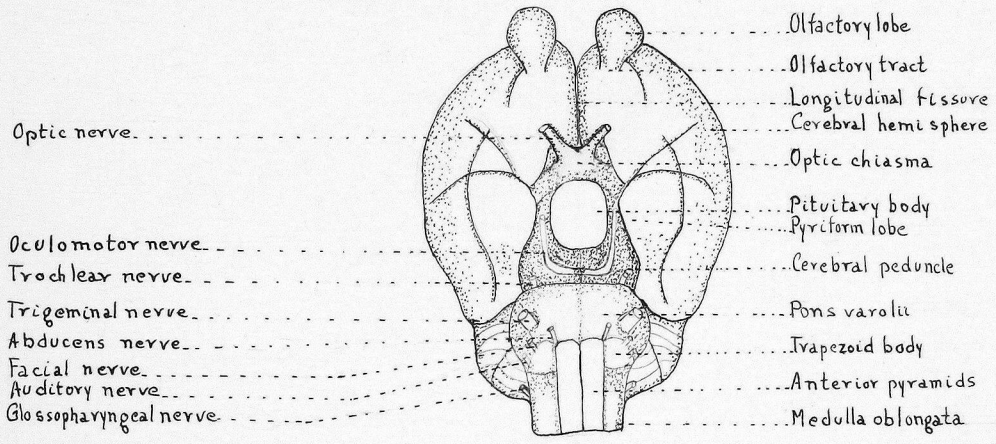

Fig. 2

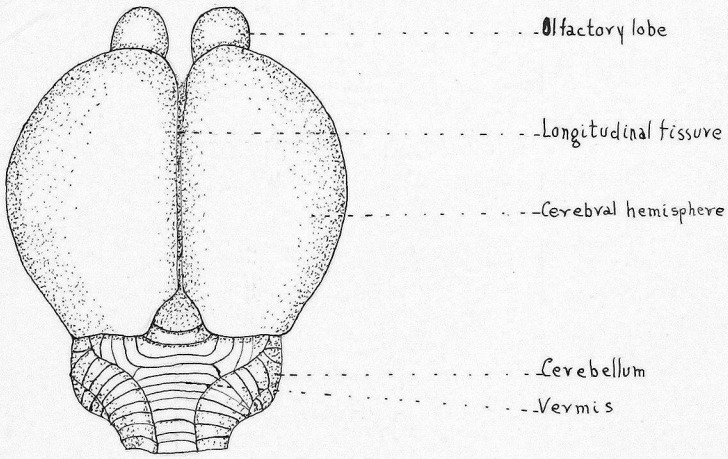

PLATE XXXIII

Fig. 1

