The Nervous System of the Dog, with some other points in its anatomy especially bearing on experimental Physiology — with plates —

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I regret that I have not been able to make this thesis as complete as I had originally intended, but owing to being appointed Professor of Anatomy in the University of Otago towards the close of the winter session, and having to sail at an early date, I have been unable to devote as much time to its completion as I should have done otherwise.

The Dog being one of the animals most frequently used in the enquiry of physiological investigations, it is important to have an accurate knowledge of its anatomy. Its locomotory apparatus has been thoroughly well described, but I have not been able to find in any book a continuous systematic description of its nervous system. The information to be found in books, while ample on some points, is extremely meagre on others. Besides it is scattered and so mixed up with the des-

criptions of the nerves of other ani-
mals that it is a matter of no
little difficulty to get a connected
view of the subject. I have therefore
been led to choose this subject for
my graduation thesis.

I have made several dissections
of the dog and it is from these that
my descriptions are taken.

The osteology of the dog is
described in Owen's comparative
anatomy, in Flower's osteology of
the mammalia, and in other
works; while the muscles are
fully illustrated in Cuvier and
Laurillard's great work. Further
an excellent and somewhat

quant comparison between the
muscles of a man and a dog is to
be found in Douglas' "Myographia
comparatoe Specimen" published
in 1707. Various other authors en-
ter more or less fully into the
description of the canine myology.
Consequently I have merely treated
these parts of the canine anat-
omy at sufficient length to ren-
der my descriptions of the nervous
system intelligible.

The only work I know of in which
the nervous system of the dog is
described in anything like a
systematic way is Chauveau's
"Comperative Anatomy of the

Domesticated animals"; but this
is principally a work on the horse,
the other "domesticated animals"
being relegated to the small print
at the end of the chapters, where
their nervous and other systems
are very briefly described. Swan
in his "Comparative Anatomy of
the nervous system" describes
shortly the arrangement of the
spinal nerves in the nearly
allied animal the Fox, and
this is copied almost verbatim
by Owen. Several references to
the dog are also to be found
scattered
through Swan's work. Very
complete descriptions of the

cervical vagus and sympathetic and ~~the~~ parts of some of the other cranial nerves are the formed in different physiological books, especially in Cyon; and in memoirs scattered through various scientific journals. From these I have derived great assistance.

The plates which form part of this thesis have all been drawn by myself from nature; those of the nerves and muscles from the dissections which I made, and those of the bones from specimens in the Anatomical museum of the University.

The drawings which have already been published of this subject are few in number. Chaveau has only one woodcut, showing the distribution of the median and ulnar nerves in the hand. Schmiedeberg in Ludwig's Arbeiten for 1872 writes a paper on the innervation of the dog's heart, illustrated with three lithographs of the anatomy of the neck. Bourgery in the plates of some of the mammals appended his work on the anatomy of man, devotes one containing two figures to the nervous system of the dog, but these show little more than the origin of

the nerves and their primary plex-
uses. Swan in his Comparative
Anatomy, illustrates his description
of the nerves of the fox above referred
to. by a beautiful drawing by
West of its entire nervous system.
But, though a marvel of arrange-
ment, it is too small and too
crowded with detail to be of much
practical value. Accurate drawings
are also given in the same book of
some of the cranial nerves, and
of the upper aspect of the brain
and spinal cord. There are three
views of the dogs brain in Leuret
and Gratiolet's plates of the
nervous system. And in the

Atlas attached to Cyon's work there are some cuts of the nerves in the cervical and submaxillary regions, one being a copy of Schmiedeberg's.

I have therefore endeavoured to make this series of plates as complete a representation as possible of the nerves of the dog, with their relations to muscles, and to some to the more important bloodvessels.

What I have written on the brain and Spinal Cord is not intended to be a description of more than their external form, and their relation to their cases,

and I have endeavoured to show this last, in regard to the brain in two figures prepared drawn from specimens prepared in the way adopted by Professor Turner in his enquiry into the relations of the human cerebrum to the outer surface of the skull.

The plates of the Bile and Pancreatic ducts, with their surroundings are introduced in account of the physiological importance of these structures.

Plate XXXI represents a section through a tar of cantil-age in the dog's gum, till now undescribed. I am indebted to

Mr. A.B. Stirling of the anatomical museum for my knowledge of this fact and for permission to make use of it here. The plate was drawn from a microscopic section prepared by Mr. Stirling.

I append to this paper a description of the method of performing the usual physiological experiments on the structures represented in the plate. These are literal translations of the directions given by Cyon, Bernard, and Schmiedeberg in their works.

It must be borne in mind that in my descriptions of the relations of parts, I always em-

sides the animal to be standing
erect on its four feet, not lying
as it would during an operation.
or in the majority of dissections.

Books consulted containing reference to the anatomy of the Dog

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Owen — Comparative anatomy and Physiology of Vertebrates

Swan — Comparative anatomy of the nervous system.

Chauveau — The Comparative anatomy of the domesticated animals (Fleming's translation)

Huxley — The anatomy of Vertebrated animals

Flower — Osteology of the Mammalia.

Turner — On the relation of the convolutions of the human cerebrum to the outer surface of the skull and head. Journal of Anat. & Physiol. Vol VIII

Ferrier — Functions of the brain

Wood — On a group of varieties of the muscles of the Human Neck, Shoulder, and Chest, with their transitional forms and homologies in the Mammalia.

Read before Royal Society June 17: 1869

Foster and Langley — Practical Physiology

Schmiedeberg — Ueber die Innervationsverhältnisse des Herzens. Ludwig's arbeiten 1871

Hitzig — Untersuchungen über das Gehirn.

Cyon — Methodik der Physiologischen Experimente und vivisectionen.

Straus-Durckheim — Anatomie descriptive et comparative

du chat.

Bernard — Leçons de Physiologie.

Cuvier — Anatomie comparée.

Cuvier et Laurillard — Recueil de planches de myologie.

Bourgerie — Traité complet de l'Anatomie de l'homme.

~~Arbrisq et Lapin~~ —

Douglas — Myographice comparatæ specimen.

Laurel et Gratiolet — Anatomie comparée du système nerveux

Osteology

The osseous skeleton of the Dog consists, like the human skeleton, of an axial and an appendicular part. The axial comprises the vertebral column, the bones of the head, the ribs and sternum, while the appendicular consists of the scapula with the forelimbs, & the ossa innominata with the hind limbs.

The skeleton though framed on the same type as that of man, presents numerous points of difference, the more important of which only call for notice here.

The vertebral column in the dog is composed of seven cervical vertebrae, thirteen dorsal, seven lumbar, 3 sacral, and from eighteen to twenty two caudal.

The cervical vertebrae are comparatively larger than in man. The atlas has very prominent flattened transverse processes, and in addition to the canal in its transverse process for the vertebral artery these are pierced by a foramen near the anterior border of its posterior arch. This transmits the suboccipital and vertebral artery nerve. The spine of the axis is a long keel, flattened from side to side, which projects in front

and behind over the atlas & third cervical vertebra. The spine of the seventh cervical is not so prominent as that of the first dorsal.

The dorsal vertebrae are thirteen in number, and articulate with thirteen pairs of ribs. The spines decrease in length from the first to the tenth, and all those in front of this vertebra, or the eleventh, have a backward slope. Those behind it, as well as all the lumbar spines, slope forwards.

In the lumbar region the transverse processes are long

and inclined forwards. The metapophyses — mamillary processes — and anapophyses — accessory processes — are well developed in this region as well as in the posterior part of the dorsal.

The sacrum consists of three vertebrae anchylosed together, but only the two anterior of these articulate with the innominate bone.

There are thirteen pairs of ribs, nine of which are attached to the sternum below by their costal cartilages.

The sternum is long and rod-shaped. It is composed of

eight segments.

The same laws rules into the formation of the canine skull as the human, but owing to the much greater development of the facial bones, and the small size of the brain cavity, the shape of the skull is very different. The position of the skull in reference to the vertebral column is also changed, lying very much in the same axis, and not placed at right angles as in man. There are several points to be noted in regard to the outside of the skull. The occipital crest, for instance,

the posterior end of the skull, & have their long diameters placed almost vertical. The external protuberance of the same line is well marked & prominent, and a high crest runs forward from it for the upper attachment of the quality developed temporal muscles. The temporal fossa is large and freely continuous with the orbital cavity. This - the orbit - is not entirely surrounded by bone, the recurring being deficient at its upper part and posterior part. The zygomatic and sphenoid-maxillary faces of human anatomy, are

not be distinguished from the large temporo-orbital fossa. The zygomatic arches are strong and wide. The temporal ridge is not far from the parietal end of the skull. Immediately behind the zygomatic arch is seen the external auditory meatus, opening into the large tympanic bulla, behind which is placed the feebly developed mastoid process. The nasal bones are much prolonged, and the internasillary lines run backwards between them and the superior maxillary lines for some distance. The lower jaw is

long, the two rami making a very acute angle with each other. The angle is slight. There is, however, a well marked sup-
ra-angular process.

On removing the mandible and looking at the base of the skull, the palate is seen to be much longer than in man. It is not, however, either so broad or so concave. It is formed of the same bones as in man, with the addition of the premaxillaries. These are permanently separate. They support all the incisor teeth and bound the incisor framina in great part. These

framina are large.

Behind the palate, between it and the basisphenoid, the skull is greatly narrowed from side to side below, and from the under surface of this narrowed portion the anterior part of the palate bones & the pterygoid processes project downwards laterally as two thin plates. A groove is thus formed, called the mesopterygoid, continuous with the nasal cavities. In the widest part of the base behind this are seen the smooth rounded auditory bullae. In front of which is the postglenoid process, behind it the paroccipital process.

In the interior of the cranium the cribriform plate of the ethmoid is seen to form the floor of a recess in front of the general cranial cavity. This is for the lodgement of the olfactory lobes. Behind this four pairs of foramina are seen arranged like a V, with the apex forwards. The anterior pair are the orbital, behind these and separated from them by the sphenoids are the sphenoidal fissures. Just mesial the foramina rotunda, and anterior to all the foramina ovalia. Laterally the pyramidal petrotic tine

projects inwards and forwards at each side, tunnelled close to its apex by a passage for the fifth nerve. At its apex in the foramen lacerum medium. The foramen lacerum posticum lies behind the petrous tone, between it and the occipital. On the posterior surface of the petrous tone are seen the internal auditory meatus, and behind that a small cavity in which the flocculus of the cerebellum lies. A short distance in front of the foramen magnum are the superior openings of the anterior condyloid foramina.

The nasal cavities are much elongated from before backwards, and contain very voluminous turbinated bones.

The Clavicle is absent in the dog, being represented generally by a mere fibrous or cartilaginous intersection the Levator humeri (cephalo-humeral) muscle. Sometimes a small nodule of bone exists in this intersection. The Coracoid process is short and thick. The radius and ulna are fixed in the prone position. There are five digits in the forefoot or manus. The first, the thumb, is rudimentary.

The pelvis is small but deep.
The innominate bones articulate
togethes by a long symphesis pubis.
The fibula is very closely applied
to the tibia below, but is not an-
chylosed to it. In the great ma-
jority of dogs there are only
four toes in the hind foot,
but in some, as the St. Bernard,
a fifth is present.

Myology

As the description of the nervous system necessitates constant reference to the muscles, I shall here briefly notice what peculiarities exist in this arrangement in the dog, and state what nomenclature I mean to adopt in regard to those muscles which have been variously named by anatomists. In general I shall adopt the terminology which is used in human anatomy as being more generally known.

The Panniculus Carnosus is well developed. Its posterior part,

which unsheaths the trunk, is inserted into the humerus along with the Latissimus dorsi.

The Latissimus dorsi in addition to its humeral insertion is attached by a flat fleshy slip to the olecranon process. This slip runs down the back of the arm superficial to the Triceps.

The abdominal muscles have the same names, and are arranged as in man. The Rectus, however, is prolonged forwards on the under surface of the thorax. This prolongation is called the Rec-

the Thoracicus.

Among the muscles of the back, the Serratus posticus anterior — serratus posticus superior of human anatomy — is very thick and and fleshy. It arises from the ribs, from the 3rd to the 10th inclusive.

The muscles about the scapula and shoulder joint are considerably modified from the human type, owing to the mode of progression of the animal, and the absence of clavicles. There is very considerable variety in the names which have been given to

some of these muscles by different authors.

The Serratus Magnus has a more extensive origin than in man, arising from the transverse processes of the five posterior cervical vertebrae, as well as from the outer aspect of the seven anterior ribs. Its function is also altered, the two Serrati serving as a sort of sling in which the forepart of the trunk rests.

The Trapezius is considerably modified. It is divided into three parts, placed one behind the other. The most

anterior forms part of the Cephalo-humeral muscle. The middle portion is separated by a distinct interval from the other portions of the muscle. It is inserted into the spine of the scapula, as well as into the acromion process. It is the "Acromio-cucullaire" of Straus-Durckheim. The last part of this muscle, the "Dorso-cucullaire" of the same author corresponds to that part of the Trapezius in man which ascends to its insertion into the scapular spine.

The Occipito-Scapular muscle

arises from the scapular bone near its crest, and passes backwards superficial to the splenius to be inserted into the anterior angle of the vertebral border of the scapula, in common with the Rhomboideus minor. This muscle does not exist in man except as an occasional abnormality, but it is found in the greater number of the lower mammalia. I have chosen the above name, under which Professor Wood described the muscle, because it expresses its attachments. Numerous other names have

however, been applied to it. It is the "Levator Scapulæ minor vel posterior" of Douglas and Burmeister; the "Rhomboïdeus anterior" of Meckel; the "Rhomboïdeus de la tête" of Cuvier; the "Levator anguli scapulæ, vel scapulæ minor" of Krause. Chauveau describes this muscle in the dog as being merely an additional origin of the Rhomboid.

Trachelo-acromialis muscle

is also not found in man. It arises, in the dog, from the transverse process of the atlas, and occasionally from the transverse process of the axis,

and passing backwards under cover of the Cephalo-humeral muscle, is inserted with the acromion process of the scapula. At its insertion it separates the Cephalo-humeral from the Trapezius proper.

Synonyms:— "Levator scapulæ major vel posterior" Douglas and Burmeister; "acromio-lasclas" Vieq-d'Azyr; "Clavo-trachélien" Chuchi; "Basio-humeralis" Krause; "Kopf-Arm-Muskel" Meyer; "Transverso-scapularis" Straus-Durckheim; "Omo-atlanticus" Haughton; "Acromio-humeral" Humphrey; "Protractor Scapulæ" Owen; "Omo-

w acromio-trachélien " Cuvier and Meckel. This last is latinized by Huxley, and is the name I have adopted.

The Cephalo-humeral muscle, is a large muscle, which, owing to the absence of clavicles, stretches continuously from the occiput and ligamentum nuchæ to the humerus. It is homologous with the upper part of the human Trapezius and Cleido-mastoid joined below with the ~~the~~ clavicular fibres of the Pectoralis major and Deltoid. The position of the clavicle, the line of separation between

these upper and lower elements.
is marked by a tendinous or
cartilaginous instruction of
the muscle. This muscle arises
from the mastoid process. from
the crest of the occiput and
from the upper part of the
ligamentum nuchæ. It gets
narrower as it descends over
the side of the neck and
shoulder joint. and is inserted
into the front of the humerus.
near its lower end. between
the Biceps and Brachialis
anticus. about the level of
the shoulder it is crossed by
the tendinous intersections

mentioned above. An accessory slip to this muscle arises from the occiput close to the sterno-mastoid. It is named by Douglas "Musculus ad Levatorem accessorii". The synonyms of this muscle are "Masto-humeral" Owen; Mastoido-humeralis" Fleming; Transleation of Chauveau; "Levator humeri" Girard, and Chauveau; "Levator humeri proprius" Douglas and Huxley. The upper part is synonymous with the "Clavo-cucullaire" of Straus-Durckheim; the "Portio Cervicalis trapezii" of Cuvier "Trapezius clavicularis" of Haughton

The Sterno-Mastoid has its clavicular origin.

