Mid brain broad - has one or two enlargements the optic lobes. termination for optic fibres.
Cerebellum a narrow wedge shaped mass overhanging cavity of 4th. ventricle - passes into epithelium covering ventricle.
In Myxine aqueduct of Silvius is cut off. Third ventricle obliterated, hemispheres practically solid. Parasitic habits may have changed this.
Pineal body double Petromyzon. Present in Myxine too.
Epiphysis - enlarges to form a vesicle - hollow sphere of cells radially arranged - pigment - evidently no longer use. Parietal organ similar - not developed into be vesicle no pigment more degenerate.
Olfactory bulbs well developed

44 Optic chiasma a 41 characteristic of vertebrates not present in Petromyzon and Myxine but as in 42, some [illegible] not nearly all.

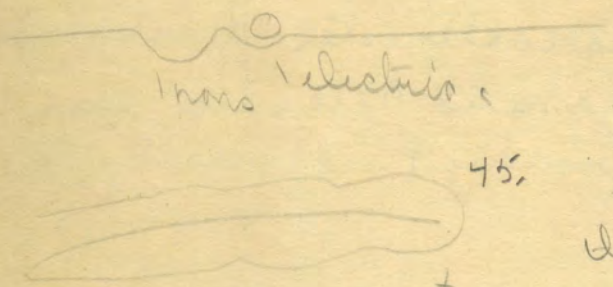
Fishes.
Spinal chord extends entire length of vertebral column, as far as vertebrae are developed - some fine [illegible] portion more elastic, rarely flattened laterally [illegible]. Tapers from anterior to posterior end. Two enlargements by pelvic and pectoral girdle.
Brain - diverse conditions.
Elasmobranchs and Holocephali similar to Marsipobranchs. Two types of modifications. Elongated form characteristic of Holocephali, short, broad.

characteristic of remaining Elasmobranchs and Rays. Prosencephalon large in Squalidae, not well divided. Olfactory lobes fairly well marked, short, broad and hollow. Cavity a prolongation of 3rd ventricle. Diencephalon in Rays.

Diencephalon roofed over by anterior choroid processes. Epiphysis and infundibulum present. Cerebellum large - covers end of medulla. 43 no longer wedge shaped.

In Torpedo just posterior to the pons lies electric lobe

44.



45.

In Crossopterygians have paired hollow cerebral hemispheres.

Downward bending, cranial flexure present in these higher fishes, increases in the Mammals. etc. Don't know whether it is homologous or not. Probably so. Roof of diencephalon gives rise to large paired pedicle, runs distal ward, has a large vesicle.

In Dipnoi brain is interesting.

Elas. and these arose from a common form, but they resemble amphibians very much.

Prosencephalon well developed. cerebral hemispheres separated, pallium thin but somewhat nervous. Paired bodies along olfactory, lies right on skull. Infundibulum, large, well supplied with nerves, close to hypophysis.

Cerebellum well developed.

Teleost brains diverse but insignificant, small, does not fill cranial cavity. Pallium entirely epithelial, no lateral hemispheres. medial evagination.

Prosencephalon small. infundibulum small. Midbrain large, optic lobes enormously well developed. Cerebellum well dev. Posterior portion brain developed greatly, anterior portion has not advanced perhaps retrograded, increase of reflex action, not of voluntary. Direct derivative of Ganoida.

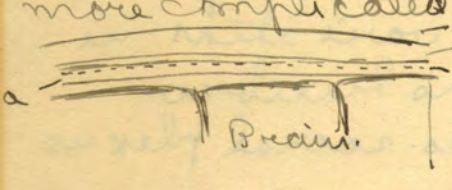
January. 16, 1905.

Central Nervous system of Amphibians.

Membranes -

dura mater, pia mater, vascular, supplying nutriment to nervous system. sub dural space.

More complicated in Amphibians, Urodeles might show transition stages if we had them preserved. Brain more nearly fills cranial cavity, membranes more complicated!



dura mater.
& sub-dural space.
& arachnoid memb.
a - sub arachnoid space.
pia mater.

Sub dural space between dura mater and the arachnoid.

Pia mater is separated from brain by a slight cavity. When there is any sculpturing of brain surface, pia mater follows the folds.

Spinal Chord.

Presents variable conditions, long in Apoda. short in , medium in the Urodela.

Nerve plexes in Apoda practically wanting.

Brain.

Like that of Elasmobranchs. like Sirens of Nipnai, least specialized of vertebrate brains excepting old fishes. Amphibian brain never shows any modification toward Reptilian brain. Pallium is nervous to a considerable extent. In Nicodela brain is elongated. perhaps an ancient character. Thalencephalon exposed. Pallium present, hemispheres well developed. separation of third ventricle roof.

Ventrally, short conical Olfactory lobes. may or may not be hollow. Optic lobes long. narrow and not excessively developed.

Cerebellum in very rudimentary condition. Infundibulum and hypophysis well developed - glandular structures. Epiphysis not well developed. Cerebral hemispheres still feebly differentiated into cortex and medulla.

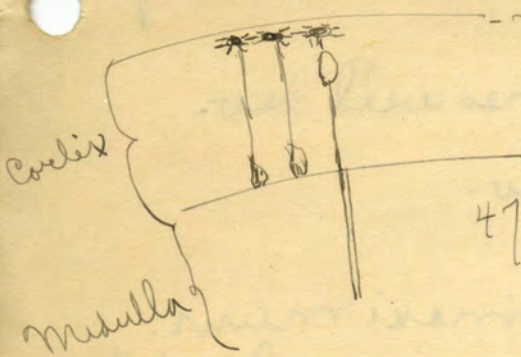
Reptilia.

Considerable jump. Membranes essentially the same. Spinal cord. shows great variation in length and modification. Develops lumbo-sacral and brachial plexi. Lumbo-sacral plexus greatly enlarged.

Brain better well developed. tends to grow upward and obliterate deeper structures. In instances 30 ft. long. brain not much larger than in fish. Brain best developed among Crocodilians. Lizards the Gannidae.

Hemispheres well developed. Specialization. Chelonia, Crocodilia. Separation of substance of

cerebral hemis pheres into cortex and medulla has advanced.



Corpus callosum. near base of 3rd. ventricle. well developed. Comissural fibres connect hemi spheres, fibres in Varanus good example of this.
Olfactory lobes - variable - little importance - long in Sphenodon. Crocodilia, Lacerta. short in Chelonia etc.
In Amphisbaena - very short, right under ventral surface of hemi spheres.
Thalamencephalon - not easily visible - has a well dev. infundibulum, epiphysis, and parietal organ well developed, latter may be used to receive light.
Optic lobes show traces of division by transverse sulcus. optic tracts form chiasma come more definitely.
Cerebellum small, consists of median and two lateral portions, latter not easily visible except in Crocodiles. Medulla has a marked ventral flexure.

Birds.

Essentially reptilian. A few points of advance. Cortex has a well developed ventral flexure. Hemispheres large and cover Thalamencephalon completely. Olfactory lobes. short conical. solid. No.

base of pineal organ of epiphysis - infundibulum present.
Cerebellum well developed. Lateral lobes well developed.
covers practically all hind brain.

Cerebrum pleurs the cortical fibres well dev.
Cochlea and medulla still further dev.

Mammalia.

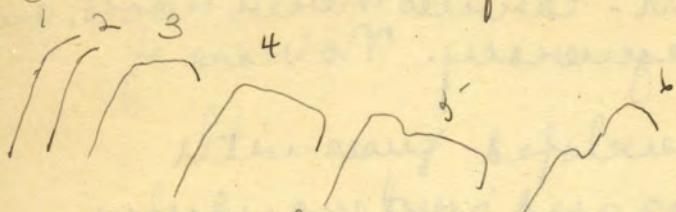
Shortening has reached its maximum.
Spinal chord never reaches beyond sacral vert. brae.
Cerebral nervous portion usually terminates in
lumbar region, pleural terminal continues
backwards to sacrum - non-nervous.
Lumbo-sacral and brachial enlargements very
complex. Membranes the same.

Brain:

Great develop. of cerebral hemispheres, process of
shortening has reached greatest development.
Cortical substance has increased from folding
of brain, into a series of folds which give great
surface area in small space. Convolution begins
in low forms and increases higher up the scale.
Embryo brain almost comparable to phylogenetic
stage.
Straight and simple - then shows modifications
etc.
Flexures peculiar to mammalian brain.
There are three. one at post. end of diencephalon
(cranial flexure) - back of mid brain (cervical flexure)

back of pons (pontine flexure).