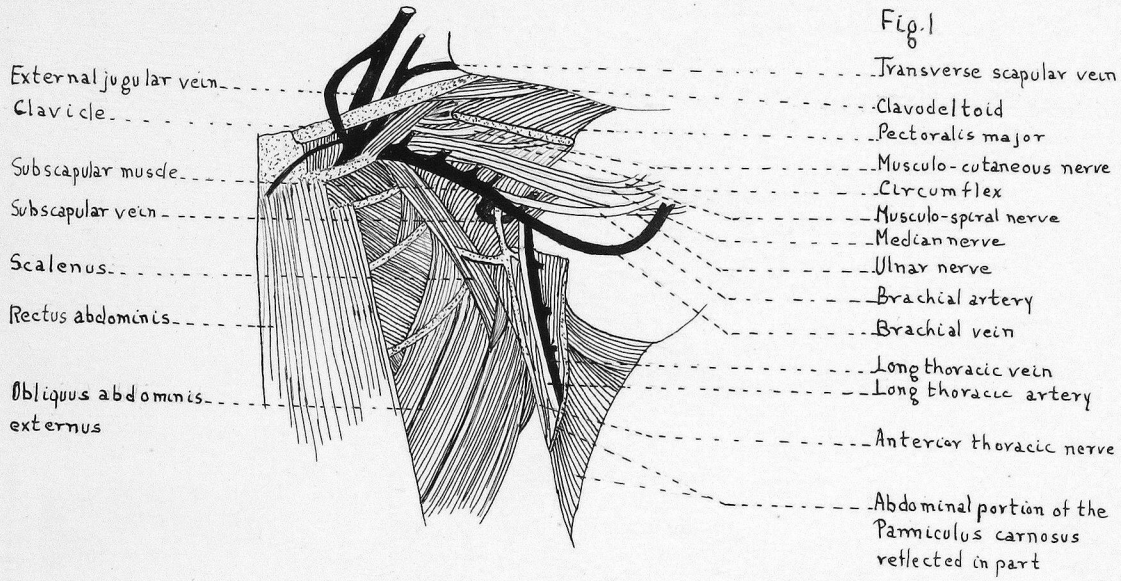

Fig. 2

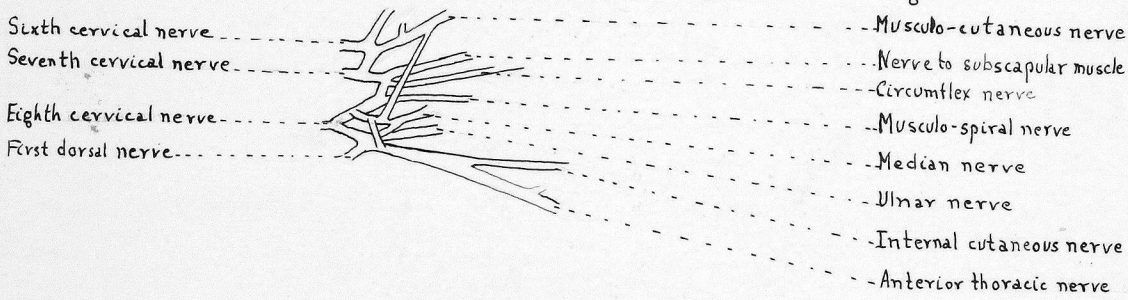
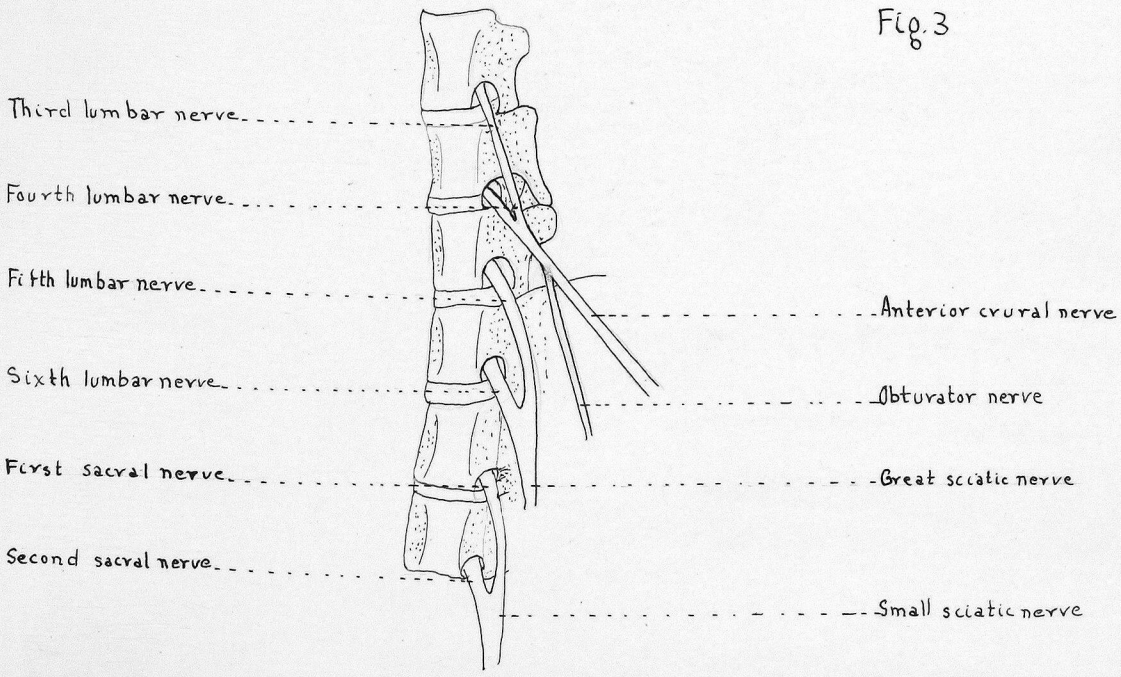
Fig. 3