The Pectoralis Major arises from the whole length of the sternum. The fibres which arise from the anterior part of that bone pass superficial to the rest of the muscle.

The Pectoralis Minor, which may almost be regarded as a part of the Major, is inserted into the upper part of the glenoid cavity.

The Subclavius and Omo-hyoid are absent.

The Scalenus Posticus is inserted into the side of the throat below the origin of the Levator magnus as far back

as the fifth or sixth ribs.

The Supra costalis or Sterno-costalis is a muscle which is most present in man. It lies on the upper part of the thorax inferiorly. It arises from the first rib close to the insertion of the Scalenus anticus, and passing backwards is inserted into the second and third costal cartilages.

The Coraco Brachialis is very small. It lies over the head of the humerus, into the neck of which it is inserted.

The Biceps or Coraco Radialis has only the glenoid head of

its human homologue.

The Brachialis anticus, or Brach-
ialis internus lies on the back
and outer side of the humerus,
separated from the Biceps by
the insertion of the Pectoralis Major
and Cephalo-humeral muscles.

The muscle corresponding to
the human Triceps has got four
thick fleshy heads.

The inability to supinate the
paw many extent, and the
difference in function of the
digits from the human fingers,
causes the muscles of the fore-
arm in the dog to differ from
those in man in several particulars.

The Supinator longus is very small and closely connected with the long radial flexor of the carpus. Its existence has been denied by some anatomists.

The Supinator brevis is present and fairly well marked.

The Pronator teres and the Pronator quadratus are both well developed. The latter runs between the radius and ulna in nearly their whole extent.

The Flexor sublimis digitorum passes superficial to the annular ligament, and sends tendons to the four large digits. These tendons are joined by three

of the Flexor profundus as in man

The Flexor profundus has three heads of origin; a large one from the humerus, another from the posterior surface of the ulna, and another, which corresponds to the flexor longus pollicis, from the radius. It ends in five tendons for the five digits.

The Palmaris brevis is a long thin muscle arising from the surface of the preceding.

There is present a Flexor carpi radialis — Internal flexor of metacarpus or great palmar flexor — as well as a Flexor carpi ulnaris — Oblique flexor —

This latter muscle has two rami-
ne from the humerus the other
from the olecranon.

There are also two radial Ex-
tensors of the metacarpus. The
muscle corresponding to the Extens-
or carpi Ulnaris is sometimes
called the "External flexor of the
metacarpus."

The Extensor Communis digi-
torum sends tendons to the four
large digits.

The "Proper Extensor of the three
outer digits" corresponds to the
Extensor minimi digiti in man.

The Extensor ossis metacarpi
pollicis, and the Extensor primi

internodii pollicis are united with the muscle.

The Extensor secundi internodii pollicis and the Extensor indicis have a common origin and muscular belly.

The muscles of the posterior limb differ from the human type in relative size. The Glutei muscles afford an excellent instance of this. They have much the same origin course and insertion as in man, but instead of the Glutaeus maximus being very much the largest of the three it is considerably smaller than the Glutaeus medius. Consequently

in Comparative anatomical works the names ecto- meso- and endo-gluteus are often substituted for the human names. Some veterinary books, however, name these muscles from their relative size, and then the muscles corresponding to the human Gluteus maximus and medius interchange their adjectives. The Gluteus minimus is sometimes called medius also. I shall I think best avoid confusion by choosing the names for these muscles which express their position. The muscle which corresponds to the human Gluteus

maximus will be called ecto-gluteus,
and those corresponding to the
Gluteus medius and minimus
will be named meso- and endo-
gluteus respectively.

The other muscles of the gluteal region are arranged very much as in man.

The Iliacus is small and closely adherent to the Psoas.

The Psoas parvus is relatively larger than the Psoas magnus.

Of the hamstring muscles the Biceps is the only one which differs much from the human type. Its large head arises from the tuberosity of the ischium,

but the small head instead of arising from the femur as in man, takes origin from the sacro-sciatic liga-ment or an anterior caudal vertebra. It is a long slender fasciculus. The muscle is inserted into the upper part of the tibia by a broad expansion, and also gives off an aponeurosis which covers in the muscles of the leg as far as the heel. The synonyms of the Biceps are:— "Long vastus" Chauveau, "Renfrei" Ambroise Paré and Strauss Durckheim. "Ischio tibialis externus" Girard.

Semitendinosus is often called Gracilis in veterinary

works.

In the dog a flat ribbon like muscle passes superficially on the front of the thigh from the anterior superior spine of the ilium to the patella, lying between the sartorius and the tensor fascice femoris. It has no analogue in man, and has been described by some authors as belonging to the sartorius, by others to the tensor. Cuvier refers it to the sartorius, and calls it the "Antérieur sartorius" Chauveau describes it as being an anterior part of the Tensor. Douglas names it the "Extensor tibiæ primus Canis

proprius. In its nervous supply it is related to the Sartorius, both deriving their nerves from the anterior Crural nerve; while the Tensor is supplied by the gluteal.

The Sartorius is sometimes called the "long adductor of the leg"

The Rectus femoris has only one head, and that arises from the anterior inferior spine of the ilium. It is the "anterior Rectus" of veterinary works; and the "Prominal" of Strauss Durckheim. The Rectus with the two Vasti form the "Triceps Cruris" of Cruveilhier and others.

The <u>Adductor gracilis</u> is a little muscle which lies over the hip joint. Arising from the edge of the acetabulum it is inserted into the front of the femur between the vastus internus and crureus. It is the "Musculus parvus in articulatione femoris situs" of Douglas.

Though the muscles on the inner side of the thigh have more of an extensor than an adductor action, I shall still for the sake of simplicity retain their human anatomical names, viz. Gracilis, Pectineus, and Adductors, longus, brevis,

and magnus.

The <u>gracilis</u> is much broader than in man. It is the "Short adductor of the leg of Chauveau", the "Droit interne" of Straus-Durckheim, and other French anatomists.

Adductors. The three together are called "Triceps" by Winslow. Owen, & Swan.

<u>Adductor longus</u> is synonymous with the "First adductor of thigh" Douglas, "Pubiotibien" Straus-Durckheim.

<u>Adductor brevis</u> is the "second adductor" of Douglas, the "Curvatus" of Straus-Durckheim,

and the "Small adductor of thigh" of Chauveau.

Adductor magnus emprises the "adductores tertius and quartus" of Douglas, and is the "Adquatus" of Straus-Durckheim.

The anterior tibial receives a muscular slip from the fibula which probably represents the extensor proprius hallucis.

The Extensor longus digitorum arises from the outer condyle of the femur. It gives off four tendons.

There are two Peronei, a long and a short, the latter being frequently divided into

two fasciculi.

The Gastrocnemius has not smaller fleshy bellies than in man, but they are hidden by the tibia.

The Soleus is small, arises from the fibula, and unites with the outer head of the Gastrocnemius — Owen — Chauveau says it is absent.

The Flexor longus digitorum arises in common with the outer head of the Gastrocnemius. It has four tendons.

The Flexor brevis digitorum is small and rudimentary, and is joined by the Plantaris, which is large.

The Tibialis posticus is a

long slender muscle.

The short muscles of the foot are similarly arranged to those in the hand.

Nervous System

Brain

The encephalon consists of the same parts as in man, the cerebrum, cerebellum, medulla oblongata, pons varolii, basal ganglia, and connecting structures.

The Cerebrum is not so large proportionately and does not cover the whole of the cerebellum, when the latter is viewed from above. In man the relative proportion of cerebrum to the rest of the encephalon is about 1 to 0.20le. In the dog 1 to 0.375 (Bourgery) The proportion between the dog's

cerebrum and man is also given
by Cuvier as being narrower.
1647, 1530, 1537, 15134, 1161.
to vary 1 in 305. The cerebrum is
divided into two hemispheres by
the great longitudinal fissure,
and on the outer face of each
of these are two primary fissures.
the Cruciate, and the Sylvian,
as well as several smaller fissures
which run principally from
before backwards separating
the convolutions. The cruciate
fissure begins at the the great
longitudinal towards its anterior
extremity and runs directly
outwards. It is generally sub-

divided at its outer end. The
Sylvian fissure runs upwards
and backwards in the same
position as in man, but is
much shorter. The convolutions
of the outer face of the cerebrum
are arranged around the Syl-
vian fissure in a curved man-
ner. They are numbered, by
Lovett, according to their distance
from it. Ferrier on the other
hand numbers them from the
longitudinal fissure. I shall
accept this latter nomenclature.
The fourth or Sylvian convolution
is small and forms the boun-
daries the Sylvian fissure. The

third convex round behind and above the fourth. It is longer than it, and is thicker below where it is marked by a ~~longitudinal~~ linear impression. Where it turns forwards it is marked by two little fissures which run out in it for a short distance. The second curves round the third convolution, dies bottom in front, divided into two posteriorly. The first convolution is the largest and longest. It bounds the median fissure, and in front is bent round the crucial fissure constituting what

Ferris calls the Lyroid gyrus.
On the base of the cerebrum there
are two named fissures convolutions
the Orbital which is continuous
above with the frontal, and the
fore part of the Internal con-
volution or Gyrus hippocampi.
Lying on the under surface of
the anterior end of the brain
are the olfactory bulbs. These
are grayish-white masses, thick
anteriorly, and pointed behind
where they lie in an antero-
posterior fissure, a little to the
outer side of the median. Be-
tween the Internal convolution
on the base, is the interpedun-

nlar space, which presents precisely the same objects as in man. The corpora albicantia are, however, not quite so distinctly separate.

The Cerebellum lies behind and below the posterior end of the cerebrum. It is larger proportionally than in man. It has a well marked superior vermiform process, two lateral lobes, and a flocculus on each side, which lies in a little cavity in the posterior aspect of the petrous bone.

Behind the Pons Varolii there is a distinct Trapezium.

The olivary bodies of the medulla are small and indistinct but the anterior pyramids and the restiform bodies are well marked.

Relations of brain to the bones of the Cranial vault:—

The sagittal suture corresponds exactly to the median fissure.

The Coronal suture lies, in the middle line above, a short distance behind the crucial fissure. It crosses the first and second convolutions where they turn outwards, and then turns somewhat forwards over the anterior end of the third con-

volution.

The lambdoidal suture corresponds pretty closely to the posterior border of the cerebrum.

The parieto-squamosal feature passes over the first fronto convolution about the posterior end of the fissure of Sylvius, and at a slightly higher level the third and second.

The parieto-sphenoid lies mostly on the third convolution in front of the fissure of Sylvius.

Spinal Cord

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Extends further back in the spinal canal than in man, its posterior extremity lying in the sacral canal. The lumbar enlargement terminates at the sixth lumbar vertebra. The backward prolongation from this is small. Otherwise it is like the human cord, presenting the same fissures, columns, and enlargements.

Cranial Nerves

— o —

First pair - Olfactory - Numerous branches arising from the large offactory bulbs, and piercing the cribriform plate of the ethmoid in the floor and lower part of the sides of the recess in which these bulbs are lodged. They are distributed on the septum nasi, but especially on the turbinated bones. Their distribution is confined to the upper third of the nasal cavity. The nerves become flattened as they lie in the peritoneum

membrane.

Second Pair - optic - arise from the optic commissure, and by the optic tracts from the corpora quadrigemina and geniculata. They diverge from each other more than in man.

Third Nerve - motor oculi - arising from the base of the brain between the crura cerebri runs forwards and a little outwards to pierce the dura mater at the side of the posterior clinoid process. Then passing through the outer wall of the cavernous sinus, lying immed-

above the fifth nerve, it enters the cavity of the orbit by the sphenoidal fissure at its inner part. It then divides into a superior and an inferior division. The former supplies the levator palpebræ and the superior, internal and posterior recti. The latter, runs forwards on the inferior rectus, supplying it and ending in the inferior oblique muscle. This division gives off the short motor root to the lenticular ganglion, which lies immediately above it.

Fourth Nerve – Trochlearis abducens –

Is the smallest of the cranial

nerves. It arises from the Pons of Varolius, and reaches the base of the brain by turning round the outer side of the crus cerebri. It lies in the outer wall of the Cavernous sinus, at first outside the ophthalmic division of the fifth nerve, and below and to the outer side of the third, but inclines upwards round their outer sides. It enters the orbit by the sphenoidal fissure, and passing superior to the supra-orbital branch of the fifth, and to the upper division of the third, it ends in the

upper surface of the superior oblique muscle.

The <u>Fifth nerve</u> - Trigeminal - arises by two roots from the pons varolii near its outer end. The sensory root is very much larger than the motor. The nerve first passes under the apex of the petrous bone, and here enlarged into the gasserian ganglion, from which are given off the three divisions of the nerve, the Ophthalmic, the Superior Maxillary, and the Inferior Maxillary. The first two of these are purely sensitive nerves. The last is partly

motōr.

The <u>ophthalmic division</u> in leaving the gasserian ganglion lies like the two preceding nerves in the outer wall of the cavernous sinus below the third nerve. It here gives off its supraorbital branch which ascends to the outside of the third, and reaches a higher level than it in the sphenoidal fissure. The whole division enters the orbit through this fissure. It then other part lying higher than the inferior division of the third. The frontal nerve runs forwards superficial to

the levator palpebræ muscle,
and leaves the orbit through
the supra orbital foramen, hav-
ing previously given off a
small twig to the lachrymal
gland which communicates
with a similar branch from
the Temporal branch of the
Superior maxillary nerve. In
leaving the foramen it turns
up on the forehead, supply-
ing the skin of the scalp in
front, and communicating
with the portio dura. The rest
of the ophthalmic division di-
vides into two, which cross
the optic nerve obliquely, from

without inwards. The internal
and larger of these is the
Nasal. It leaves the what Eg.
an ethmoidal foramen, and
enters the cavity of the Cranium,
but outside the dura mater,
towards the back part of the
roof for the olfactory bulbs,
and a little above its floor.
It then courses round the wall
of that cavity to its anterior
end, where it again leaves
the Cranium and enters the
nose. It passes forwards
immediately under the roof
of that cavity, giving branches
to the mucous membrane, as

for as the anterior end of the
nasal bone. It then passes be-
tween that and the cartilage
of the nose, and appearing on
the face communicates with
the facial and takes part in
the cutaneous supply of that
region. While still in the or-
bit and after it has given off its
ninth the nasal gives off a
slender filament which passes
forwards closely applied to
the outer side of the optic nerve,
as far as the eyeball which
it enters. It receives a sympa-
thetic twig, and gives off the
sensory root to the lenticular

The lenticulare ganglion lies close
above the inferior division of the
third, below the optic nerve. It
gives off two branches which
subsequently divide and enter
the eyeball.

ganglion which it reaches
by passing under the optic nerve.
The other branch, which is ex-
ternal to the nasal, runs more
directly forwards along the
side of the eyeball, and passing
above the upper edge of the
internal rectus, it leaves the
orbit below the superior oblique,
and ends in branches to the
skin of the side of the nose.