Cervical flexure only present in embryo. Pontine flexure consists of a ventralward bending.

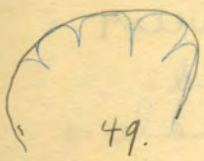


48.

Caused partly by change in position of the head. Cervical flexure a cenogenetic character - others palingenetic.

Hemispheres. in Mammals. Jan. 24. 1905

Much developed - not to be mistaken - go backward over mid brain - cerebellum covers medulla and hind brain - more generalized portions not visible from dorsal side. Recapitulate condition in fish &c. Hemis. show a clearly marked cortex, pari metal cells reach a great development. Surface roughened - invagination of the surface - gyral - sulci - are for increase in amt. of cortex - do not increase medullary surface.



49.

Increase in number and complexity greater among higher mammals - not an absolute indication of mental power of animals - in some mammals the brain is smooth.

Frontal - parietal - temporal and occipital lobes of brain.

Transverse commissures - more lamination in mind - developed in mammal brain - corpus callosum - fornix fibres - anterior commissures.

Specialization of ventricle - 3rd. ventricle passes thro' foramen of Monro and becomes lateral ventricle. In mammals the lateral ventricle is divided into 3 -

cornua - lateral - ventral - dorsal -

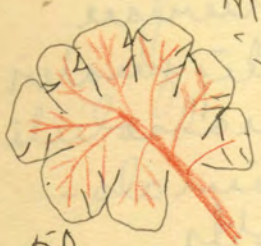
Diencephalon lowers structures (pineal body) not well developed. Pineale is on posterior portion of roof of thal. encephalon - carries nerve roots, but has secretions showing degeneracy. No trace of parietal foramen.

Infundibulum well developed - fuses with hypophysis - part nervous and part glandular - function uncertain; but when organ is deranged as in gigantism it has an effect upon the body - dwarfism also seems to be produced by pathological condition of this organ.

Mid brain small and not visible from dorsal side - optic lobes solid - appear as four bodies - corpora quadrigemina - anterior pr. larger. Cavity of mid brain (aqueduct of Sylvius) shows no imp. modifications

Cerebellum has 3 portions - median and two lateral - fissures increasing cortex. Cortex has large cells - Cells of

White matter sometimes called arbor vitae.



50.

Three peduncles well developed - posterior middle and anterior. Posterior ped. carries fibres into cerebellum - middle is bundle of fibres crossing pons - anterior bundle running to cerebrum.

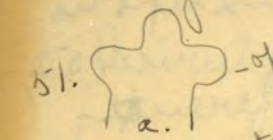
Medulla like reptilia shortened - posterior choroid plexus as in roof.

Infinite progression in dev. of brain - cerebral hemispheres - cerebellum began as a thickening of dorsal wall of fourth ventricle - became seat of its voluntary brain actions. Reduction of mid-brain and of appendages of diencephalon. Divisional modification important.

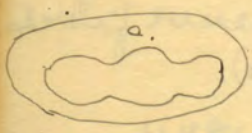
Sense organs. Optic organ - organ of vision.

Most closely associated with central nervous system - develops directly from it - others from somatic mesoderm.

Evaginations of wall of brain grow out and come in contact with the surface ectoderm.

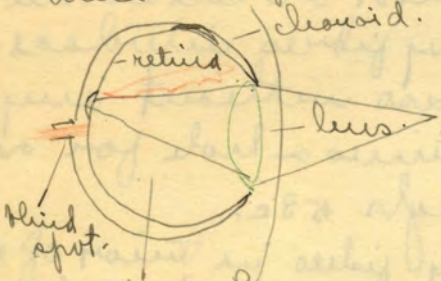


Invagination takes place in lobe - forming optic cup. Choroid marks point where invagination began - while lens sometimes shows place in eye of frog - or other amphibians.



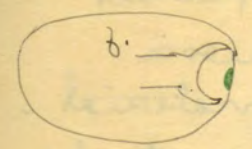
Ectoderm thickens and begins to invaginate - these two processes go on side by side simultaneously.

Vitreous humor is mesodermic in origin - comes through choroid fissure

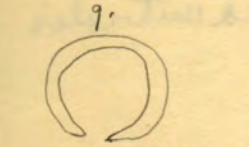


Optic peduncle becomes solid and develops into optic nerve.

Point where nerves enter eye is blind spot; near it a depression in retina - close to focus of lens - fovea centralis - area of most acute vision - sensory cells more numerous in this region.



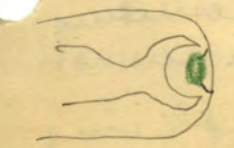
Eyes of fishes, birds and some mammals have pecten - probably a nutritive organ.



In Amphioxus no eye - pigment spots supposed to be light perceiving organs.

In Marsipobranchs - Petromyzon we have normal vertebrate eye.

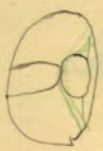
In Myxine - Bdellostoma eyes is degenerate. In Myxine eye muscles -



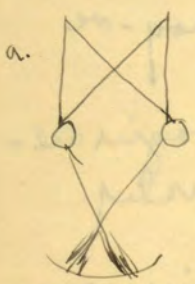
sclerotic layers are absent - very primitive eye in adult but in embryo all parts are present - absence due of retrogressive specialization.

In young Petromyzon eye is primitive.

In fishes eye is much used - all parts present except in cave fishes. In fishes eyes are more or less hemispherical 52, 52 lens rounded - otherwise no special differentiation - shape is an adaptation to aquatic environment.

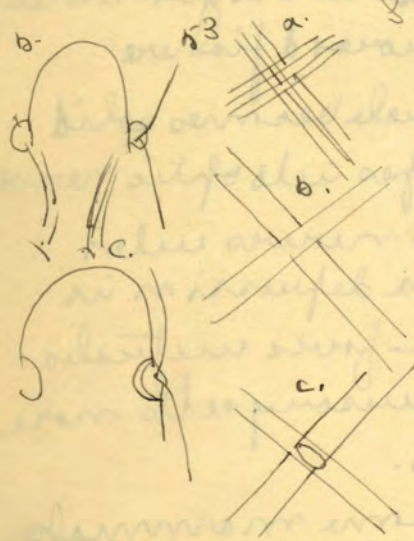


a. vertebrate eyes - b. fish eyes - c. snake eye.



In fish right eye sees things on right side and left eye things on left side. With this retarded development is lack of decussation of nerve fibres. frequently no crossing of fibres at all (b).

In Teleosts decussation or chiasma very complete - ordinarily fibres interlace a. 53.

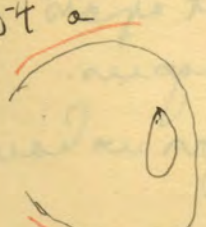


Sometimes pass without any connection 53. b. Sometimes a hole for one nerve to pass through 53 c.

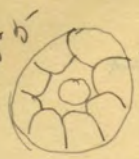
In many fishes in terior of eye is complicated by growths like pecten and fovea centralis. Sometimes a condensation of choroidal material. Only in air animals is fovea centralis important.

In Cuttle fishes eye shows adaptation to air environment - eye ball is not as flattened as often, corneal surface more complex.

54 a

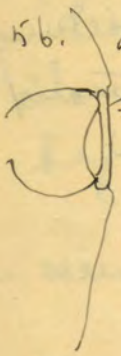


In reptiles eye undergoes specializations in sclerotic layer - 54 a. Heavy calcifications take place - develops a series of bones surrounding the iris - protect eye ball. Seen in Dinosaurs - Thalatosuchia etc. Seen in Chelonia of living


55

reptiles. Eye ball is round - processus falciformis - has no visual properties tiophic or nutritive in function. Eyelids well developed - under control of will. Nictitating membrane present - well developed in all reptiles - thin sheet of in ligament. Palpibrae best dev. in Gekko. In snakes and Amphisbaena grow together - but are thinned and devoid of pigment. During process of shedding of skin the snake is almost blind.

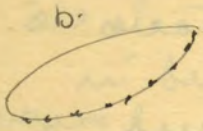
56. a. Palpibrae.



Glands - In Urodela glands along entire length of lower eyelid - perm sebaceous glands. Harderian glands and Lachrymal glands. 56 b.

In reptiles grouped at two ends. 56. c. - function is to keep eye surface clean.

b.



c.

In birds, eye has two areas of acute vision - reach extreme development in birds of prey - vision very long and clear and keen.

Fovea centralis well developed in birds as a whole. Pecten undoubtedly nutritive. Eye round - no other modifications.

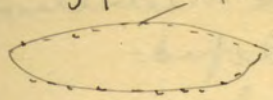
In mammals eye is highly specialized - round in all forms - functional in all except in moles - has undergone retrogression adaptation. well developed in rabbit. Two brows - movable eyelids - no ossification in sclerotic coat. Cornea always convex except in aquatic forms - Cetaceans - Pinnipeds - where it is somewhat flattened.

Glowing of eyes - especially in carnivora at night - interference reflection of rays by corneal coat.

Glands same as in reptiles - also another series of glands

on both eyelids.

57 Meibomian glands



Meibomian glands oily.
Harderian glands absent in primates and higher animals.

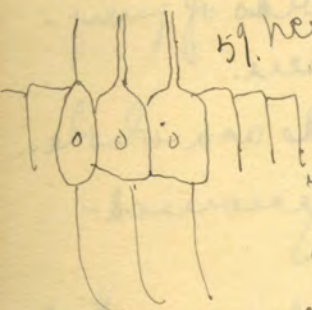
glands of Wallace modified sweat glands at edge of eyelids. In Cetacea Meibomian glands are lacking. In the Otter and Hippo. lachrymal gland much reduced and duct is wanting. In Manis - no Meibomian glands - In Moles all the glands are lacking. In interior of eye - blind spot well dev. fovea centralis present - no pecten - columnae mass well developed.

Jan. 26. 1905 -

Auditory organs.

Olfactory organs - used for detection of chemical substances in a volatile cond.

Much in Acrania - oral hood - funnel - tentacles etc. have bristle cells - mod. epithelial cells - concerned in

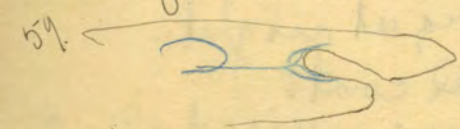


59. reception of stimuli - both olfactory and organs of taste - gustatory, heat, cold etc. Generalized for reception of any stimuli - no definite regions for different senses.

In Manis olfactory organs lie deeply implanted on dorsal side of head in front of brain in an olfactory capsule. Really a paired structure - becomes from olfactory lobe of brain and is applied to base of capsule. True in Myxine too.

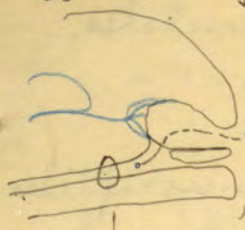
Olfactory organs in fishes well developed. In sharks we find two external openings - ending blindly in lower fishes. Externally may appear almost fused.

59.



Olfactory organ like that of Amphibians - nares situated anteriorly.

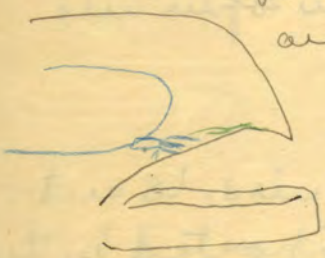
60. Have an opening - internal nares. water comes in and passes out thro' gill slits - serving a double purpose.



In Amphibians arrangement is very similar. only nerve is better distributed. and form of nasal chamber is different.

In Reptilia growth of brain - facial region and terrestrial habitat have modified organ; it no longer lies in front of the brains but more beneath it. Secondary palate - shelf of bone dev. from upper jaw and cutting off a distinct dorsal cavity, internal nares are carried further back. Specializ. of nasal cavity into anterior and posterior cavities

61



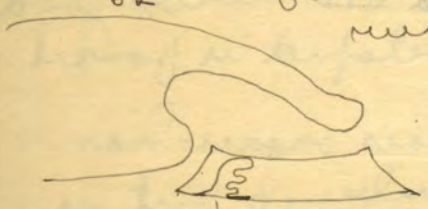
Anterior chamber no longer very sensitive. posterior chamber more so.

Ridges (61a) covered with thin membrane and full of nerves - have a bony foundation. Anterior chamber more sensitive to dryness etc.

61a.

Jacobson's organ is a simple evagination of the roof of the mouth - remains more or less open - function is unknown. Often becomes rudimentary.

62



Jacobson's organ.

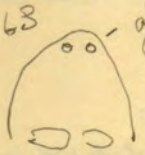
In Mammals best development. mod. of skull have pushed brain brain forward and nasal organ under the fore brain. True nose only in the Primates - Olfactory organ wonderfully well developed - necessary as they have no warning colors and glands are powerfully developed.

The nasal cavity always has ext. and. int. nares and a well developed false palate - Two distinct chambers. Turbinal

rolls characteristic of nearly all mammals - five is the usual number. Echidna has six - seven or eight - Edentates. have less. Ungulates eight. Primates one to three. In Cetacea, primates 1½ - usually only one nasal

Turbinals dev. from ethmoid in mammals - in reptiles and birds from maxillary. Maxillary turbinals are far forward in mammals but have no nerves - except facial branch of V nerve. Lined with much mucous - specialized to prevent entrance of injurious air to inner chamber. Olfactory terminations limited to posterior region and situated over ethmoid turbinals.

Glands associated with olfactory organs - begin in amphibians and reptiles - glands of Nasmyth open into anterior part of mouth.



External nose of mammals equiv. to ant. chamber of reptiles and birds - supported by the nasals and a dev. of the ethmoid. In Cetacea is a dev. of cartilage - not present in Primates. In Edentates - some Ungulates this cartilage is well developed.

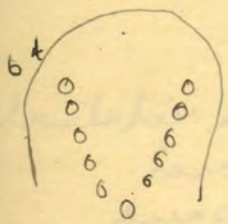
Prehensile appendages - Proboscidea - ridiculously prolonged - finger like processes - V and VII nerves - good muscles. Tapirs, pigs, moles. well developed in fossil mammals.

Connected with nasal cavity is Jacobson's organ - has olfactory epithelium and nerves in embryo but in adult is cut off and loses nerve supply - don't know much about it.

Ability to perceive minute amounts of chemical material in air very great - 1 - 2 or 3,000,000 parts of air. musk. 1-500,000! can be perceived for long distances. Air is better adapted than water for the diffusion of odors.

Gustatory sense. Edinger Von Lenhossek.

In Amphioxus - bristle cells have this sense.
In Marripio branchs organs are not well defined.
In tongue of Myxine three are groups of sensory cells concerned in perception of chemical stimuli but not exclusively so. V VII and IX nerve. used for chemical sense in a general way.
In fishes it is better localized - in tongue we have bristle cells - nothing like taste buds of higher forms.
In floor of mouth we have groups of bristle cells supplied by V VII and IX nerves which serve to give animal warning of material.
Amniota have sense well developed and localized in tongue - scattered over mammalian tongue is a whole series of sensory structures 64. - a V shaped series of spots for back on root of tongue. spots with rich nerve supply.



Gustatory area centralized - little expansion well adapted to catching liquid impregnated with substances.
Specialization of general chemical sense into 2 - gaseous and liquid matters - Olfactory and gustatory.

Jan. 31. 1905.

Auditory organ.

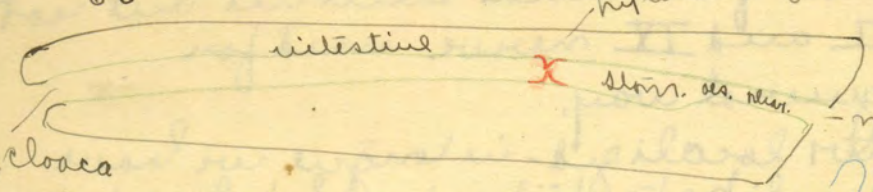
Alimentary canal and its glands. Endoderm has 2 portions - mesoblastic somites and true archenteron of embryo (alimentary canal) - a simple oval space - forerunner of gut and vitelline sac in mammals etc. 65

Invaginations from posterior and anterior ends coming to archenteron and uniting with it - first part is

ectoderm (buccal cavity etc.) next is endoderm (cloaca) (Hypophysis marks approximate limit of ectoderm) anus is ectodermal again.

Buccal region - two divisions anterior (~~teeth, tongue~~) and posterior (pharynx, respiratory, gills, trachea)

6b



- gums + teeth.