The <u>Superior maxillary</u> nerve
leaves the skull by the foramen
rotundum, and is directed for-
wards between the internal pter-
ygoid and temporal muscles
to the infra-orbital canal in

the superior maxillary tone. It
emerges from this canal on to
the face and ends there in branch-
es which descend on the side
of the nose to the upper lip, com-
municating freely with the
portio dura of the facial nerve.
Soon after leaving the skull
it gives off a branch which
divides into the temporal and
malar nerves. These pass forwards
at first below and then to the outer
side of the external rectus muscle
of the eyeball. The temporal branch
which lies above and to
the outer side of the malar,
communicates with the frontal

× but no nerve cells were to be seen in examining this microscopically, merely nerve fibres & fat cells.

nerve, through a branch which it sends to the lachrymal gland, and then leaves the temporo-orbital fossa either at the outer side of the orbit, or by piercing the malar bone. On the face it communicates with the facial nerve, and supplies the skin outside the eye, and the lids. The malar nerve passes the malar bone below the temporal, and on the face where it joins with the facial it supplies the skin of the cheek and lower eyelid. It has a well marked zygomatic swelling on it immediately before it enters the malar bone.

The vidian nerve seems to join
me of the branches of the super-
ior maxillary division, generally
the naso-palatine, and at the
point of junction there is situ-
ated a ganglion — Meckel's —

some little distance

before entering the infra-orbital canal the superior maxillary nerve gives off its palatine and nasal branches, and these, at least in the four cases in which I dissected them, arose from the nerve itself, without the intervention of a sphenopalatine ganglion. The great palatine nerve passes downwards with a very considerable forward inclination to the palatine canal through which it passes, giving off forwards in its course a branch to the mucous membrane on the turbinated bones. Emerged on the palate it passes for-

wards, giving branches inwards,
supplying the mucous membrane.
In addition to this some small
palatine nerves are given off which
enter the palate behind the
large nerve. The naso palatine
passing across the roof the nose,
reaches the septum, and
then runs forwards and down-
wards between the bone & cartil-
age and the mucous membrane,
to the incisor foramen through
which it passes and ends
in the mucous membrane of the
front of the palate. One or two
dental nerves for the two front-
erior teeth are given off he-

fro the superior maxillary nerve
enters its canal. It passes through
the canal in two divisions, which
may communicate with each
other. The lower division gives
off the superior dental nerve
immediately on entering the
canal. This runs forwards
giving branches to the teeth
and coming up internal to
the main trunk to a higher
level in the middle of its
course.

The Superior maxillary

division of the fifth receives the
motor root of that nerve. It
lies outside and below the

other divisions, and leaves the cranium by passing through the foramen ovale, and then emerging from the skull lies to the inner side of the Eustachian tube. It passes downwards, giving several branches, external to the internal pterygoid, and on the outer face of this muscle it divides into three, the Lingual, Superior dental and Stylohyoid. Close under the skull it gives off three branches which pass outwards. The most anterior of these is the Lingual. It passes forwards and outwards above the external pterygoid,

to the inner face of the temporal
muscle, and then passing down
through the fat which lies
internal to the masseter, and
go to the auriculo temporal gland
giving branches which, ~~as it~~
~~in that fat~~, it emerges on
the face from under cover of
the masseter and joining with
the facial sends branches through
the buccinator muscle. The middle
branch passes outwards into
the temporal muscle, above the
external pterygoid to which it
gives a branch. The posterior
branch passes to the notch of
the jaw, giving branches to the
temporal in its course, and

ends in the masseter muscle.
Quite at the upper border of the
internal pterygoid the main
trunk gives off the nerve of sup-
ply to that muscle. This branch
passes down in the mass face
of the nerve to enter the muscle
at its upper edge, and quite
else this region it is joined
by a branch — small petrosal —
which passes forwards from
the temporal bone, joining the pte-
rygoid nerve at a right angle.
At the point of junction is the
otic ganglion which lies a
short distance below the skull
between the inferior maxillary

nerve and the tensor palati muscle.
a little below this the nerve gives
off the Auriculo temporal which
passes backwards, accompanied
by a vein, and turning outwards
behind the condyle of the jaw
& reaches the front of the ear
where it communicates with the
facial and supplies the skin
of the auricle in front, and the
neighbouring portion of the temple.
ral.

Inferior dental nerve the
most external of the terminal
branches of the inferior max-
illary, passes downwards &
enters the dental foramen. It

runs forwards below the roots
of the teeth giving a branch to
each, as far as the mental
foramen, where it leaves the
dental canal, giving, however,
a little branch to the incisor
teeth, and appears on the face
supplying the lower lip and
joining with the facial.

The Mylo-hyoid nerve lies be-
hind the other two, and is the
smallest of the terminal divi-
sions. It at first passes down-
wards between the lower jaw
and the internal pterygoid
muscle, and behind the post-
erior edge of the mylo-hyoid

muscle. Then, dividing, it sends
no branch forwards on the
superficial aspect of that
muscle, lying at first deeply
between it and the digastric.
It gives a branch to the anterior
end of the digastric. It divides
into branches which spread
inwards, backwards and for-
wards on the cutaneous sur-
face of the mylo-hyoid, sup-
plying it and joining with
the inframaxillary branches of
the facial nerve. The other
branch runs outwards above
the digastric, between it and
the jaw, and turning up

m to the face communicates with the facial, and supplies the skin over the lower jaw behind the mouth.

The <u>Lingual</u> is the most internal of the three divisions. It is smaller in proportion to the size of the tongue than in man. It passes downwards and a little forwards in front of the superior cerulate, at first between the jaw and the internal pterygoid, and then passing on to the inner, or upper, surface of the mylo-hyoid muscle, it crosses the sublingual gland and Wharton's duct. It then

turns forwards & upwards on the outer side of the genio-hyo-glossus, above and parallel to the hypoglossal nerve, with which it communicates, and ends by supplying the mucous membrane of the anterior 3/4 of the tongue. A short distance from its origin, on the outer surface of the internal pterygoid it is joined by the chorda tympani nerve, which passes forwards almost horizontally and joins it at nearly a right angle. This branch of the facial runs along with the ~~fascia~~ lingual, connected to

its posterior aspect, & a little beyond the origin of the internal pterygoid, immediately above the sublingual gland, and then leaving it, getting branches from it, it passes backwards and a little outwards between the digastric and the jaw, on the outside Wharton's duct sub-lingual gland, & reach the inner face of the submaxillary gland, where it communicates with the sympathetic nerve to the gland from the superior cervical ganglion. At the back of the palate the lingual nerve gives off a branch which runs forwards & supplies the

mucous membrane of the posterior part of the cheek and gums, and of the lateral wall of the nasal cavity. A little above the foramen where the chorda tympani leaves the nerve, a good sized branch is given forwards to the mucous membrane of the floor of the mouth.

The <u>Sixth nerve</u> arises from the medulla behind the pons and passes along the inner wall of the cavernous sinus, where it receives a sympathetic branch. It enters the orbit by the sphenoidal fissure and supplies the external rectus.

The Seventh nerve consists of two, the auditory, and the facial. The apparent origin of the facial is from the outer end of the trapezium upon which it seems to be a continuation. The auditory winds round the restiform body and joins the facial at the extremity of the trapezium.

The auditory Nerve enters the internal auditory meatus below the facial. At the outer extremity of that passage it divides into branches for the cochlea, vestibule and semicircular canals.

The Facial nerve, leaving

the Eustachian at the deep end of the meatus, enters the aqueduct of Fallopius, and at first runs outwards behind the cochlea. It then makes a turn on itself - genu - and runs backwards above the inner wall of the large tympanic cavity, and turning downwards leaves the bone by the stylo-mastoid foramen. From the genu the great and small petrosal nerves are given off. The great passes forwards to the superior maxillary division of the 5th, while the small goes to the otic ganglion. Before e- merging from the stylo-mastoid

passes it gives off the chorda tympani, which, as in man, enters the tympanic cavity, crosses the membrana tympani between the handle of the malleus and the long process of the incus, and leaves the temporal bone to the inner side of the articulation of the lower jaw. It then runs forwards outside the internal pterygoid muscle to join the Lingual nerve, leaving it again as before described beneath the submaxillary gland. The Facial nerve on leaving the foramen, first gives off two small branches to the posterior end of the digastric

× the posterior auricular nerve which ends in the posterior muscles of the auricle, and gives off a branch ↗

and the stylo-hyoid muscles, and ~~coooother~~, which, piercing the cartilage of the pinna, is distributed on its external surface. It then divides into four. And these divisions run more or less directly forwards over the face and submaxillary region. The highest runs upwards and forwards to the eye, giving off in its course an anterior auricular nerve which after communicating with the auriculo-temporal branch of the fifth, supplies the muscles of the front of the auricle. Above and to the outer side of the

ope this division communicates
with the temporal and malar
branch of the superior maxillary,
and with the orbital branch of the
ophthalmic division of the fifth.
It terminates at the root of the
nose. The next division passes
forwards over the masseter in
company with Steno's duct, to
the muscles of the upper lip and
side of the nose. It communicates
with the buccal branch of the
inferior maxillary, and then
with the infra orbital branch
of the same nerve, and with
the nasal branch of the fifth
nerve. It also communicates

posteriorly with the facial branches
of the second cervical nerve.
The lowest of the facial branches
of the portio dura is directed
forwards to the angle of the mouth.
It communicates with branches
of the myto-hyoid nerve on the
face, and also sends branches
to the submaxillary region which
form a network with the myto-
hyoid nerve, and with corresponding
branches from the opposite
side. It communicates with
the second cervical behind. It
ends in the muscles of the
lower lip after communicating
with the terminations of the in-

and the facial branch of the mylo-hyoid
from dental nerve. These three
divisions of the facial but especi-
ally the last two have very
frequent intercommunications.
The last trunk of the seventh,
smaller than the preceding,
passes downwards and forwards
over the submaxillary region,
communicating with the second
cervical nerve behind, and
the inferior facial division of
the seventh, and the mylo. hyoid
nerve in front.

The <u>Eighth nerve</u> is com-
posed of three in reality. the
Glosso-pharyngeal, the Vagus,
and the Spinal accessory.

The <u>Glosso-pharyngeal</u>, the smallest division of the Eighth, arises from the medulla behind the hapezium and in the groove w the inner side of the resti-form body. It leaves the skull by the jugular foramen, lying w the outer side of the other nerves. It has a ganglion on it in the foramen, and then communicates with the vagus and sympathetic. From the ganglion is given off a fine branch which running below the tympanic wall, pierces it and ramifies on its inner wall. After leaving

the pharynx it is directed for-
wards a little below the bulla
and passing to the outer side
of the stylo-glossus, and stylo-
pharyngeus supplying them, it
ends by supplying the post-
erior ⅓ of the tongue. In its
course it gives several branches
to the plexus on the pharynx, and
one which passing between the
superior and middle constrictors
of the pharynx, comes internal
to the great cornu of the hyoid
bone to the mucous membrane
of the tonsil and fauces.

The <u>Vagus</u> or Pneumo-
gastric arises from the

medulla from the same groove as the glosso-pharyngeal, but behind that nerve. It leaves the skull by the jugular foramen by the inner side of and closely connected with the glosso-pharyngeal and spinal accessory nerves. On leaving the skull it is dilated into a long fusiform ganglion, and lies between the digastric and rectus capitis anticus major muscles, below the rectus lateralis, and above the internal carotid artery. It lies slightly to the outer side and above the superior cervical ganglion of the sympathetic. This

ganglion communicates with the first cervical nerve, the sympathetic, the other divisions of the eighth and the ninth nerves. It also gives off from its lower side the Pharyngeal and Superior laryngeal branches. The nerve a short distance behind the ganglion is joined by the sympathetic cord at its inner and lower side, and the combined vago-sympathetic passes backwards, at first below the rectus major & then below the longus colli, and above the carotid artery to the root of the neck. a very short dis-

latter enters the subclavian
artery these two nerves again sep-
arate, the point of disjunction
being marked by a triangular
ganglion (inferior cervical) which
is on the sympathetic to the outer
side of the vagus but intimately
connected to that nerve. The sym-
pathetic cord passes outwards
to the first thoracic or stellate
ganglion, while the vagus con-
tinues backwards crossing, on
the right side below the sub-
clavian artery and above the
vein, and sending its recurrent
branch round the former ves-
sel. It continues back to the

root of the lung, lying by the side of the trachea and above the vena cava superior, and being crossed externally by the vena azygos major as it passes round the bronchus. On the left side the vagus enters the thorax by the inner side of the subclavian artery, and passing below the arch of the aorta, by the outer side of the phrenic, sends its recurrent branch round above that vessel, and reaches the root of the lung. Both nerves give branches to the heart, and after forming the superior pulmonic plexus, pass above

the root of the lung, and, approach-
ing each other, divide into branches
on the oesophagus, with which
they pass through the diaphragm,
and after supplying the stom-
ach, end by joining the Coeliac
and hepatic plexuses.

The Pharyngeal branch arises
from the ganglion of the vagus
close to the skull, and passes
forwards and downwards ex-
ternal to the internal carotid
artery and a little below the Glos-
so-pharyngeal nerve. It, after
passing internal to the external
carotid, is distributed in the
pharynx, & communicates with

the Pharyngeal branch of the
superior cervical ganglion of
the sympathetic.

The Superior Laryngeal nerve
is a somewhat larger branch.
It arises from the ganglion of
the vagus a little behind the
knee. It runs backwards and
downwards, beside internal to
the internal carotid artery and
the sympathetic cord, to the inter-
val between the hyoid bone and
the thyroid cartilage, and pierces
the thyro-hyoid membrane into
the larynx. a short distance
from the larynx it gives off
its external laryngeal branch

wh enters the crico-thyroid muscle
under cover of the sterno-thyroid.
after entering the larynx the
superior laryngeal divides into
two, one to supply the mucous
membrane. The other much
larger passes backwards internal
to the anterior cornu of the thyroid
cartilage, and leaves the lar-
ynx by passing above the su-
perior border of that cartilage
in front of the cricoid. It then
runs backwards in very close
relation with the recurrent laryn-
geal at first, in the angle be-
tween the trachea and oesopha-
gus giving numerous branches

both; and entering the thorax, sometimes communicating with the superior cervical ganglion and cardiac nerves, & ends by joining the trunk of the vagus a short distance behind the origin of its recurrent branch (Chauveau)

The Recurrent Laryngeal nerve arises from the vagus, on the right side below the subclavian artery, on the left below the arch, and turning round above these vessels communicating with the cardiac nerves, runs forwards along the side of the trachea beside the larynx

under the inferior constrictor muscle of the pharynx, and supplies the intrinsic muscles of that organ. In its course it gives few tracheal or oesophageal branches, these being chiefly supplied by the posterior branch of the superior laryngeal. Opposite the inferior cervical ganglion it is joined by a sympathetic branch.

The <u>Spinal accessory Nerve</u>

the third division of the eighth, arises from the lateral column of the cord by roots extending as far back as the fifth or sixth cervical vertebra. It enters the cranium by the foramen magnum

and passing forwards and out-
wards over the basi-occipital
bone, leaves it again by the
jugular foramen, where it com-
municates with the vagus and
sympathetic, and lies by their
outer side. On leaving the
skull it lies at first between
the digastric and rectus capi
muscles, and turns backwards
below the rectus lateralis and
outside the first cervical nerve
with which it communicates to
enlist the deep surface of the
sterno-mastoid muscle close to
its origin. After piercing this
muscle it runs backwards

on the deep surface of the cephalo-
humeral muscle, above the
superior divisions of the cervical
nerves, with which it communicates.
It gives branches to the sterno-mas-
toid, cephalo-humeral muscle,
trapezius, and rhomboides in
which it ends.