Teeth arise always from ectodermal invaginations.

Amphioxus - a simple tube shorter than animal mostly pharyngeal gill slits.

67

No differentiation into digestive and absorptive tissue.

Cyclostomes and fishes.

Fishes - Elasmobranchs - pharyngeal region reduced relatively short, oesophagus and stomach well marked. Spiral stomach - cardiac, fundus and pyloric areas. having different kinds of glands.

Spiral in intestine - a series of funnels - three which food passes - spiral valve - absorptive region. characteristic of most fishes.

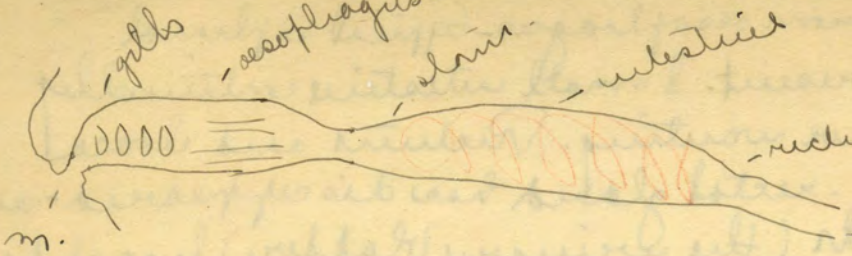
68

Caecal gland more or less marks the end of the endoderm.

Sub intestinal vein is very rudimentary in Elasmobranchs. Hepatic portal system takes the place.

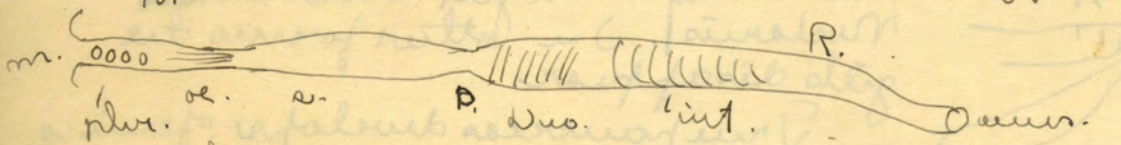
Two glandular structures outside duodenum - pancreas and liver.

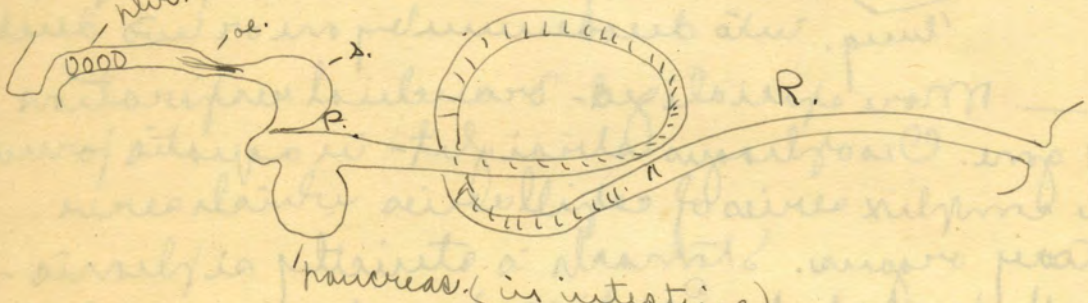
In Chimaera alimentary canal is straight - pylorus almost entirely wanting. (69)



Dipnoi have very elementary almost straight and undifferentiated.

70. Condition in Ceratodus

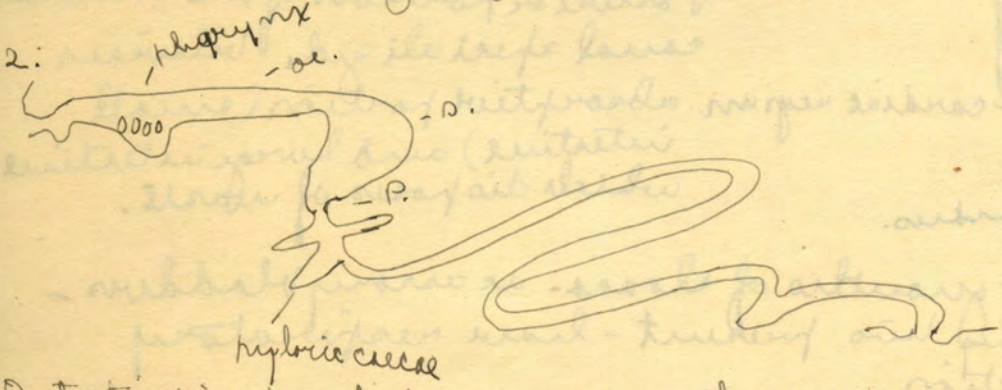




71.

71. shows condition in Teleosts - canal longer than the fish - in more specialized fish the intestine increases in length.

72.



Duodenum in fresh becomes smaller in di ameter and longer.

73 - cross section of intestine showing villi.

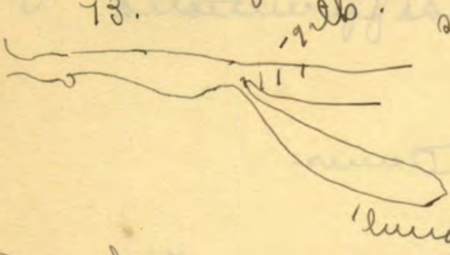
Specializations are increase in lenght of absorptive region, reduction of spiral valve etc.

Amphibians Buccal and pharyngeal cavity well separated

from each other and from oesophagus - typical siphonal stomach usually present. Small intestine continually elongated - spiral valve wanting. Rectum and cloaca well differentiated - rectal gland has disappeared - and ventral outgrowth (the urinary bladder) has appeared - simply a receptacle for waste products.

Transition from respiration by gills to that by lungs. (13)

13.

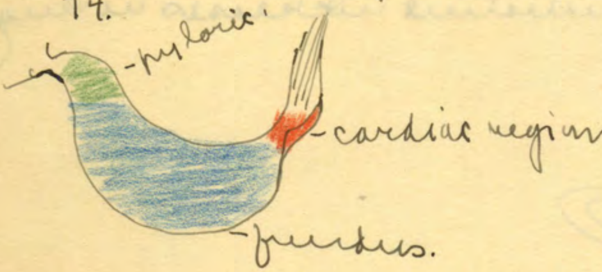


shows lung and gill slits in the Necturus. In other forms the gills disappear.

True pancreas develops opening into duodenum by one or two ducts.

Reptiles. More specialized - branchial respiration absolutely gone. Oesophagus straight - in aquatic forms has villi or complex series of capillaries which serve as respiratory organs. Stomach is strictly siphonic - pylorus well developed. Cardiac, fundus and pyloric areas well developed.

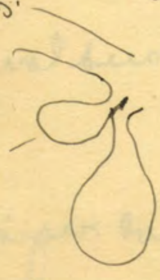
14.



Posterior portion of alimentary canal specialized, between absorptive portion (small intestine) and large intestine which disposes of waste.

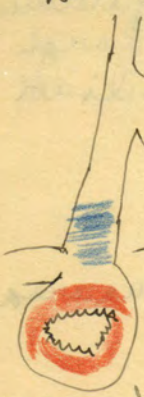
Numerous outgrowths of cloaca - accessory bladders - usually two present - have respiratory function.

15.



In birds alimentary canal like that of reptiles - a little more differentiated. Stomach much changed.

76



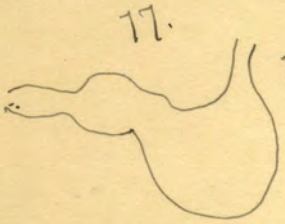
Is pouch on oesophagus (crop) in which food is prepared for gizzard - moistened and softened. Passes into glandular area of stomach where glands are mostly fundus glands.

Rear part of stomach - very muscular - chitinized walls - ground up then passes into intestine. Replacement by a secondary function of the primary office of a structure.

Mammalia.

Pharyngeal area like that of reptiles - Stomach very diverse in shape and functions - essentially simple.

77.



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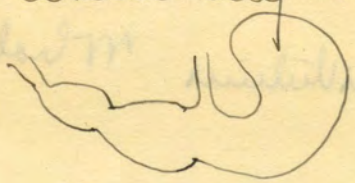
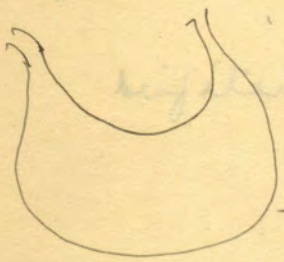
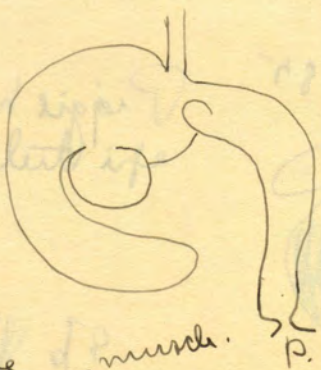


Mus - rodents generally.

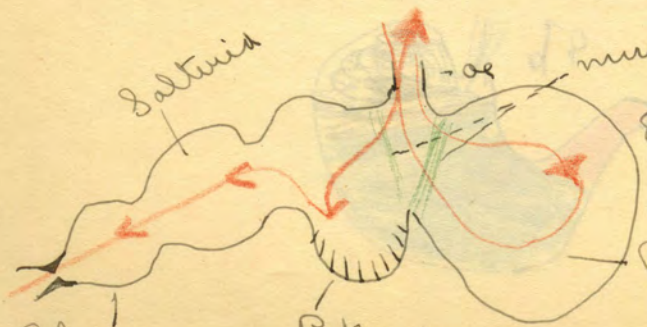
79





Bradypus - a sloth

80

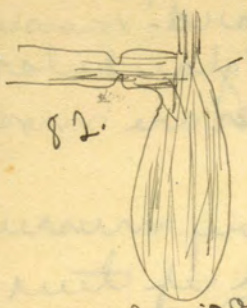


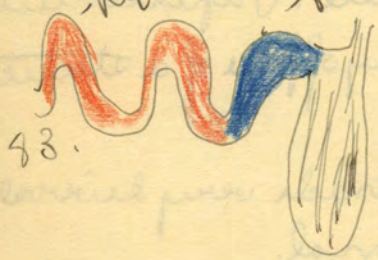
81 Ruminant Mygalalis.

Reticulum enormously developed in camel - can hold much water - has three or four large sacs -

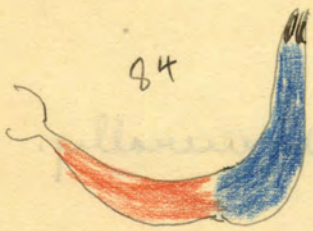
Ornithorhynchus.

Has whole stomach covered with stratified epithelium. no granular structures. Large ant - calvis shape a somewhat similar arrangement.





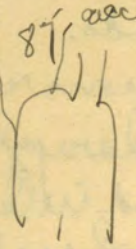
Papasie has no cardiac area



Whole.

Pigeie has little stratified epithelium.

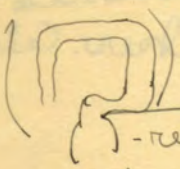
Small intestine always uniform in diameter - ends abruptly in ileo-caecal flap passes into large intestine - ileum or



large intestine (a receptacle for waste products - but sometimes redigests waste material) Caecum is developed for this purpose.

Food in mammal takes a short course path - large. int.

88.



Feb. 2. 1905.

Region of the mouth - Transition in localization and reduction of respiratory area. Teeth in connection with skeleton.

Tongue - Fold of mucous membrane on base of hyoid bone - homologous to lingual muscles of other animals - gustatory organs more thickly placed there in fishes. In Amphibians where gills are persistent tongue is practically absent. In Anura present and well developed - modified for seizing thrown forward - has well developed mucous glands. Chamaeleon has protrusible tongue - taste buds well developed.

In Reptilia tongue is easily movable. In crocodiles and Chelonia tongue little movable and not much moved. Forked tongue in Lacertilia

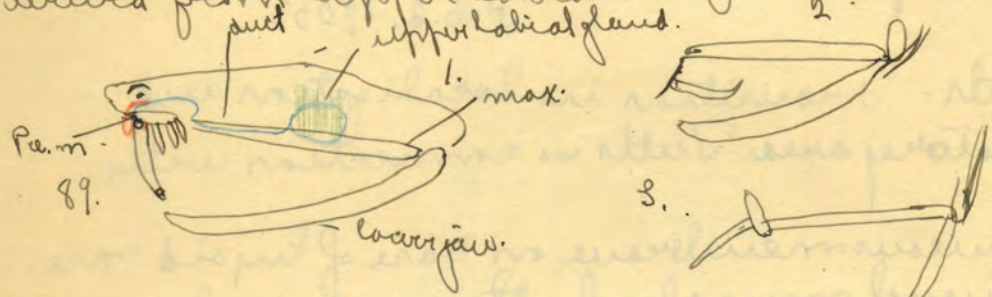
In Mammals tongue broad - rounded - extensible. Not comparable to others - as it is not supported by hyoid cartilages but has lingual muscles attached to the base - hyoid.

Tongue arises in three ways - a fold of membrane in

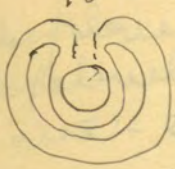
fishes - a muscular arrangement associated with hyoid bone in amphibia and Reptiles.

Glands in mouth -
Not present in fishes as recognizable mouth glands.
Amphibians have a no. of tubular glands dev. from roof of mouth, lying immediately - Pre-maxillary glands absent in Perennibranch salamanders. Go hand in hand with devel. of terrestrial habit. In Anura these glands are around internal nares. Aglossa have oral glands opening far forward in the mouth.

Reptiles Glands very highly specialized. Lingual - sub-lingual upper and lower labial glands. Snakes and Chamaeleons have glands best developed - crocodiles and Chelonia least. -
Toxic material in upper labial glands of some snakes. Always derived from upper labials.



Premaxilla is rotated by contraction of adductor of the mandible thrusting the fang forward - this crowds the

90

- cross section of gland - the muscles over it contract fang. thrusting the venom forward - the mucous membrane becomes applied closely to the fang so that the poison goes well into the opening of the fang. Poison itself is a proteid - compound of several proteid - neuro - toxine - haemo - toxine neurotoxin acts on nervous system - the other on the blood.

In crotaline snakes - haemotoxine predominates.
In cobra di - the neuro toxine predominates.
Crotaline snakes most venomous snakes in America treatment ineffectual - serum treatment is the best but rarely obtainable.

Cobra bite may be cured by this anti-venom or serum treatment after some hours. Not so effective with crotaline snakes. 1% solution of permanganate of potash injected near bite - ligature above the wound and make a V shaped incision, then inject this solution - gangrene is apt to develope from bite - do not keep ligature on for more than half an hour at a time - risk of an hour.

Gila monster, a lizard, has poison glands developed - lives in burrows under mesquite bush - can't bite unless you put your finger in its mouth - bite is not very poisonous. No other Lacertilia poisonous.

In mammals buccal glands are very well developed with a digestive function - maxillaries - sub-maxillaries sub-lingual and parotids.

Sub-maxillaries and sublinguals - homologous to glands in snakes. Mallei cat's have a gland comparable to upper labial gland in reptiles - never toxic.

Thyroid and thymus glands.

In Elasmobranchs thymus glands develope from the membrane of the gill clefts - 5 pairs of them.

Thyroid is unpaired gland united to mandibular symphysis. In some is paired - in Dipnoi is migrating caudalward.

In Cyclostomata they have the same embryonic origin but lie further back - thyroid in pericardial area - thymus gland lies behind lower jaw and is paired.

In Reptilia thyroid lies often close to heart - thymus lies close to carotid artery.

In Mammalia thyroid is 2 lobed - has a rich blood supply - thymus lies near the heart - degenerates in adults.

Function is practically unknown. Goitre connected with

the thyroid gland - congenital.

Two glands just behind stomach - dorsal - pancreas - ventral - paired structures - the liver.

In Amphioxus a simple structure - paired in the higher animals - good blood supply - connected with storing of food - secretion of bile and urea.

Pancreas secretes a digestive fluid.

The spleen - a lymphoid gland - function not definitely known - concerned with circulation

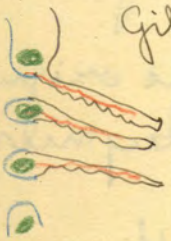
Rectal glands behind small intestine.

Endodermal origin - respiratory system. Branchial clefts and gills in fishes. Inner wall is pushed out - outer is pushed in.

91. 