Ninth nerve or Hypoglossal.

arises by two or three bundles
of roots from the medulla at
the outer side of the anterior pyra-
mids. It leaves the cranial cav-
ity by the anterior foramen,
as it lies in this canal it is
joined by a branch from the
superior ganglion of the sympa-

that which passes backwards internal to the vagus. It appears on the under surface of the skull behind the eighth, but soon passes in front to the outer side of the vagus with which it communicates, but internal to the spinal accessory. It passes forwards in a curved direction, at first internal to but soon below the digastric, and crossing the external carotid artery, about the origin of its facial trunk, it passes internal to the mylo-hyoid muscle with the lingual artery. Under cover of this muscle it lies on the hyo-glossus and stylo-

hyo-glossus, giving branches to them and to the genio-hyoid. It runs upwards parallel to the lingualn. and communicating with it, to end in the intrinsic muscles of the tongue. Before crossing the external carotid artery, it gives off a descending branch, which, after being joined by the communicating branch from the first cervical nerve, crosses the carotid and divides into branches for the sterno-hyoid, sterno-thyroid, and thyro-hyoid.

Sympathetic System

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This has essentially the same arrangement as in man. It differs however, in a few points. The greatest differences are found in the cervical region. Here the vagus and sympathetic are closely connected together as one cord for a considerable distance. The Cervical sympathetic has two ganglia on it, one before it joins the vagus anteriorly, the other placed on the side of the embedded trunk immediately before the nerves separate fort-

vicinity.

The superior or anterior cervical ganglion lies immediately under the skull, a little ~~in~~ below ~~front~~ and internal to the vagus. It is shorter and thicker proportionally than in man. It gives off a good sized branch to the carotid artery, which after forming a plexus round that vessel is carried by the facial artery, and its glandular branch to the submaxillary gland. Its other branches are so similar to those in man as not to merit a special description.

The inferior, or posterior, cer-

vical ganglion projects from the
outer side of the vago-sympathetic
cord at their point of separation.
The vagus is closely connected with
the ganglion. It lies by the side
of the trachea, a little above the
first rib, and from 1 to 2 centimetres
~~above~~ in front of the subclavian
artery. It is covered by the carotid
artery. On the left side it is same
distance internal to the subclavian
artery. It is generally larger on
the right than the left side.
It is connected with the first thor-
acic ganglion (ganglion stellatum)
generally by two branches which
pass outwards me above the

other below the subclavian artery, embracing it in a ring, called the annulus Vieussenii. Of these two branches the upper is nearly horizontal and is shorter and thicker than the inferior, which sometimes, instead springing from the ganglion internally arises from the vagus trunk behind it. This anterior trunk sometimes also gives off a nervous accelerans to the heart. In addition, the posterior (inferior) cervical ganglion gives off two nervi accelerantes which cross below the subclavian artery in company with the vagus, and reach the heart

by passing along the innominate artery; also a connecting twig to the recurrent laryngeal as it passes it. From this connecting twig another nervous accelerans sometimes arises. The Phrenic nerve also receives branches from this ganglion.

The first thoracic ganglion or stellate ganglion lies on the longus colli above the subclavian artery, and a little internal to and behind the origin of the vertebral. It receives internally the branches which connect it with the last cervical ganglion, and posteriorly it gives off

the end which passes back to the next and subsequent ganglia. It is also connected with the last three cervical nerves and the first and second dorsal. The branches to the latter, joining either its intercostal or its brachial divisions. The branch from the last cervical nerve lies on the vertebral artery. This ganglion also gives off one or two nerves accelerantes to the heart.

The rest of the sympathetic cord may differ from the human in the number of ganglia on it, which correspond

the number of vertebrae. Similar plexuses are given off from it. It must be borne in mind in connection with the splanchnic nerves that the right nerve is not so near the aorta as the left.

Spinal Nerves

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There arise as in man by two roots an inferior and a superior. The superior is ganglionated, & corresponds to the posterior root in man. The two roots join and interchange fibres beyond this ganglion and the resulting Spinal Nerves leave the spinal canal by the intervertebral foramina incased for a short distance as they lie between the vertebrae in a sheath of the dura mater of the cord. On emerging from the foramina they divide into two

All the superior divisions of the
spinal nerves communicate near
their origin with the ganglia of
the sympathetic cord by one or
two branches.

branches, called the superior and inferior primary branches of these the superior is & the smallest. The superior branches turn up through the the spinal muscles, supplying them, to end in the skin on the superior aspect of the body. The inferior and larger have a general direction downwards, and also supply skin and muscles. They are, however, much more complicated in their arrangement than the superior branches, forming in parts plexuses from which arise the nerves of the extremities.

The spinal nerves are divided into groups named from the region of the cord from which they arise.

Cervical Nerves

Eight in number.

Superior divisions

These give off two sets of branches, one the smaller and outer is principally muscular. The other which is generally a single branch, is distributed in great part to skin. This division into an external and internal branch is often not distinctly present. The nerve then in its course to the skin gives off muscular branches. All the

cutaneous or internal divisions
of these nerves curve inwards
under the emplexus to the
mid aspect of that muscle,
and then running up on its
mid face or in its substance.
Trapezius and
pierce the platysma close to
the middle line, the nerves of
opposite sides not always
appearing at corresponding
points. They then pursue a
very tortuous course in the
subcutaneous tissue in their
passage to the skin.

The first or suboccipital
nerve leaves the spinal canal
by the foramen in the pert-

vir arch of the atlas, where it
is crossed by the vertebral artery
as that vessel passes inwards.
It gives short branches to the
superior recti and obliqui and
the anterior part of the com-
plexus. It gives a small cu-
taneous branch which appears
behind the ear close to
the middle line, and then
runs outwards and forwards
in a curved direction to the
back of the auricle, ending
there in branches to the skin.
In its course it gives some
small branches to the extrin-
sic muscles of the ear.

The second nerve, and all the succeeding superior divisions on leaving the pramina, turn upwards through the intertransversales muscles. It gives branches to the obliqui, the splenius, and the complexus, and then sends a large branch through the substance of the latter muscle to the occiput, where it gives a few filaments to the retrahens auriculam muscle, but is principally distributed to the skin of the back of the auricle.

The third nerve gives branches to the splenius, complexus,

and short muscles. Its cutaneous branch appears above the middle line, and first runs outwards and forwards being crossed by the corresponding branch of the fourth nerve. It then turns forwards and ends by supplying the skin on the scalp. It gives off from its convexity a branch which runs outwards to the skin of the side of the neck.

The fourth nerve pursues a very similar course to the third, supplying the deep muscles of the neck, and its cutaneous branch first

running outwards and then
curving forwards, giving off a
lateral branch, and ending
after crossing the third nerve
by supplying the skin of the
nape of the neck.

The fifth sixth and seventh
nerves are somewhat smaller
in size than the preceding.
Their cutaneous branches run
outwards and forwards, sup-
plying the skin on the outer
and upper parts of the neck

The eighth nerve does
not generally furnish a
cutaneous branch

Inferior divisions

The first nerve leaves the upper margin of the atlas with the vertebral artery, and turns down in front of the transverse process of that vertebra in the substance of the rectus capitis lateralis, supplying this muscle, and also giving branches to the inferior recti. When it emerges from the lateral rectus it lies to the outer side of the rectus capitis anticus major, and internal to the sterno-mastoid muscle and spinal accessory nerve. It is directed backwards and downwards, lying

at first above the vagus, but afterwards turning downwards external to the vago-sympathetic cord & the common carotid artery and coming out from under cover of the sterno mastoid muscle buried in branches to the sterno-hyoid and thyroid muscles. Soon after leaving the vertebral it gives off a slender branch which passes forwards a little below the skull and external to the spinal accessory and vagus nerves, to join the superior cervical ganglion of the sympathetic. a little behind this it gives a sin-

ilar branch which runs for-
wards to join the posterior or
lower end of the ganglion or
the trunk of the vagus. Behind
this and about the level of the
submaxillary gland, it gives
off another and larger branch
which crosses internal to the
vago-sympathetic nerve and com-
mon carotid artery and joins
the descending branch of the
hypoglossal nerve. This branch
is sometimes the termination
of the nerve, which then goes
entirely to the descendens noni,
but as a rule the first nerve
gives branches to the laryngeal

muscles. as this communicating branch passes internal to the submaxillary gland it gives a branch to it.

The second nerve, large in size, first passes through the fibres of the intertransversalis muscle, and then between the acromio-trachelian and rectus capitis anticus major muscles. It then passes outwards above the accessory part of the cephalo-humeral muscle, communicating with the spinal accessory nerve. It becomes cutaneous by passing between the sterno-mastoid and cephalo-humeral

and communicating in the face with

the facial bones

muscles, behind the prominence caused by the large transverse process of the atlas. It now turns forwards over the atlo-axoid where it lies in that process, & the submaxillary gland, where it divides into branches the superior and larger of which runs up & the auricle supplying behind, and in front it, ~~and~~ communicating with the facial — great auricular n. —; while the inferior branch or branches run forwards over the gland in the line of the ramus of the lower jaw*. About immediately after becoming cutaneous this nerve gives a slender twig

backwards to communicate with the cutaneous branch of the third nerve. About the same point it also gives off two lesser branches which run downwards round the neck giving off branches to the platysma and skin, crossing in their course the external jugular vein. The anterior of these branches is inclined forwards as well as downwards and ends by supplying the skin of the submaxillary & region superficial to the back part of the mylo-hyoid joining with the lowest division of the facial muscle. The posterior branch ends in filaments to the

skin of the anterior part of the throat.

The third cervical is a much smaller nerve than the preceding one. It passes outwards from the intervertebral foramen between the scalenus posticus and the anterior rectus with a somewhat backward direction, and almost immediately enters the acromio-trachelien muscle. It pierces this muscle and then communicates with the spinal accessory nerve, and becomes cutaneous by piercing the cephalo-humeral muscle near its anterior border. It

now gives off two little branches,
one of which passes forwards to
complete the loop of communica-
tion with the second nerve;
the other runs backwards to
join a corresponding branch
from the fourth nerve. From this
loop some small twigs arise
which pierce the platysma and
end in the skin. The nerve
itself runs downwards over
the external jugular vein, and
ends in the skin of the middle
of the neck.

The fourth nerve, larger than
the second and third, but not so
large as the second, arising

like the preceding nerve passes outwards and backwards to reach the deep surface of the acromio-trachelien muscle. It here divides into two. One branch generally ends in the substance of the muscle., The other which is larger pierces its upper border and then runs back-wards for a short distance between it and the cephalo-humeral muscle, communicating in this part of its course with the spinal accessory by one or two slender twigs. It then pierces the last named muscle and becomes subcu-

taneous. After piercing the muscle it gives a twig forwards to join the branch of the third described above, and then runs downwards and backwards over the external jugular vein buried in branches to the skin of the anterior part of the thorax. In this course it gives off numerous branches to the skin at the root of the neck. The largest and most anterior of these runs across the sterno-mastoid to the middle line of the neck inferiorly, taking a course parallel to the cutaneous branch of the third nerve. The

branch of this nerve which supplies the acromio-trachelien sometimes pierces that muscle and becomes cutaneous.

The fifth nerve as it lies deeply between the scalenus and the rectus capitis gives off a twig which runs backwards to join the phrenic nerve. The nerve then runs outwards and backwards below the acromio-trachelien muscle, and passing in front of the scapula becomes cutaneous either by piercing the cephalohumeral muscle near its posterior border and a little above

its tendinous intersections, or by passing out behind it and below the acromio-trachelien. It then divides into branches which descend over the anterior division of the deltoid muscle, and over the pectoralis major external to the thoracic branches of the fourth cervical nerve.

The fifth, seventh, and eighth cervical nerves enter into the formation of the brachial plexus and will be afterwards described.

Dorsal Nerves

Thirteen in number

Superior divisions.

These turn upwards between the muscles of the back supplying them, and end in cutaneous branches on the dorsal aspect of the trunk.

The anterior two pierce the trapezius close to the middle line, and run outwards down the side of the neck, the first usually reaching over the shoulder to the outer aspect of the upper arm. Those which become cutaneous behind the spine of the scapula do

so at some little distance from
the middle line. From the third
to the tenth pairs the serratus
posticus anterior the last three
pairs the serratus posterior.
The third, fourth and fifth
pairs the Rhomboideus major
and lumbus subcutaneous li-
ther by passing out from under
the border of the trapezius or
by piercing its fibres near its
outer border. From the sixth to
the eleventh pairs the lat-
issimus dorsi. The last two
lumbi subcutaneous by
piercing the aponeurosis
posticus. The more posterior

nerves become cutaneous near
the middle line of the back
then those about the middle
of the series. These nerve in
becoming subcutaneous, as they
lie under the panniculus car-
nosus, divide into two branches,
one, the smaller, turns up to
supply the skin on the back;
the other, which is considerably
larger runs outwards and
downwards, with a backward
inclination in the more posterior
nerves, giving off branches in its
course, to supply the skin on
the upper part of the flank.
As the more anterior of these

branches pierce the panniculus they communicate with the network which the nerve of supply to that muscle makes in its substance.

The vessels which accompany these nerves are given off from the intercostals at the outer edge of the superior serrati.

Inferior divisions

or Intercostal nerves.

These are larger than the superior divisions. They run downwards in the walls of the thorax and abdomen, either in an intercostal space or between the abdominal muscles.

In their course between the ribs they at first lie between the pleura and the external intercostal muscles, but soon, crossing the space to reach the posterior border of the anterior rib, they lie between the intercostal muscles, accompanied by an artery and vein.

The first nerve goes almost entirely to assist in the formation of the brachial plexus (q.v.). It has, however, a small intercostal branch, which terminates before it reaches the lower end of the space.

The next five or six inter-

costal nerves in reaching the sternum pierce the pectoralis major and turning outwards supply the skin on the inferior aspect of the thorax. These cutaneous branches decrease in size from before backwards. The second nerve differs from the others in giving a small branch to the brachial plexus. (4.0) The cutaneous ending of this nerve is generally the formed piercing the anterior or lower division of the pectoralis major near its posterior edge.

The remaining nerves in leaving the intercostal spaces run

between the abdominal muscles,
at first between the transversalis
and internal oblique, and then
between the latter muscle and
the external oblique, supplying
them. They pierce the sheath
of the rectus near its outer
border, and generally end in
the substance of that muscle.
A few, however, may send
small filaments through
the sheath & the skin of the
belly.

At about the middle of their
course each of these inferior
divisions of the dorsal nerves
— with the exception of the first —

gives off a lateral cutaneous or
"perforating intercostal" branch
This branch of the second in-
tercostal space
pierces the scalenus portions
near its upper margin, and
crosses the axilla a little behind
the great ends of the brachial
plexus, and below the nerve
to the serratus magnus. It pierces
the latissimus dorsi not far
from its insertion, having pre-
viously communicated by a
twig with the nerve of supply
to that muscle.

The lateral branch of the
third leaves the intercostal

space above the scalenus posticus,
and between two of the digitations
of the serratus magnus. It gen-
erally communicates with the
corresponding branch of the
fourth nerve and then runs
outwards and backwards be-
low the lower border of the lat-
issimus dorsi to pierce the
panniculus carnosus where it
is thick and fleshy not far
from its insertion. Before en-
tering this muscle it gives off
one branch which runs for-
wards on its deep surface
supplying that portion, and
another which joins the

proper nerve supply of the muscle. It usually pierces the pectoralis in two divisions which reach the upper arm and supply the skin in its inner and posterior aspects, extending as far as the elbow.

The lateral branch of the fourth appears above the scalenus, which it crosses, communicating with the third, and supplying the skin external to the pectoralis major.

The lateral branches of the fifth and sixth leave their intercostal spaces between the digitations of the serratus

magnus and external oblique, un-
der cover of the latissimus dorsi,
through which they may reach
a branch. As soon as they
emerge from under the latissi-
mus dorsi each gives off a
branch which pierces the pan-
niculus immediately supplying
the skin of that region of the side.
after giving off this branch they
run downwards and slightly
forwards to the under aspect
of the chest, communicating
with the nerves of the panniculus.