One fish is believed to have external gills -

Amphibians have external gills often. All embryos have five gills slits - but are reduced to 4-2 or none. Some have tufted external gills - ectoderm in origin.

92. 

Gills of Myxinoids - Mountain whether this is an intricacy from Cyclostomi origin fishes - or a redevelopment - Branchiostomus had their external gills -

Above amphibians gills slits always appear in embryo - but never as functional gill slits in adult - supernumerary auricles - an abnormality sometimes seen in goats, pigs and man - little ear like projections.

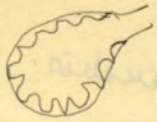
Other appliances for respiration with coming of terrestrial habitat. Dessication of surfaces frequent respiration in air. First appearances are in the Dipnoi -

evagination from wall of pharyngeal region - single or double.

Urodela have lungs arising as evag. from ventral floor of pharynx - simple sacs - Metarbis.

93.

94.



Ostariophysi forms.

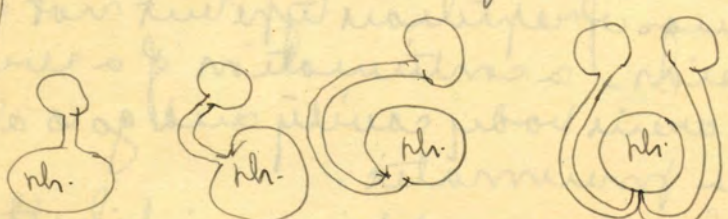
Phythodonlas no lungs as adult - has integumentary respiration - rich supply of capillaries - Epithelium of alimentary canal also has respiratory function - little red brown lizard about 4 in. in length -

Cyprodactylus Light lung is developed - has internal trabeculae - correlated with drawing out of body.

Where the lung arises is a problem - structures in Dipnoi definitely respiratory. Ostariophysi - air bladders in all fishes except Elasmobranchs and Holocephali, where there are only small evaginations from ventral floor of pharyngeal region homologous to lungs, perhaps.

95

air sacs - filled with gases - in some fishes have a definite respiratory function - often in very various portions of ali mentary canal.

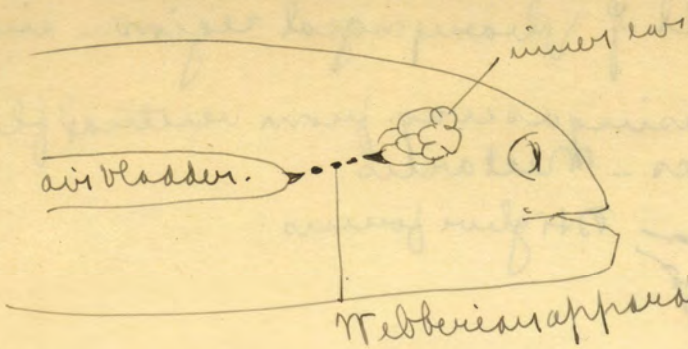


Air sacs arose from buccal cavity and are probably the direct fore runners of the lungs of higher forms.

Weberian apparatus - chain or less variable series of bony ossicles - connecting with labyrinth of internal ear.

Seems to vibrations in air bladder to the inner ear - probably associated with process of equilibration has to do with depth and pressure - no auditory function.

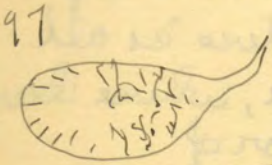
96.



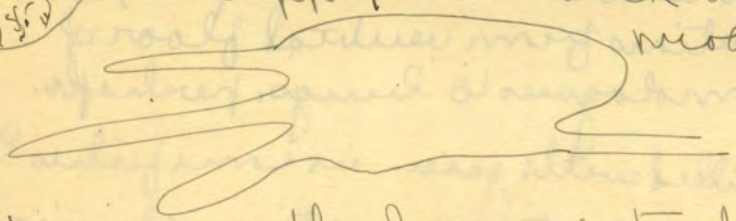
Reptiles and birds homologous with lungs of amphibians - larynx present - pair of arytenoid cartilages - supporting wall of pharynx - trachea well developed - in Sauria - crocodilia etc associated with hyoid body.

Lung depart for respiration shaped of heart - anterior end spongy - posterior end enlarged in storage of a supply of air for use under water.

97



In Chamaelon lung has finger like processes at posterior end - little blood supply - runs back among viscera - produce air spaces.



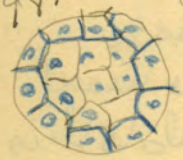
In Dinosaurs the lungs extended into the bones - had pneumatic bones. Birds approach this.

Birds have lungs of reptilian type but not capable of much expansion - a continuation of a series of processes which are in body cavity and go to all parts of the body. Bones are pneumatic.

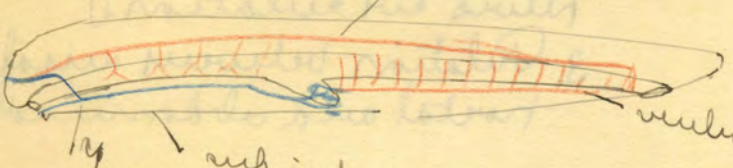
Syrinx - (bird larynges) upper one is like that of mammals but at base of trachea before it divides - is syrinx, birds voice comes from here. pneumatic ducts and sacs - various acoustic appliances - Strasi - Morph. Jahr. Bd. V Hft III. 1877 - Feb. 7. 1905 - Mammalia - gills present in embryo but never functional - larynx of reptilian type but specialized - resounding sacs - vocal chords - new muscles -

Resounding sacs characteristic of the primates - Vocal cords from hyoid to attenoid cartilage - trachea have cartilage rings which prevent them from absolutely collapsing - bronchial tubes - 2 - breaks up passing to different lobes of lung. Lungs spongy thro-out - enclosed in pleural cavity lined with pleural membrane and with serous secretion to make movement easy. Usually 2 lobes on each side - sometimes four. Lining of pleural cavity passes over peri stomeum and forms cavity for vena cava etc.

Circulatory and lymphatic systems - Arise from mesoderm - perhaps part comes from primitive archenteron. Blood vessels arise as solid chords from mesoderm - mesenchyme - the cells

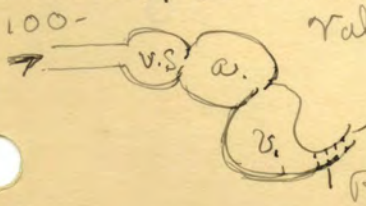


settle down as a solid tube the outer cells thicken and form wall of tube - inner cells loosen and form lymph - nuclei with little else. Amphioxus - no heart dorsal aorta blood forced forward by a



rhythmical contraction of the walls of the vessels themselves. Embryos of higher vertebrates have analogous structures - no hearts yet developed.

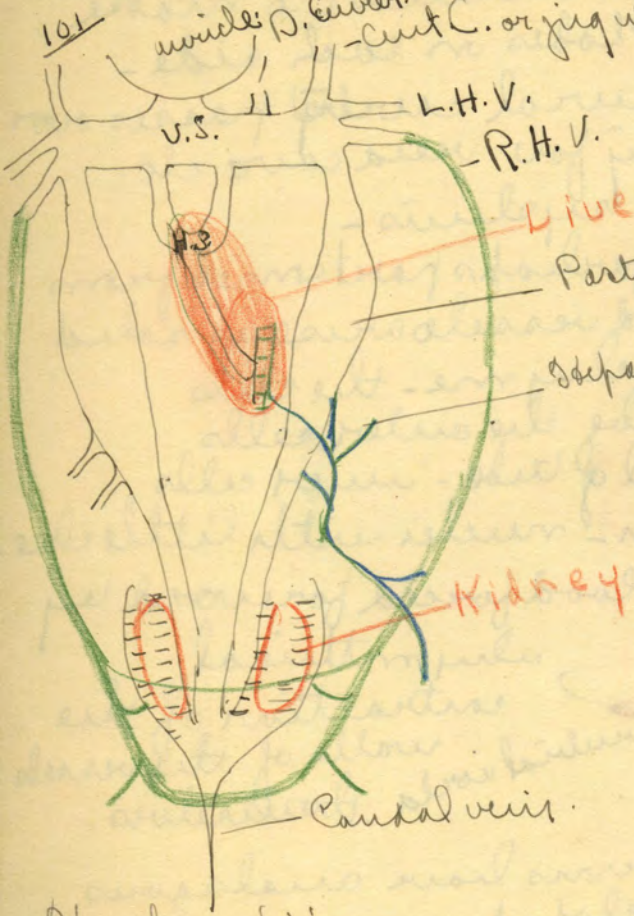
Marsipiobranchs and fishes have a distinct heart - posterior chamber that receives venous blood - then into anterior chamber - then into ventricle - then into aorta.



Valves prevent the backward flow of the blood -

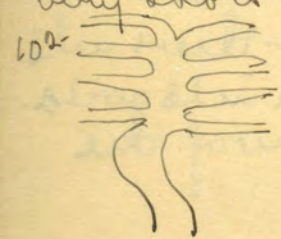
Ventral aorta is long and gives off branches to the gills.

Condition in fishes similar, but Bulbus arteriosus is enlarged- in Elasmobranchs it is contractile and guarded by rows of valves- same and in Holocephali.
In Dipnoi it becomes lacunal ~ as it is later in Amphibians.
V. C. sends blood forward to gill arches not to gills - then to the dorsal aorta - In fishes



Venous system in Elasmobranchs - and as it is in embryos of higher forms. Arteries are small with fibrous walls - the veins are large with thin walls - sac like.
1. Relation of hepatic veins to veins region behind the heart.
2. Of Posterior cardinals to this and to the kidneys and pelvic in relation.
3. Relation between renal portal and abdominal vein.

Heart in Dipnoi - comes short and twisted - ventral aorta very short gives rise to four branches - going to gill arches.
Veins and arteries are about the same size.

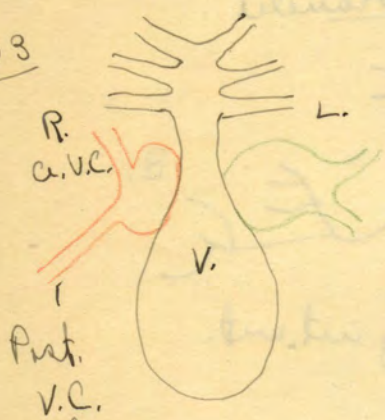


Amphibians - In all except Gymnophiona the heart lies well forward - but not so far as in fishes - near pectoral girdle.

Heart no longer 2 chambered - auricle has become partially divided into right and left, it is punctuated allowing blood to mix - it is fibrous - auricles have valves - Pulmonary veins unite and enter left auricle - Ventricle is still unpaired - physiological separation sometimes - conus arteriosus slightly twisted, has a series of valves.

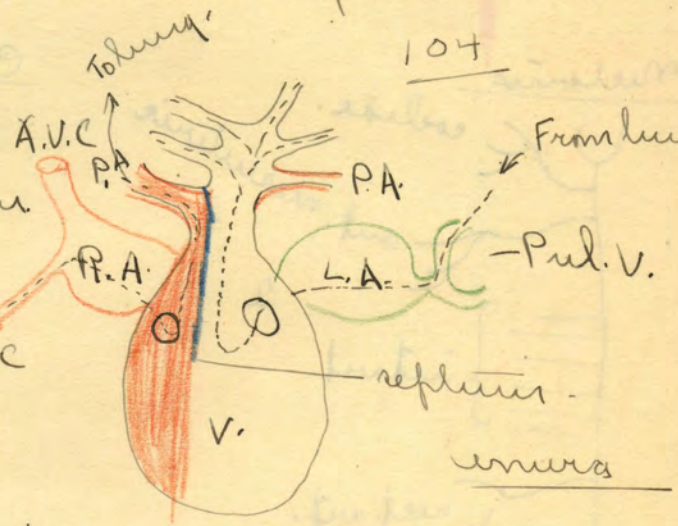
In Gymnophiona - Proteus and Necturus - conus is short and muscular. But in Amphiuma there is a spiral fold which runs back into ventricle - tends to separate two kinds of blood.

103



Vertebrata

104

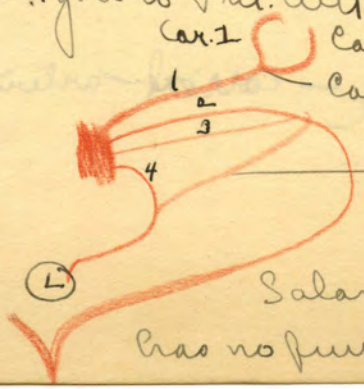


Amphiuma

Aortic arches - are in close relation to visceral arches not to gills - connected to bony skeleton -

105

Young salamander (105) - 1st three arches go to gills - but fourth goes to Pul. Cut. and hence to the lungs.

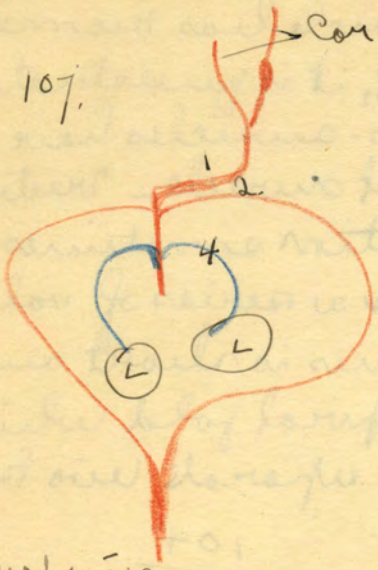


106.

Salamandra which has no functional gills.

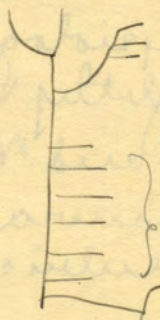
Condition in adult Cumra.

107.

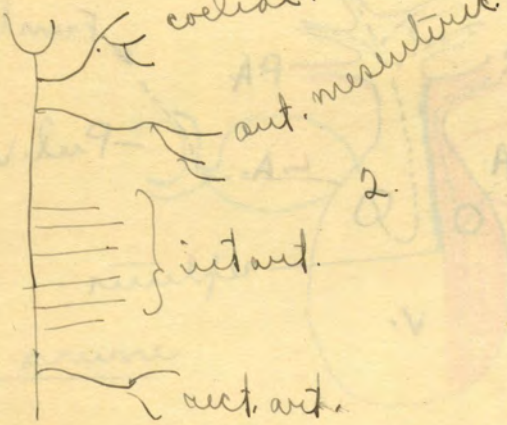


Modifications of coeliac and intestinal arteries - back where the dorsal aorta has received the aortic arches.

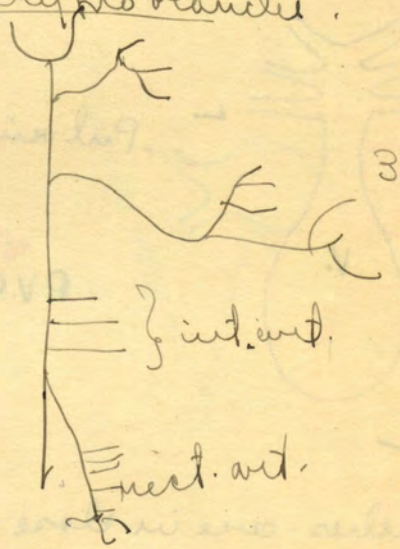
Siren



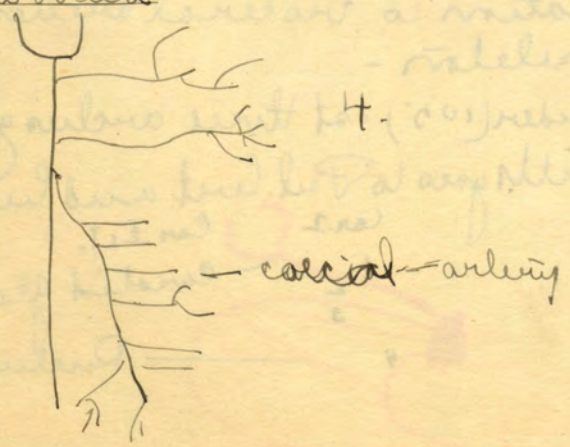
Necturus



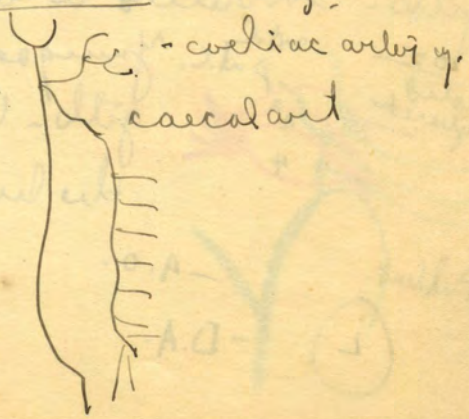
Cryptobranchus.