The next four or five lat-
eral branches either pierce
the digitations of the external

oblique, or the external intercostal immediately above them. They are larger than the preceding, but are similarly arranged, giving off a branch to the skin of the flank, and ending in that of the belly, communicating also with the nerve to the panniculus, not to pull, however, as the anterior nerves. In the bitch they supply the mamma.

The last two or three lateral branches are given off as the nerve lies between the abdominal muscles. They pierce the external oblique at some distance from its origin, and

are directed somewhat back-
wards, but are otherwise sim-
ilar to those just described.

Lumbar Nerves

Seven in number

Superior divisions

These are somewhat larger
than the corresponding branches
of the dorsal nerves, but are
arranged in the same man-
ner. Cutaneous branches are,
however, only given off from
the anterior two or three or four.
These are directed more back-
wards than in the dorsal
region, the last extending over
the pre part of the gluteal

Guis Wanches Bl Roux Quadrates

as also dothe other Lunches heroes

region.

Superior divisions

The first nerve passes out-
wards between the psoas parvus
and quadratus, and running
backwards and outwards for a
short distance enters the trans-
versalis muscle. It subsequent
course is the same as that of
a dorsal nerve. It gives off a
lateral cutaneous branch which
becomes cutaneous by piercing
the external oblique near its
superior border.

The second nerve takes a
very similar course.

The third nerve, enters

into the formation of the Lumbo-
sacral plexus and will be de-
scribed subsequently.

It will be seen from the
preceding description that the
dorsal and lumbar nerves
pierce the panniculus in four
rows. The highest, which is
most far from the spine, is
formed of the short upper
branches of the superior divis-
ions; the next by their longer
and more deeply placed branches.
In the next which runs along
about the middle of the flanks
are the lateral branches of
the lateral cutaneous branches.

of the inferior divisions; whilst the lowest situated on the belly is formed by the terminations of these lateral cutaneous branches themselves.

Sacro-Coccygeal Nerves

Superior divisions

These are small in size. The anterior sacral nerves after leaving the supra sacral foramina give branches to the erector spinae, and piercing it end in branches to the skin of the gluteal region. They also give branches to the superior caudal nerve, which receiving the superior divisions of the remaining sacral and

all the coccygeal nerves give branches to the skin and muscles on the superior aspect of the tail.

Superior divisions

These diminish in size from before backwards. The first, second and a branch of third sacral enter into the formation of the lumbo-sacral plexus. The others togethes with a branch from the second and third from the inferior caudal nerve which receives all the inferior divisions of the coccygeal nerves. and is distributed to the skin and muscles of the ventral aspect of the tail.

Brachial Plexus

Formed by the whole or part of the inferior divisions of the fifth sixth, seventh, eighth cervical nerves, and the first and second dorsal nerves.

The twig which the fifth cervical gives to the plexus is very small and inconstant.

The sixth, larger than any of the preceding cervical nerves with the exception of the second, is joined about the outer border of the scalenus by a branch from the seventh, and then divides into two, the nerve to the cephalo-humeral muscle and

the suprascapular nerve. While still under cover of the scalenus it gives off a root to the phrenic nerve, and a small twig which joins a branch from the seventh from the nerve to the subscapularis muscle. It sometimes also gives off another branch which joins the communication with the seventh.

The seventh cervical, much larger than the sixth, has a somewhat backward inclination below the scalenus, where it gives off another root to the phrenic. It soon divides into branches which join with other

from the eighth cervical and put dorsal to some of the branches of the plexus to be described presently.

The eighth cervical as large as the seventh has a greater backward inclination. It is joined by the first dorsal soon after it leaves the intervertebral foramen, and the resulting cord crosses below the scalenus anticus, close above the subclavian artery, and divides into its branches at the outer border of that muscle.

The first dorsal runs almost directly outwards under

the neck of the first rib to join the eighth cervical. The small intercostal portion of this nerve runs along its intercostal space below its inferior extremity.

The second dorsal nerve, in great part behaves like the other intercostal nerves, but in addition it usually sends a small branch across the neck of the second rib to join the brachial portion of the first nerve, and thus enters into the formation of the brachial plexus. I have not always found this branch, but it seems to be present in the majority of cases. Upon figures it in me of the

plates in the atlas appended this "Methodik der Physiologischen Experimentir". In man it is present in the greatest proportion of bodies, but it is by no means an invariable occurrence. Chauveau describes it, and figures it, as the invariable rule in the horse; and D. Cunningham has seen and described it in the dolphin & human subject. I have also dissected it out in the rat.

Branches of the Plexus

Phrenic nerve arises by three roots from the fifth, sixth, and seventh cervical nerves, and it occasionally gets a very slender one from the branch of com-

munication between the sixth and seventh nerves. It passes backwards and inwards in front of the upper nerves of the anterior aperture of the thorax. In this part of its course it at first lies above the transversalis colli artery, then curving round its outer side, and closely applied to it at origin from the subclavian, it crosses below the latter vessel obliquely from without inwards, lying between it and the vein. It enters the thorax by the inner side of the internal mammary artery, but soon crosses above that vessel to its outer side. On the right

side the phrenic lies at first to
the outer side of the superior vena
then below that vessel, reaching
the side of the heart along which
it passes backwards to the dia-
phragm lying in its course be-
tween the pericardium and the
pleura. On the left side it
passes above the left innominate
vein, and then crosses the
arch of the aorta internal to and
near the ventral aspect of
the body than the vagus. It
reaches the diaphragm by passing
as on the other side between the
pericardium and the pleura.

Nerve to Cephalo-Humeral muscle arises from the sixth cervical with the suprascapular. It runs outwards across the neck, at first below the scalenus anticus, anterior to the suprascapular nerve and the transversalis colli artery, but generally behind the corresponding vein. It enters the substance of the cephalo-humeral muscle a little in front of the shoulder, supplying it, and ~~running~~ sending two branches through its substance which appear on its superficial aspect below the tendinous intersection and run down the front of the

upper arm as far as the elbow, supplying the skin of that region.

Suprascapular Nerve, is the other terminal branch of the sixth cervical nerve. Sometimes, however, it arises from the seventh and then communicates with the nerve to the cephalo humeral by a small branch. It runs across the neck in company at first with the transversalis colli artery, and then with its suprascapular branch to the anterior border of the scapula, over which it passes near its glenoid end with the artery, between the supra-

supinatus and subscapularis muscles. It supplies the former muscle, and then runs in its substance to the scapular notch through which it passes to supply the infraspinatus.

Nerve to Subscapularis is also derived in part from the fifth cervical. The root derived from this nerve is small and springs from it near its origin close to its phrenic root. It runs back to join a larger branch which comes from the upper part of the seventh. The nerve thus formed runs above the other ends of the plexus to the

subscapularis muscle, which it enters near its glenoid end.

Nerve to Serratus Magnus lies above the other branches of the plexus, crossing them nearly at right angles. It arises from the seventh cervical close to its origin, and lies at first on the scalenus anticus. It crosses it and the posticus obliquely outwards to reach the outer face of the serratus magnus, on which it runs to near its posterior extremity giving off branches in its course to the muscle. It lies above the lateral branches of the intercostal nerves.

Nerves of Pectoral Muscles.

The is derived from the musculo cutaneous, and through it from the seventh cervical. It runs downwards and outwards, sometimes inwards, between the transversalis colli and the subclavian arteries, and enters the anterior part of the pectoralis major. Another arises from the anterior part of the eighth nerve, or from the branch that nerve gives to the musculo-cutaneous. It enters the pectoralis minor and the posterior part of the major, and communicates with a third pectoral nerve

which is derived from the first dorsal, & which reaches the post-erior part of the muscle by passing between the subclavian artery and vein. Some small branches are also derived from the next nerve.

Nerve to Pannicular Carnosum, or Subcutaneous thoracic nerve.

Is derived from the first dorsal along with the pectoral branch of that nerve as it lies on the scalenus anticus. It passes down between the subclavian artery and vein, and then turns backwards below the latter vessel and below the

medio Ulnar nerve, giving two or three branches to the pectoralis major. It then runs back along the outer wall of the axilla to near the anterior end of the Panniculus, where it enters its substance. But immediately before doing so it communicates with the lateral cutaneous branch of the third dorsal nerve. In the substance of the muscle it divides into branches which diverge from each other and subdivide as they pass backwards towards the thighs. These branches communicate freely with each other, and with the cutaneous

branches of the intercostal nerves especially the anterior ones. A network of nerves is thus formed in the substance of the panniculus which is coextensive with the muscle.

Nerve to Latissimus dorsi

arises from the eighth cervical from the trunk it goes to the musculo-spinal. It passes backwards above the point of emergence of the lateral cutaneous branches of the intercostals communicating with the second, and receiving a slender branch from the musculo spinal. It enters the latissimus in two

or three divisions

Circumflex, arising from the 7th cervical runs outwards and downwards across the subscapularis and a little above the axillary vessels, to the space between that muscle and the teres major near the humerus. It crosses above the subscapular artery, and passing between these two muscles winds round the back of the humerus below its superior extremity, and in front of the scapular head of the triceps. It reaches the back of the scapula by turning round below the teres minor to which it gives

a twig, and ends in branches to the deltoid. This nerve communicates with the musculo-spiral in the axilla, the connecting branch passing above the axillary artery.

Musculo-cutaneous nerve arises from the seventh cervical and occasionally from the sixth by a small filament. It passes outwards a little anterior to the axillary artery towards the shoulder joint. In this part of its course it gives off two branches, one to the pectoralis major already described, and a short one to the coraco-brach-

ialis. It is also joined here by a branch from another of the pectoral nerves derived from the eighth cervical. Below the level of the shoulder on the teres major tendon it gives off a larger branch which passing outwards enters the biceps at its inner edge and near its superior extremity. The nerve then passes down the arm close along the outer side of the brachial. About the middle of the arm it sends a branch across in front of the artery to join the median nerve. Opposite the elbow the nerve divides into its terminal branches. One of these enters

the brachialis anticus near its insertion, giving a slender filament to the elbow joint. The other passing behind the biceps becomes cutaneous in front of the elbow and to the outer side of that muscle. This branch can be traced down the anterior and inner aspect of the forearm as far as the inner-radial side of the paw. It gives branches in its course to the skin, and communicates at the wrist with a cutaneous branch of the median nerve.

Musculo-Spiral nerve arises by three roots, one

from the circumflex, axillary or from the seventh cervical, another from the eighth cervical, and a third from the first dorsal. The nerve crosses the axilla close behind the artery, giving off in its course a slender branch to the nerve to the latissimus dorsi. In the teres major the nerve gets behind the brachial artery, and then leaves the inner aspect of the arm by passing below the teres major and between the scapular and humeral heads of the triceps. It winds obliquely round the back of the humerus between the heads

of the triceps, supplying them,
and sending a long branch down
to the anconeus. It gains the
outside of the arm between the
brachialis anticus and the outer
head of the triceps a little above
the elbow. It here divides into
two, the radial and the "poster-
ior" interosseous.

The Radial is subcutaneous
in all its course. It runs down
the anterior part of the outer
aspect of the forearm in com-
pany with the large radial vein,
giving branches in its course to
the skin of the front and outside
of the forearm. In front of

the carpus it gives off a branch which supplies the dorsal-anterior — collateral nerves of the thumb, and the inner — radial — dorsal collateral of the index. It then divides into three which run down to the bifurcation of of the other digits, and their dividé sending a branch down the opposing side of each. Thus all the dorsal collaterals are derived from the radial nerve with the exception of the outer — ulnar — of the little finger which is derived from the Ulnar.

"Posterior" Interosseous is larger than the radial, and in

entirely distributed to muscle. It
has at first at the inner side of
the radial extensors of the carpus,
supplying them and the supina-
tor longus, and then passing be-
tween the radius and the supin-
ator brevis — supplying that mus-
cle — it reaches the anterior as-
pect of the forearm. There it di-
vides into several short thick
branches which enter the exten-
sor communis digitorum, the ex-
tensor carpi ulnaris, and the ex-
tensor minimi digiti near their
origins, and also sends a long
slender branch on the surface
of the extensor ossis metacarpi

pollicis what muscle and the ex-
tensor indicis. It is said never
the ganglia at the back of
the wrist.

Medio-Ulnar nerve arises
from the ~~seventh~~ eighth cervical and
first dorsal. It crosses the ax-
illa behind the axillary ar-
tery, crossing between the artery
and vein from above downwards.
It divides into the Median and
Ulnar nerves in the fore mapi
or a little lower.

Median Nerve at first
not more than half the size of
the Ulnar, runs down the arm
in close proximity to the inner

and posterior side of the brachial artery. about the lower third of the arm it receives the branch from the musculo-cutaneous nerve. It enters the forearm b the inner side of the brachial artery under cover of the pronator teres to which it sends a short branch. On leaving this muscle it gives off a thick branch wh. directed outwards, first gives a twig to the flexor carpi radialis, and then passing between the two heads of the flexor profundus, supplying them, ends in the flexor sublimis. a little below this the median gives off a small branch b the

pronator quadratus, and about the same place the "anterior" interosseous — posterior in reality — This is a long slender branch which gives twigs to the flexor longus pollicis and the pronator quadratus, and ends by winding round the ulna beneath the ulnar head of the flexor profundus digitorum. The Median nerve now passes down the forearm between the flexor carpi radialis and the flexor sublimis digitorum and enters the palm under the annular ligament between the superficial and deep flexors of the fingers. A short distance above the

wrist it gives off a little cutaneous branch which pierces the fascia above the annular ligament between the tendons of the flexor carpi radialis and the flexor sublimis, and after communicating with the musculo-cutaneous ends in the radial side of the small upper pad. The median nerve is accompanied in the forearm by the median artery and crosses the ulnar artery near its commencement. Almost immediately on entering the palm the median divides into two primary branches. The radial of these first sends

branches to both sides of the palmar aspect of the thumb, and then dividing into two, one branch goes to the radial side of the forefinger and is joined by a very slender branch from the ulnar. The other bifurcating at the fork of the fore- and middle fingers supplies their adjacent sides on their palmar aspect. It is joined at its bifurcation by a branch ~~by a branch~~ from the ulnar nerve. The other primary division of the median is joined not far from its origin by a branch from the ulnar which runs across the palm superficial to the other nerves. It then runs

to the fork between the middle and third fingers, where it is joined by a deep branch of the ulnar, and then bifurcates to supply the contiguous sides of these two digits. It also sends a branch along one of the digital arteries. all these nerves except those to the pollex send branches between the flexor tendons to the lower palmar part. That given off from the last described branch is smaller. ally the largest. The median then supplies the palmar collaterals of both sides of the thumb, fore and middle fingers and the radial side of the ~~third~~ finger.

Internal Cutaneous, I shall describe before the ulnar nerve. It is a branch of that nerve arising from it not far from its origin from the medio-ulnar trunk. It lies a little behind the ulnar in the upper arm and pierces the fascia a little above the elbow, generally in two branches. The smaller and posterior of these winds round the back of the ulna, and supplies the skin on the back and outer aspect of the forearm on its upper half. The other runs down the inner aspect of the forearm posteriorly as far as the carpus, giving

numerous branches to the skin in its course.

Ulnar nerve is the largest of the terminal branches of the medio-ulnar cord. It lies in the upper arm a short distance behind and to the inner side of the brachial artery. It gives off the internal cutaneous nerve far from its origin, and passes straight down the arm to the internal between the olecranon process and the inner condyle of the humerus. It enters the forearm behind the former of these muscles over the flexor carpi ulnaris. It immediately gives

a branch to the olecranon head of
that muscle, and a little below
this another to the humeral origin
of the flexor profundus digitorum,
which enters that muscle
near its origin. It also supplies
the extensor carpi ulnaris. It
then runs down in front of the
humeral origin of the flexor carpi
ulnaris, to which it gives branches,
in company with the ulnar artery.
It leaves the cover of the tendon
of this muscle at the wrist and
enters the palm under the an-
nular ligament to the inner side
of the pisiform bone. In addition
to its muscular branches the

ulnar nerve gives off in the upper
third of the forearm a long branch
which runs for some distance
close with ulnar side, giving a
cutaneous twig, which passes un-
der cover of the olecranon head
of the flexor carpi ulnaris, and
pierces the fascia about the
lower fourth of the arm between
the tendons of the flexor and ex-
tensor carpi ulnaris, and ends
by supplying the skin of the
lower and outer part of the fore-
arm. The branch itself becomes
cutaneous at the wrist between
the same tendons, and runs down
the ulnar side of the palm fingers

— fifth digit — on its dorsal aspect, communicating with the other dorsal collateral of the same digit derived from the ulnar radial.

The last branch of the ulnar nerve in the forearm is a little twig which becomes cutaneous immediately above the wrist between the tendons of the flexor sublimis and flexor carpi ulnaris, and supplies the ulnar side of the upper pad ending in the skin of the ulnar side of the palm. The ulnar nerve and artery are bound into the pisi-form bone by a strong fibrous sheath. Before entering this

the nerve gives off the ulnar palmar collateral of the fourth finger. This passes superficial to the fibrous band, and close with origin gives off a branch to the upper pad, and the communicating superficial branch to the median. On leaving the pisiform bone the ulnar nerve dips deeply between the abductor and flexor brevis minimi digiti; and is then directed across the palm bound in the short muscles of the thumb, lying on the interossei muscles & the deep palmar arch. It is crossed by the adductor and flexor brevis minimi digiti. In this part of its course it

gives off a great number of branches, short twigs to the muscles of the little finger. & the interossei, and from long branches. The first of these runs to the fork of the third and fourth toes, and then bifurcates into the collaterals of their opposing sides. It is crossed at its origin by the abductor minimi digiti, and sends a branch to the lower pad. The next two at first lie deeply between the palmar interossei and then coming from between the tendons of the flexor profundus join the branches of the median at their bifurcation at the roots of the fingers.

The last branch is very slender and joins the radial collateral palmar of the forefinger. It at first lies deeply between the short muscles of the thumb and the first inter-osseous.

The ulnar then supplies both sides of the little finger on its palmar aspect & the ulnar side of the third, and partially supplies the other side of the third, and both sides of the second and forefinger.

Lumbo-Sacral Plexus.

Formed by the third, fourth, fifth, sixth, and seventh lumbar nerves, and by the first and second Sacral. The anterior of these nerves intercommunicate in the substance of the psoas muscle, the posterior lie in the pelvis below the pyriformis

The third lumbar nerve gives off the genito-crural or spermatic nerve, as well as twigs to the psoas and communicates with the fourth by a branch which lies in the psoas. The fourth first gives a thick root backwards to the anterior crural nerve (which gives

branches to the psoas and iliacus)
and then passes outwards as the
external cutaneous, receiving the
branch from the third. The
fifth soon after leaving the in-
tervertebral foramen receives the
branch from the fourth, then
being joined by a branch from
the sixth becomes the anterior
crural nerve. The fifth also gives
off another large branch which
passes backwards in the psoas
to join a branch from the sixth
and form the obturator nerve.
The sixth after giving off this
obturator branch joins the
seventh, the cord thus formed

passes into the pelvis and being
joined by branches from the
first and second sacral nerves
becomes the great sciatic. The
first sacral in addition to the
branch to the sciatic, gives one
to the rectum and then passes
back to join the second nerve. This
nerve after giving a twig to the
levator ani joins the branch of
the first to form the pudic nerve.

Branches of the Plexus

Spermatic Nerve, or genito femoral arises from the third lumbar nerve close to its origin. It at first lies in the inner side of the psoa muscles, between them

and the vertebrae. It then passes backwards below the psoas parvus breach the external iliac artery. It sends a branch backwards along that vessel, and then leaves the abdominal cavity by passing through the abdominal ring, lying on the spermatic cord in the cremaster muscle. In the bitch after leaving the external ring it is distributed to the adjacent part of the mamma.

External cutaneous derived from the third and fourth passes outwards between the psoas magnus and parvus, or sometimes piercing the parvus, then

crossing below the quadratus lumborum it pierces the transversalis and the internal oblique muscles, becoming cutaneous in lumbar region from the latter above the superior border of the external oblique, and a little in front of and below the anterior iliac spine. It then divides into numerous branches which supply the skin in the anterior, and front part of the external and internal aspects of the thigh.

Anterior Crural nerve arises from the fourth, fifth and sixth lumbar nerves as above described. This large nerve runs backwards

in the substance of the psoas, giving short twigs both and the iliacus, and one long slender branch from near its origin which runs in the psoas to the little muscle on the hip joint, and to the joint itself (c.) The anterior crural enters the thigh still in the substance of the psoas, but leaves it at its outer side close below poupart's ligament, some little distance to the outer side of the femoral vessels, and under cover of the sartorius. It immediately divides into branches, some running outwards and forwards to the sartorius, anterior sartorius, rec-

tus and vastus externus; others
running downwards to the vas-
tus internus and crureus. One
of these branches can be traced,
lying deeply between the vastus
internus and crureus as far
as the knee joint. It also gives
off from its inner side the
long saphenous nerve, which
runs obliquely across the thigh
along, or under cover of, the inner
border of the sartorius, crossing
the femoral vessels at the apex
of scarpa's triangle to reach the
inner side of the knee where it
lies on the gracilis muscle. Be-
fore crossing the femoral vessels

it gives off a branch which runs
towards the patella under cover
of the sartorius, superficial to
and at first in the line of the
femoral vessels. As the nerve
lies on the inner side of the
knee it gives off numerous branch-
es to the inner side of the thigh
knee, and upper part of leg.
It then passes down the leg,
in company with the internal
saphena vein and artery to the
inner side of the foot, ending
as the dorsal collateral branch
for the inner side of the first
toe. In its course it gives off
one large branch to the inner

side of the calf and heel; and numerous others to the skin on the inner side of the leg and foot.

Obturator Nerve arises from the fifth and sixth lumbar nerves. It runs backwards along the side of the pelvis, above the tendon of the psoas, and enters the thigh by passing through the lower part of the obturator foramen, giving as it does so a large number of twigs to the obturator externus. On leaving the foramen it is split into two by the adductor brevis muscle. The branch which passes superficial to that

× and sending collateral branches
down towards the keep.

muscle is the largest. It passes between the adductor longus and brevis supplying both, and then passing across the adductor magnus giving a branch to it, enters the gracilis in one or two divisions. It ends by piercing that muscle and supplying the skin on the upper and inner aspect of the thigh. The deep division passes above the adductor brevis, &, after giving a branch to the hip joint ends in the substance of the adductor magnus.

Gluteal Nerve arises from the junction of the seventh lumbar and first sacral. It passes

out of the sciatic franeu in
front of the pyriformis, sometimes
sending a branch through the
substance of that muscle to the
meso-gluteus. It then passes
downwards and forwards be-
tween the meso- and ecto-gluteus
muscles supplying them, and
ending by entering the inner
surface of the tensor fasciæ
femoris

Nerve to Pyriformis arises
also from the junction of the
seventh lumbar and first
sacral. It enters the pyriformis
in the pelvis.

Sciatic nerve is the

largest branch of the plexus.
It is formed by the sixth and
seventh lumbar nerves and
the first two sacral. It leaves
the pelvis by the sciatic foramen
behind the pyriformis. It is
covered in the buttock by the
ecto-gluteus, and lies in succes-
sion on the endo-gluteus, the
gemellus superior, the obturator
internus, the gemellus inferior,
and the quadratus femoris.
It then passes down the back of
the thigh behind the adductor
magnus, and in front of the
biceps and semitendinosus.
About the middle of the thigh it

divides into its terminal branches.
the external and internal pop-
liteal nerves. The small sciatic,
which may be described as
one of its branches arises from
it inside the pelvis. It leaves
that cavity either with the parent
trunk, or further back piercing
the sciatic ligament under cover
of the exto-gluteus muscle. It
descends superficially on the
back of the thigh, giving branches
to the skin there, but also sending
one or two branches round to the
perineum below the tuberosity
of the ischium and behind the
hamstring muscles. On emerging

from below the pyriformis the quat
sciatic gives a branch to the
recto-gluteus. It gives off two little
branches as it lies on the sacro-
gluteus, The first reaches the pel-
vis and supplies the obturator
internus, The other passes under
the gemellus superior supplying
it, and then crosses below the
obturator band in the quadratus
femoris and inferior gemellus.
About the level of the quat to-
chanter it gives off a large
branch which subdivides into
branches for the semitendinosus
semimembranosus and biceps.
These for the latter pierce it

substance, supplying the skin on the outer side of the thigh as far as the knee.

Internal popliteal nerve passes between the two heads of the gastrocnemius with the popliteal artery, and becomes the posterior tibial nerve. A little above the gastrocnemius it gives off the external saphenous nerve. This is a very long slender branch, which descends on the cutaneous surface of that muscle, giving branches to the skin, to the outer side of the tendo achillis where it communicates with the posterior

tibial nerve, and ends in numer-
ous filaments to the skin on
the outer side of the ankle and
heel.

Posterior tibial nerve is the
direct continuation of the inter-
nal popliteal, beginning where
it passes between the heads of
the gastrocnemius. It descends
between that muscle with the Soleus,
and the deeper muscles, and
then by the side of the tendo ach-
illis as far as the internal mal-
leolus, where it divides into the
external and internal plantar
nerves. In the upper part of its
course where it lies deeply a-

nung the muscles, it gives branches
to the gastrocnemius, soleus, tibialis
posticus, flexor longus digitorum,
and the representative of the
flexor longus hallucis. Lower
down where it lies superficially
beside the tendo achillis it re-
ceives the branch of communica-
tion from the external saphenous
nerve, and also gives off cutan-
eous branches to the inner side
of the leg and ankle, and the
under surface of the heel. It
is accompanied by the poster-
ior tibial artery.

Internal plantar nerve
smaller by half than the external

descends with its artery, along
the inner side of the sole behind
the bases of the metatarsal bones,
where it divides into two, One the
smaller and internal continues
on in the same direction, giving
branches round the inner edge
of the foot, and ends as the in-
ternal plantar collateral of the
first toe. The other passes down-
wards and outwards across the
foot superficial to the tendons as
far as its outer edge where it
ends by giving numerous pric
kings to the skin. Before divi-
ding, the internal plantar gives
off a nerve which runs out-

wards bends the deep surface of the flexor brevis digitorum. The outer terminal branch of the nerve in its course across the foot gives off numerous branches to the pad, and three longer branches which run to the sides of the toes, and there are joined by branches from the deep arch of the external plantar nerve, and then dividing supply the contiguous sides of the first and second, second and third, & third and fourth toes. These three branches give twigs to the pad and the lumbrical muscles.

External plantar nerve, larger than the preceding is directed obliquely downwards across the foot in company with the external plantar artery, between the flexor brevis and the tendons of the flexor longus digitorum. A little below the heel as it lies by the inner side of the flexor brevis it bends a little directly outwards between that muscle and the os calcis to the abductor minimi digiti. Not far below this it gives off another little branch which supplies the accessorius muscle and ends in twigs to the skin on the outer side of

the tarsus. about the same spot it gives off a much larger branch which runs obliquely across the outer side of the fourth toe the outer plantar collateral of which it forms. The nerve itself on reaching the outer side of the long flexor tendons gives some twigs to the outer interosseous muscle, and then turns inwards across the foot in front of — deeper than — those tendons, running almost transversely, about the level of the base of the metatarsus bones in the interval interosseous muscle. From this deep arch are given off numerous short branches

to the interossei, and three long branches which run downwards to the fork of the toes, and then pass backwards between the flexor tendons to join the collateral branches of the internal plantar at this bifurcation. The innermost is very slender. The two outer are larger than the corresponding branches of the internal plantar which they join.

The great similarity in the nervous supply of the hand and foot will be seen by comparing Plate XVIII fig 2 with Plate XXVIII fig 1.

External popliteal nerve

in the other division of the great

sciatic. It lies close to the biceps internally, and passing down external to the outer head of the gastrocnemius, winds round the outer side of the fibula under cover of the peroneus longus. Here it divides into two the musculo-cutaneous, and the anterior tibial.

Musculo-Cutaneous gives branches to the peronei muscles, and then descends between the peroneus longus, and the extensor longus digitorum, becoming cutaneous between these two muscles about the middle of the leg. It runs down to the front of the

ankle, in company with a large vein, giving off cutaneous branches, and then enters the foot passing superficial to the annular liga-
ment. On the ankle it gives off a slender branch which passes to the outer side of the fourth toe. The nerve after descending a little on the dorsum of the foot divides into three, which running to the forks of the toes bifurcate, supplying the opposing sides of the four toes. Its most internal branch is joined by the anterior tibial.

Anterior tibial after giving off branches to the tibialis an-

hēus, and the extensor longus
digitorum, passes down the leg
b the inner side of the extensor
longus digitorum, lying on the tibia
and closely applied to the outer
side of the anterior tibial artery.
It passes under the Annular
ligament between the tendons
of the extensor longus digitorum,
and the tibialis anticus, and
then divides into two. One passes
outwards under cover of the ex-
tensor tendons to the extensor brevis,
giving off a twig to the tarsal
joints. The other continues on
to join the inner division of the
musculo-cutaneous.

Pudic nerve arises from the
first and second sacral nerves.
Passing back across the
sciatic foramen, it lies internal
to the obturator internus muscle
and tuber ischii, giving off
branches in its course to the
rectum and upper part of
the perineum. It then turns down
to the crus penis, giving numer-
ous twigs to the lower end
of the gut, the perineal muscles
and the scrotum, and then
running forwards round the
outer side of the crus becomes
the dorsal nerve of the penis.

Method of performing the chief operations in Experimental Physiology

Operations on the structures in the submaxillary regions, from Cyon's "Methodik der Physiologischen Experimente"

"The methods of operating in the dog, for making experiments on the salivary glands, differ according to the purpose of each experiment. We shall first describe the method of exposing all the parts which especially come into consideration in such experiments and then some mod-

ifications of this method.

The dog is fastened on its back and the head held immovable; the palate lying against the under jaw must often be left as they may stand in the way of in this operation. On the proper side of the region of the lower jaw and neck the hair is carefully removed, and smoothed with a wet sponge. The skin cut begins at the second third of the lower jaw & about a centimetre internal to it, and reflected to the level of the transverse process of the atlas. The platysma is cut through at the same time with the skin;

bleeding vessels must be carefully tied as the wound must be kept ~~as~~ thoroughly clean during the whole operation. The digastric muscle lying bare is bound in two places with a firm knot and divided between the ligatures. It is very advisable before applying the ligature, to carefully isolate the muscle from the underlying parts:- the Chorda tympani, mylohyoid nerve and finder and deeper the threads of the sympathetic which accompany the arteries, and the duct of the gland; and then place the ligature as near as possible to the hinder attachment of the muscle

to the temporal bone. After its division almost the whole muscle is then drawn forwards. Claud Bernard passes a cut through the muscle without ligaturing previously, & draws the fore part upwards with a hook & then carefully isolate it from the underlying parts, and then separate it by ligature. Bleeding is stopped, vessels lying in the way are ligatured. This method of Bernard has the advantage, that, in the isolation of the divided muscle one is much sure of sparing the underlying important parts. On the other hand it necessitates two divisions of

the same muscle which makes bleeding unavoidable. When this muscle is divided in one or the other way, we proceed to the Transverse section of the mylo-hyoid muscle. This broad thin muscle running from under upwards and inwards is divided perpendicularly to the course of its fibres in large after layers, in doing which the knife is held very lightly, without pressure, lest to injure the lingual nerve or the duct, which are covered by it. The direction of the cut is best parallel with the duct, and a little inwards from it. Reflection of this muscle is not necessary, if it is not divided

two far from the duct, as the re-
tractile fibres of the muscle separate
from each other. We see now the
lingual branch of the trigeminal
nerve come upwards and in-
wards from the deeper parts, cross-
ing the duct and then ~~branching~~
forwards and running parallel
with the hypoglossal nerve which comes
up from below. The duct is sub-
sided forwards from this place of
crossing and a cannula inserted
into it, in the same way as into a
blood vessel. To find the chorda
tympani we needs only to follow
the lingual towards its source.
It lies quite near to the above.

mentioned plane of crossing, some-
what deeper and external to the
duct. To reach the bloodvessels
of the gland, it must be cut short
raised with a blunt hook or a
bent spatula, and drawn inwards.
We see then the facial artery coming
from below inwards which
sends a branch to the gland. The
facial artery springs from the
carotid near the place where it
is crossed by the hypoglossal nerve.
One can be guided in case of
necessary by this nerve. It is
somewhat more difficult to find
the branch from the temporal ar-
tery to the gland. One must to

reach it draw the submaxillary gland in the opposite direction inwards and downwards, as this branch comes from above and behind the convex side of this gland. This branch is not generally used. The Ext. jugular vein is found not far from the gland, and we see also the branches into which it divides. The two small veins from the gland join this. We find the branch of nerve coming from the sympathetic if we divide the hypoglossal where it crosses the external carotid artery, & search for the superior cervical ganglion near its central end.

In operating on the chorda tympani alone, Cyon recommends a much shorter cut, not extending as far back as the ramus of the jaw. It is also unnecessary besides the digastric. To observe the effect of stimulation of the sympathetic on the gland a second cut must be made in the neck to expose the vago-sympathetic

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Method of reaching the auriculo-temporal nerve.

I first lay bare the digastric muscle in its whole length, isolate it from the other muscles, tie it in two places, cut it between the two ligatures

chan it, and thrust the knife's point back. I proceed further to the articulation of the lower jaw; this is best done without help of the knife: some little bloodvessels must be tied, in order to work more easily in the depth. The internal pterygoid (especially its hinder border) is cleaned, and after it has been raised with a blunt hook, its fibres are divided carefully one after the other, till the inferior dental nerve with the lingual is exposed. The auriculo-temporal runs nearly at right angles to these nerves, usually covered by a vein. The connective tissue is carefully removed and the nerve raised with a hook.

Schneidebung.

Operations on the inferior cervical or first thoracic ganglion

after making a skin cut be-

ginning on the pectoralis major

& reaching past the middle of the

neck, the upper part of the pec-

toralis major on the manubrium

sterni is bound with ligatures &

cut across between them so that

the anterior surface and upper

border of the first rib are free. After

the great veins down to the vena cava

superior are separated from the

connective tissue by dragging, the

four largest, Innom. Subclavian,

Ext. & Int Jug., are ligatured and

divided between the ligatures. Thus

we come upon the bones, and of
the common carotids, and after re-
moving a little connecting tissue on
the other arteries (Innom, subclav.
Int Mammary, Vertebral, Sup. thyr.
ext lab, deep cervical, and trans-
verse cervical) they are tied together
and ~~together~~ divided like the veins.
The ligature is placed round the
innominate trunk between the
origin of the left carotid and its
division. The Carotids and the
sources of most of the arteries are
so closely surrounded by the fol-
lowing nerves — in front the vagus,
the descending part of the recurrent,
the rami cardiaci, and the an-

trivs intergaughionic branch; behind,
the ascending part of the recurrent
n portions
of the first intergaughionic branch —
that care should be taken not
to include me of the nerves in the
ligature which might easily happen
with the first intergaughonic from
its proximity to the vertebral artery
and with the superior cardiac from
its position to the innominate artery.

In order to reach more easily the
first thoracic gaughion, it is advisable
to divide the sympathetic cord behind the
gaughion, by which means it may
be easily brought up higher up as
it has only loose connections be-
low.

To make a Pancreatic fistula.

Cl. Bernard, Leçons de Physiologie. Vol II
Lecture 8.

The animal being laid on its left side and firmly fastened, I make an incision between 7 and 8 centimètres long in the right hypochondrium below the border of the ribs, which allows me to draw out the duodenum, and a part of the pancreas. The tissue of the organ is, as you see, of a rosy colour. I separate as rapidly as possible the larger of the two pancreatic ducts, which in the dog opens alone and obliquely into the duodenum about two centimètres below the bile duct. This duct is

of a pearly white colour and is of the size of a crow quill. You see it here filled with pancreatic juice. I open the duct with point of a fine pair of scissors, and immediately there flows out big drops of a colourless limpid fluid pancreatic juice, which is of viscid consistency; and it has this peculiarity that this viscidity is such that the pancreatic juice does not mix easily with the blood which surrounds it, and that it remains distinct like an oily liquid or a strong solution of gum.

Now, we introduce into the pancreatic duct, a little silver tube

5 millimètres in diameter, and 10 or 12 centimètres long, which is fixed by a thread previously placed behind the duct. We then return the duodenum and pancreas to the abdomen, close the wound by a suture, taking care first to unite the abdominal muscles before bringing the edges of the skin together, and leave outside the end of the silver tube. But previously, in order to give more fixity to the arrangement, we have fixed the tube by a ligature passed in the wall of the intestine by the aid of a needle. ×××× . We now fix a caoutchouc bladder to the end of the tube to collect all the juice that

will flow from it for some hours."

Biliary fistules.

Bernard recommends an incision below the false ribs to the right of the xyphoid cartilage. The bile duct is found by feeling along the under surface of the liver as far as the fissure of Winslow.

Parotid Fistula

Bernard Vol II lecture 3

You follow with your finger the inferior border of the zygomatic arch as far as its anterior in-
ferior root, which is inserted into the maxillary bone forming an arch with its convexity backwards. When you arrive at the extremity

of this arch a little depression
is felt, at the level of the second
upper molar between the prominence
of the fang of this tooth and the in-
ferior of the zygomatic arch. at
this point and exactly at the
level of this depression you make
an incision directed from the inner
angle of the eye towards the angle
of the mouth. Divide the cellular
subcutaneous tissue and you will
find in a single bundle the facial
artery and vein, a nerve, and the
salivary duct. This last is of a
pearly white, and it is the recog-
nized by its being the most deeply
placed, and crossing the course of

the racemo-nervous bundle. When you have isolated the duct make an incision through its walls, which are thick compared with those of the ducts of the other salivary glands, and introduce into its interior a little silver tube fur-nished with a stilette. × × × × × × × ×

You won't obtain the juice pure if you don't take the precaution to introduce the metallic tube deep enough, because near the opening of glenoid duct these cysts sometimes little glands which open into it, and mix their viscid secretion with the parotid fluid.

In the gum of the dog & the inner side of the jaw, three bars of hyaline cartilage exist, arranged as shown in fig XXXI. They lie between the mucous membrane and the bone. They can scarcely be seen by the naked eye. I am therefore not positive as to their terminations, but they were traced from near the symphysis to near the last molar tooth.

— .. —

The rod of cartilage which lies in the under surface of the dog's tongue anteriorly, and which is known by the name of the worm, consists of very

cellular hyaline cartilage. It is a very vascular structure, the blood vessels running in from the periphery towards the centre. For a short distance in the middle of its length the capillaries are few & have wider meshes than towards the extremity of the "worm". The capillaries are derived from arteries the raphe, which run along side of the rod.

Explanation of Plates

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Plate I. Side view of skeleton of Dog. probably Canelie Drimont.

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Plate II. View of the under surface of the skull.

1 Occipital crest; 2 Foramen magnum. 3 Condyles; 4 Occipital; 5 Condyloid foramen; 6 paroccipital foramen; 7 stylo-mastoid foramen; 8 Tympanic bulla; 9 Ext. auditory meatus; 10 Foramen lacerum medium; 10' Jugular foramen; 11 foramen ovale; 12 foramen rotundum; 13 Sphenoidal fissure; 14 Optic foramen; 15 Post sphenoid process; 16 Zygomatic process Squamosal; 17 Malar bone; 18 Pterygoid;

19 Presphenoid; 20 Palate; 21 Vomer; 22 posterior palatine foramen; 23 Basi occipital; 24 Ext. Palatine foramen; 24 Palate bone; 25 superior maxilla; 27 Premaxilla; 28 anterior palatine foramen; 29 Mastoid process.

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Plate III. Fig 1 — view of the interior of the skull from behind. 1 Frontal sinus; 2 Olfactory cavity; 3 optic foramen; 4 Sphenoidal fissure; 5 Foramen rotundum; 6 foramen ovale; 7 planum sella turcica; 8 Canal for fifth nerve; 9 Petrous bone; 10 internal auditory meatus; 11 Cavity for flocculus; 12 Lingular process; 13 Condyloid foramen; 14 occipital condyle; 15 paraoccipital process; 16 mastoid process; 17 Zygoma; 18 Posterior palatine canal; 19 Infraorbital ditto; 20 Lachrymal ditto; 21 Foramen magnum.

Fig 2 — view of interior of skull from the side.

1 Nasal bone ; 2 Frontal bone ; 3 Mesethmoid ; 4 Cribriform plate of the ethmoid ; 6 Parietal bone ; 7 Squamosal bone ; 8 canal for fifth ; 9 Int. auditory meatus ; 10 cavity for flocculus ; 11 Occipital ; 12 Pterygoid ; 13 Vomer ; 14 Palate ; 15 Turbinated bone ; 16 Basisphenoid ; 17 Basioccipital ; 18 Tympanic bulla.

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Plate IV. Fig 1 view of brain from above. 1. 2. 3. 4 convolutions ; 1' sygmoid gyrus ; 5 Crucial fissure ; 6 olfactory bulb ; 7 Superior vermiform process ; 8 Lateral lobe of cerebellum ; 9 Medulla :

Fig 2 View of base of brain. 1 olfactory bulb ; 2, 3, 4, 5, 6, 7, 8, 8', 8'', 9 cranial nerves ; 10 orbital convolution ; 11 Gyrus hippocampi ; 12 Corpora albicantia ; 13 Infundibulum cut ; 14 Cerebellum.

Plate V shows the relation of the convolutions to the lines of the cranial vault.

Fig 3. 1. 2. 3. 4. 5. 6. 7. 8. same as in figure 1; 9 Flocculus; 10 Pons; 11 medulla; 12 Gyrus hyppocampi; 13 Sylvian fissure; 14 Orbital convolutions;

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Plate V. Fig 1. 1 Frontal bone, 2 Parietal bone; 3 Occipital bone; 4 Squamosal bone; Fig 2. same numbers as Fig 1. 5 great wing of sphenoid.

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Plate VI diagram of the distribution of the fifth cranial nerve.

III Third cranial nerve; V. 5th Cranial nerve; O its ophthalmic division; S. its sup. maxillary division; I its inf. maxillary division; VII Facial nerve; IX 9th nerve; 1 Frontal nerve; 2 infra-trochlear nerve; 3 Nasal nerve; 4 lenticular ganglion; 5 Temporal br; 6 malar branch;

7 auricula temporal nerve; 7' temporal muscular branches; 8 Supra orbital n; 9 Sup. dental n.; 10 Naso-palatine n.; 11 great palatine n; 12 its nasal br.; 13 small palatine n; 14 Posterior dental n; 15 Lingual n; 16 Gt. petrosal n; 17 small petrosal n; 17' N. to inf. pterygoid with Otic ganglion; 18.18. Corda tympani; 19 Lingual n; 20 Inf. dental n; 21 Mylo-hyoid n; 21' & 21" its posterior and anterior cutaneous branches; 22 Buccal br. of lingual.

Plate VII. 1 Facial n; 2 its posterior auricular br; 3, 4, 5, 6, its superior, middle, and inferior facial, and its cervical divisions; 7 auriculo-temporal n; 8 Temporal br. of 5th n; 9 Supra-orbital of 5th n; 10 infra-trochlear of 5th n; 11 Malar br. of 5th n; 12 Supra-orbital of 5th n; 13 Nasal of 5th n; 14 Lingual of 5th n; 15 Mental of 5th n; 16 Cutaneous portion of inf. div. of 2nd cervical n;

17 Sup. division of same.

Plate VIII Dissection of side of neck, lateral view. a Sterno mastoid; b cephalo-humeral; c sterno-hyoid; d rectus capitis ant. major; e pectoralis major; f trachea; g common carotid; h subclavian a.; i transverse cervical a; k. Vertebral a.; l Vago-sympathetic; 2 Inf. laryngeal; 3 Inf. cerv. gang. of Symp; 4 ant. portion of annulus vieussenii; 5 Continuation of vagus; 6 nervi accelerantes; 7 post. portion of annulus vieussenii; 8 Phrenic n:

Plate IX Diagrammatic view of the cervical vagus and sympathetic with their connections. 1 sup. cerv. gang. of symp; 2 its pharyngeal br; 3 its carotid br; 4 its br. to 6th Cranial n. & lenticular ganglion; 5th br. to 9th Cranial n; 6. 7. 8. 9. 10, communications with upper 5

spinal nerves. 11 Pharyngeal br. of vagus. 12 ganglion on trunk of vagus; 13 Sup. laryngeal br. vagus; 14 Communication with sp. accessory n; 15 Inf. cav. ganj. of sympt; 16, 16' annulus vieussenii; 17 first thoracic ganglion; 18 Thoracic cord of sympathetic; 19. 20, 21, 22, 23, communications with last 3 cervical and first 2 dorsal nerves; 24 recurrent laryngeal n; 25 Its communication with inf. cerv. ganj; a, a, a, a, a, nervi accelerantes in their most usual positions; S Sympathetic; V. Vagus; S.a. Spinal accessory

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Plate X Dissection of the submaxillary region. a submaxillary gland; b sublingual gland; c.c. digastric m. cut; d sterno-mastoid; e sterno-thyroid; f thyro-hyoid; g sterno-hyoid; h stylo-glos. m; i hyo-glossus; K genio-hyo. glossus; l genio-hyoid; m mylo-hyoid; n common carotid a;

o facial a; p lingual a; 1 lingual n; 2 corda tympani; 3 buccal br. of lingual; 4 communicating with hypoglossal; 5 hypoglossal; 6 its descending br. the numeral is placed at the communication with the 1st spinal n; 7 Vago-sympathetic; 7' sup. laryngeal of vagus; 8 its br. to crico-thyroid m.; 9 1st spinal n; 10 Carotid br. of sympathetic going to submaxillary gland.

Plate XI superficial dissection of the front of the neck. a mylo-hyoid m; b. digastric; c sterno-hyoid; d sterno-thyroid; e sterno-mastoid; f submaxillary gland; g cephalo-humeral; h pectoralis major; I lower jaw; m ext. jugular vein; n lingual vein; o facial vein; p temporal vein; r cephalic vein; 1 mylo-hyoid n. 2 sub-maxillary br. of facial n; 3 2nd cervical n; 4 its cervical brs; 5 9th Cranial n; 6 common

ication between 2nd & 3rd nerves; & 3rd Cervical n;
& communication between 3rd & 4th nerves; & 4th Cervi-
cal n; 10. 11 hs of 5th Cervical nerve; 12 termination
of one of the superior divisions of the cervical nerve;

Plate XII. Front view of deep dissection
of the side of the neck. a cephalo-humeral m.;
a' its accessory part;
b sterno-mastoid; c sterno hyoid; d sterno-thyroid;
e rectus major; f. acromio-trachelian; g. i. pectin-
alis major; h sterno-costalis; k supraspinatus;
l ext. jugular vein; m subclavian v; n int. jug. v.;
o trans. colli. a; 1 spinal accessory n; 2 2nd cervical
nerve; 3 3rd ditto. 4. 5. 6. 7. 8. the other C. nerves. 9 1st
dorsal; 10 N. cephalo-humeral; 11 Suprascapular n;
12 subscapular n; 13 phrenic; 14 n. to pect. major:

Plate XIII. Diagram of cervical & brach-
ial plexuses. S.A. Spinal accessory. IX hypoglossal.
1 Descendens noni; 2 communicans noni;

16' communication between musculo-

cutaneous and median;

4. 6. 6.

3, ^ communications between cere. nerves & spinal accessy;

7, 8. loops between 2nd & 3rd. & 3rd. & 4th. nerves; 9 phrenic;

10 n to cepth. humeral m; 11 supra-scapular; 12, 12, 12, 12

13 its root from the 8th;

12 nerves to pectorals; 13 musculo-cutaneous; 14 n to

subscapularis; 14' n to coraco brachialis; 15' to biceps;

15" circumflex; 16 musculo-spiral; 17 Posterior thor-

acic; 18 n. to Panniculus; 19 n. to Latissimus dorsi;

20 Medio ulnar; 21 median; 22 ulnar; 23 int. cutaneous;

Plate XIV. Dissection of the axilla. all the structures crossing it are stretched & the pulling outwards of the scapula. a cephalo-humeral; b acromio-brachialis; c serratus mag; d scalenus posticus; e sterno-costalis; f scalenus anticus; g sterno-hyoid; h sterno-mastoid; i rectus thoracicus; k ext: oblique; l intercostals; m lat-issimus dorsi; n panniculus; o, o' pectoralis majo: p subscapularis; r supraspinatus; s biceps;

v' trans. colliarton

z teres majr; u triceps; v. apillary a in W axillary v;

xc. * int. jugular v; y ext. jugular v; z common car-

6th C. nerve

otid a; 1 ~~n to cepts humeral~~ n; 2 n to br of phrenic from 4;

5th. 3 phrenic; 4 7th C. nerve; 5 n. to sch. humeral;

6 suprascapular n; 7.7.7" nerves to spectrales; 8.8.

15 musculo-cutaneous; 9 n to subscapularis; 10 Ci-

cumflex; 11 communicates with musculo spiral;

12 musculo-spiral; 13 medio-ulnar; 14 br. of musculo

cutaneous. to biceps; 16 n. to pannicular; ~~X~~ 16' its

communication with 3rd intercostal n; 17 N. to Latissimus;

18 its br from musculo spiral; 19 Post. thoracic; 20. 2nd

intercostal, lat. br.; 21 its communication with n.

to Lat. dorsi; 22, 23, 24, 25th, 26. lat. cut. brs. of inter-

costal nerves; 27 brs. of 3rd intercostal to upper arm;

28 continuation of same nerve on the ant part of

the pannicular.

Plate XV shows the distribution of the

nerves in the pannicles. a, a, a, a, communications between nerves & Pannicles, and the upper brs. of the lateral cutaneous brs of intercostals.

b. b. b, b, b. ditto with lower brs. of ditto; c. n. to Pannicles; d, d, its brs. to pectorals; f br. of 3rd intercostal to pannicles; g its brs to upper arm.

Plate XVI. Deep dissection of outer aspect of upper arm. & superficial dissection of forearm & hand. a teres major; b infraspinatus; c. f deltoid; d acromio-trachelien; e scapular head of triceps; g. h. o. other heads of triceps; i brachialis anticus; K cephalo-humeral; l pect. major; m biceps; p anconeus; r, s. radial extensors of carpus; t teres minor; v. v upper and lower pads; 1 Circumflex; 2 musculo-spiral; 3, 4 etc brs. to biceps & anconeus; 6 radial n; 5'. 5' cutaneous brs.; 7, 8, terminations of int. cutaneous; 9 cu-

lateral br. of ulnar; 10 br. of ditto to ulnar side of little finger; 11, 12, 13, dorsal collaterals of digits from radial; 14 terminations of n. brachialo-humeral.

Plate XVII deep dissection of inner aspect of upper arm and superficial dissection of forearm and hand. a continued cephalo-humeral, & pectoral; b. biceps; c coraco-brachialis; d subscapularis; e teres major; f Latis. anim dorsi; i its olecranon insertion; g br. triceps; l brachial artery; m, m, upper and lower pads; 1.1. musculo-cutaneous n; 2 circumflex; 3 musculo spiral; 4 medio-ulnar; 5 br. to coraco-brachialis; 6 br. to biceps; 8 median; 9 ulnar; 10 int. cutaneous; 11 br. of ditto to inner aspect of forearm; 12 cutaneous br. of musculo-cutaneous; 13 cutaneous br. of median; 14 ditto of ulnar; 15 br. of int. cutaneous to back of forearm; 16 termination of 3rd intercostal; 17 com-

munication between museculo-cutaneous and median; 18. 18. dorsal collateral of radial.

Plate XVIII. Dissection of forearm and hand, showing the distribution of the median and ulnar nerves. Fig I Median N. in forearm. a Brachialis anticus; b. biceps; c triceps; d. extensor carpi rad: longior; e dito brevior; f supinator longus; g pronator teres; h "flexor longus pollicis"; i pronator quadratus; k. m. p. heads of flexor profundus digitorum; l flexor carpi radialis; m flexor sublimis digitorum; o flexor carpi ulnaris; r tendon of flex. carp. radialis; s. annular ligament; t. inter. condyle of humerus; u olecranon; 1 Median n. 2 its br. to flex. carp rad. & flexors profundus & sublimis digitorum; 3 Median; 4 br to pronator quad. & flexor long pollicis; 5 cutaneous br; 6 post: interosseous; 7 its br.

with the radial extension. Fig. 2. Dissection of Palm — (1) median (2) ulnar (3). (4). palmar collaterals of thumb (5). communicating ulnar with (6)th radial collateral of index (7) (8). (9). placed at the bifurcation of the collaterals of the opposing sides of the four fingers. (10) ulnar collateral of 4th finger (11). deep branch of ulnar (12). (13). junctions with collaterals of median (14). termination of ulnar Fig. 3 — (a) biceps (b) triceps (c) flexor sublimis (d) flexor carpi ulnaris (e) flexor profundus digitorum (f) ulnar head of flexor profundus (h) and (i) ulnar head of flexor carpi ulnaris (k) tendon of flexor sublimis (l) annular ligament (m) tendon of flexor carpi radialis (n) extensor carpi ulnaris (o) internal condyle (p) olecranon (r) radius (s) pisiform bone (1) ulnar nerve (2) branch to flexor carpi ulnaris (ulnar head). (3) branch to humeral head of same muscle (4) branch dividing into (5) & (6) cutaneous branches (6) being continued into (7) the ulnar ~~dorsal~~ collateral of 4th finger (8) ulnar nerve (9) twig to flexor profundus digitorum (10) branch from median to ulnar head of flexor profundus (11) cutaneous twig to pad

Plate XIX - shows the nerves piercing the panniculus.

Plate XIX - (a) cervico-auricular muscle (b) cervical panniculus (c) acromio-trachelien (d) & (e) trapezius (f) deltoid (g) triceps (h) panniculus of trunk (i) External oblique (k) crural aponeurosis (l) infraspinatus (1) superior divisions of cervical nerves (1') inferior of ditto (2) upper branches of the superior divisions of dorsal, lumbar & sacral nerves (3) lower branches of ditto (4) upper branches of the lateral cutaneous nerves of lumbar & dorsal nerves (5) inferior terminations

Plate XX - Superficial dissection of the muscles and nerves of the trunk. (a) and (b) trapezius (c) deltoid (d) triceps (e) latissimus dorsi (f) external oblique (g) internal oblique (h) dorsal aponeurosis (i) crural ditto (k) pectoralis major (1) superior divisions of dorsal nerves (2) ditto of lumbar (3) lateral cutaneous branches of dorsal nerves (3') their upper branches (4) lateral cutaneous of lumbar nerves (4') their upper branches (4'') External cutaneous ———————

Plate XXI - Superficial dissection of inferior aspect of the trunk (a) and (a') pectoralis major (b) latissimus dorsi

(c) external oblique (c') external abdominal ring (d) rectus (e) sartorius (f) adductor longus — (i) inferior extremities of the anterior intercostal nerves (2) lateral cutaneous branches of dorsal nerves (3) ditto of lumbar (4) external cutaneous (5) external Spermatic. (6) inferior termination of lumbar nerve

Plate XXII — In this plate the cervical panniculus has been removed and from the flanks the panniculus trapezius and Latissimus dorsi (a) Submaxillary gland (b) sterno-mastoid (c) cephalo-humeral (c') its tendinous intersection (d) acromio-trachelian (e) trapezius (f) & (f') deltoid (g) infraspinatus (h) rhomboideus major (i) Serratus magnus (K) teres major (l) scalenus posticus (m) pectoralis major (n) Serratus parvus superior (p) ditto posterior (o) intercostals (external) (r) External oblique (r') its tendon (s) triceps (t) internal oblique (u) anterior sartorius (v) tensor fasciae femoris (w) meso-gluteus (x) ecto-gluteus (y) biceps (z) vertebral aponeurosis — (1) superior

(6) cutaneous termination of nerve to cephalo-humeral (7) superior divisions of dorsal nerves (8) ditto of lumbar (9) lateral cutaneous branches of dorsal nerves (10) ditto of lumbar (11) Ext. -ernal cutaneous (12) inferior terminations of anterior inter- -costals (13) Small sciatic (14) cutaneous branches of great sciatic ———————

Plate XXIII — Lumbar plexus and its branches —
(a) diaphragm (b) transversalis (c) psoas parvus (d) quadratus lumborum (e) psoas magnus (f) rectus abdominis (g) anterior sartorius (h) Sartorius (i) meso-gluteus (k) Endo-gluteus (l) rectus femoris (m) vastus internus (n) tendon of psoas & iliacus (o) add- -uctor longus (p) adductor brevis (q) obturator Externus (r) add- -uctor magnus (s) gracilis — (1) last dorsal nerve (2) & (3) 1st & 2nd lumbar nerves (4) genito-crural (5) External cutaneous (6) anterior crural (7) obturator (8) gluteal (9) branch of Ant. crural to Sartorii muscles (10) branches of ditto to rectus and vastus & crureus (11) long saphenus (12) superficial

division of obturator (13) its deep division (14) cutaneous branch of obturator.)

Plate XXIX. Diagram of Lumbo-sacral plexus ——

(1) genito-crural (2) twig to 4th nerve (3) external cutaneous (4) branch of 4th to anterior crural (5) anterior crural (6) obturator (7) great sciatic (8) nerve to quadratus (9) nerve to obturator internus (10) gluteal nerve (11) nerve to pyriformis (12) small sciatic nerve (13) pudic nerve (14) perineal nerves (15) inferior caudal nerve (14) haemorrhoidal nerves (17) branch to bladder.

Plate XXV Dissection of inner aspect of thigh, leg and foot. — (a) external oblique (a') external abdominal ring (b) rectus abdominis (c) ant: tarsorius (d) tensor fascia fem: (e) rectus femoris. (f) sartorius (g) vastus internus (h) psoas and iliacus (k) adductor longus (l) adductor magnus (m) gracilis (n) semimembranosus (o) patella (p) tendo-achilles (1) femoral artery (2) femoral vein — (1) ant: crural nerve

(2) obturator nerve (3) its cutaneous branch (4) external cutaneous (5) branches to anterior sartorius (6) branch to sartorius (7) branch to rectus femoris (8) to vastus internus (9) long saphenus (10) patellar branch (11) cutaneous branch to lower part of thigh (12) ditto to calf (13) ditto to heel (14) termination as dorsal collateral of 1st digit.

Plate XXVI. Dissection of outer aspect of thigh — ecto. gluteus reflected —— (a) meso-gluteus (b) pyroformis (c) ecto-gluteus (d) endo-gluteus (E) obturator internus (f) g. gemellus inferior (g) quadratus femoris (h) biceps (i) adductor magnus (k) the vastus externus (l) tens. or fasciae femoris (m) rectus femoris (n) ant: sartorius (o) semitendinosus (p) superior gemellus (r) sacro-sciatic ligament —— (1) gt sciatic nerve (2) branch to meso-gluteus piercing pyroformis (3) small sciatic nerve (4) branch to ecto-gluteus (5) pudic nerve (6) nerve to ob-turator internus (7) nerve to quadratus & gemellus (8) branch to hamstrings (9) & (10) cutaneous termination

Plate XXVIII — Fig. 1 — Dissection of the sole of the foot

(1) posterior tibial nerve dividing into (2) & (3) external and external plantars (4) branch of latter to skin on outer side of foot (5) branch of former to flexor brevis digitorum (6) branch of Excl: plantar to accessorius & skin on outer side of foot.

(7) internal plantar collateral of 1st toe. (8) Continuation of the internal plantar (9) (10) (11) collaterals of opposing sides of toes (12) termination of internal plantar. (13) Excl: plantar collateral of 4th toe: (14) deep branch of Excl: plantar (15) (16) (17) its communications with collaterals of int: plantar — (a) flex. or brevis (b) accessorius (c) tendon of flexor longus —

Fig: 2 — Dissection of the dorsum of the foot. (c) tibialis anticus (a) peroneus (b) extensor longus digitorum (d) Excl: brev: digitorum (1) musculo cutaneous (2) its Excl: dorsal collateral branch of 4th toe (3) (4) (5) its dorsal collaterals to the opposing sides of the 4 toes (6) ant: tibial (7) its branch to Excl: brevis & tarsal joints. (8) its continuation to form the musculo-cutaneous (9) termination of long saphenous.

Plate XXVII - Dissection of outer aspect of thigh, leg and foot, ecto & meso gluteus, tens or fasciae femoris & biceps reflected —— (a) meso-gluteus (b) tens or fasciae femoris (c) Endo-gluteus (d) pyro-formis (e) ecto-gluteus (e') Sacro-Sciatic ligament (f) & (h) gemelli (g) obturator internus (i) quadratus femoris (k) adductor magnus (l) biceps (m) Semi tendinosus (n) vastus Externus (o) rectus (p) ant: tibialis (r) patella (s) psoas & iliacus (t) tibialis anticus (u) Extensor longus digitorum (v) & (w) peronei (x) soleus (y) gastrocnemius (y') tendo-achilles (z) Extensor brevis digitorum —— (1) gluteal nerve (2) its branch to tensor fasciae femoris (3) Sciatic nerve (4) Sciatic (4') (5) nerve to Obturator internus (5') nerve to quadratus and femellus (6) nerve to hamstrings (7) int: popliteal nerve (8) Ext: ditto. (9) External Saphenous (9') its communication with posterior tibial. (10) musculo-cutaneous (11) its dorsal collateral branches (12) posterior tibial (13) ant: tibial.

Plate XXIX —— Relations of the Bile-duct ——

× The Pancreas in the dog has two ducts. The larger, which is shown in the plate, is below the other and opens into the intestine singly. The other, smaller, opens higher up on the same papilla as the bile duct.

(a) liver (b) gall-bladder (c) gastro-hepatic omentum (d) stomach (e) duodenum (f) gt omentum (g) bladder (h) small intestines — (i) hepatic artery (2) hepatic vein (3) bile-duct

Plate XXX — Relations of Pancreas & its duct —

(a) liver (b) gall-bladder (c) gt omentum (d) coecum (e) colon (f) small intestine (g) bladder (h) duodenum (i) pancreas (k) its duct. ×

Plate XXXI — Vertical section through canine tooth of lower jaw in situ. (a) tooth: (b) alveolar process: (c) the bars of cartilage. (d) pulp cavity (e) gum.