Lisbolica

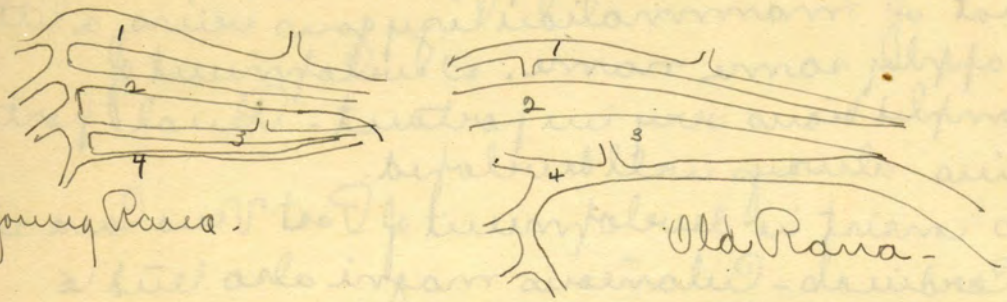


Cumra.

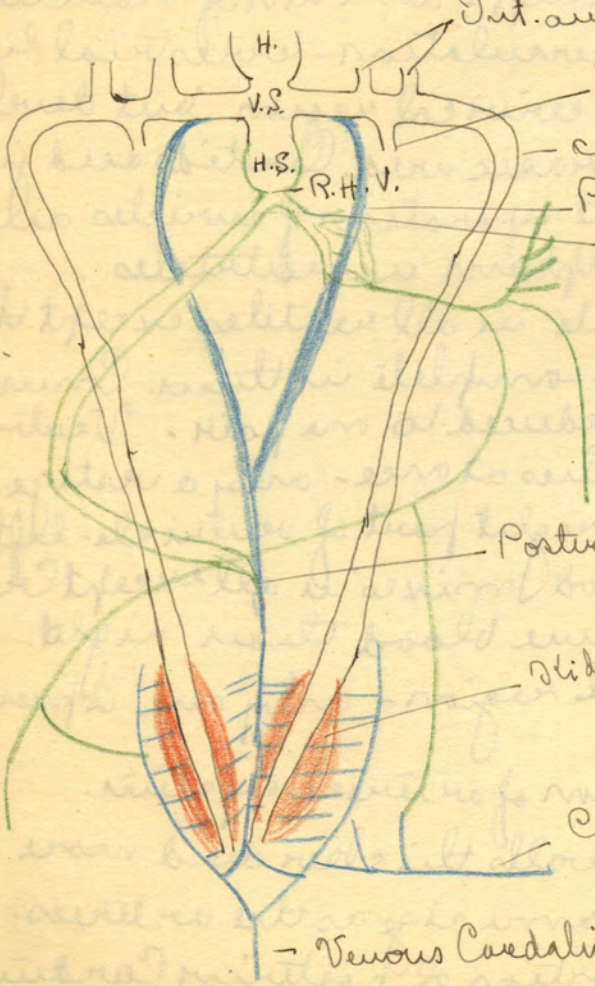


Feb. 9, 1905

Cortic arches of Amphibians. Rana Esculenta - metamorph in arches.



Venous system in Amphibians - especially Necturus -



Posterior Cardinals and Hepatic Vein rarely functional at the same time, the Vena Cava being formed by the Hepatic vein alone.

1. Condensation of sinus area.
2. Development of Posterior Vena Cava.

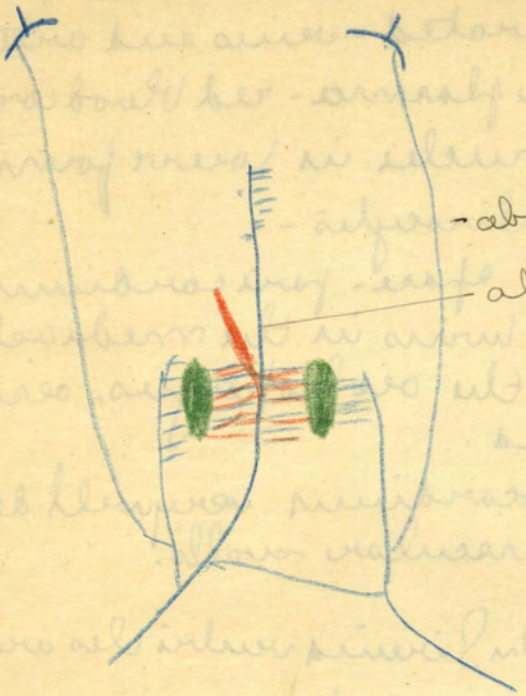
Post Cardinals frequently called the Azygous - lie in a position analagous to that of mammalia. Azygous veins, a little questionable to apply same name. Development of Vena Cava in Amphibians very important - Renal portal and caudal veins always well developed.

Modifications consist in development of Post Vena Cava and degeneration of Cardinals - Cutaneous magni also tend to degenerate.

Reptilian systems - great jump - abolition of branchial respiration — embryonic circulation - terrestrial life.
Heart arises far forward in cervical region, but develop. of neck pushes it back into thoracic area. Carotids and jugulars elongated - Heart has complete separation of auricles and dev. of a true muscular septum in ventricles.
Ventricular septum incomplete in all reptiles except the Crocodile - separation of blood complete in them. Conus is practically resorbed - valves reduced to one pair. Ventral aorta divides into aortic arches at once - only a vestige.
Blood enters rt auricle - rt part of ventricle - left auricle - left ventricle. Blood mixes in all except Crocodiles Left aortic R has more impure blood than right.
Degeneration in branchial region - only one is present as well marked structure
No points in posterior portion of arterial system.
Veins smaller, former, walls thicker and more muscular, have valves - same size as the arteries.
Degeneration of anterior portion of posterior Cardinal - middle portion persists connected with another vein from jugular vein - vertebral or azygous vein.

Renal caudal system well developed- more less abdominal veins.

Lacertilia



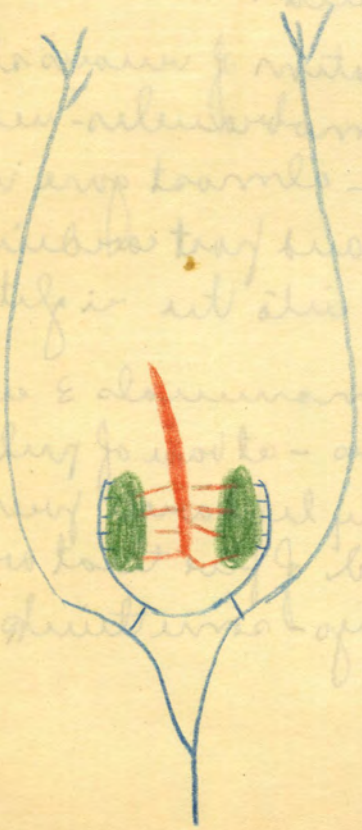
-abdominal vein.

abd. vein

Chelonia -

Renal Portal System.

Develops in all Reptilia - likewise renal-caudal system - Degenerate in Crocodiles - Persistent in adult Chelonia.



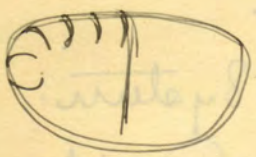
Mammalia Heart four chambered - same plan as in Reptilia, structures degenerated - veins and arteries the same size. Lymph or plasma - red blood corpuscles without nuclei - have nuclei in lower forms $\frac{1}{3500}$ in. in diameter in man - erythrocytes -

Heart has mediastinal space - pericardium surrounds it.

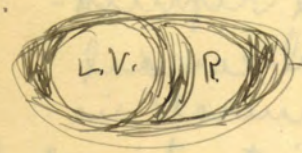
Aorta turns in the mediastinal space - so does the oesophagus - oesophagus and trachea.

Myocardium very well developed. muscular walls.

In 5 pieces ventricles are almost separated.

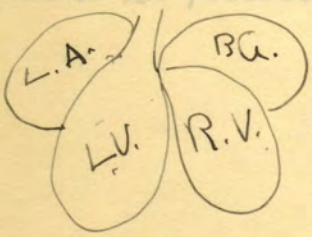


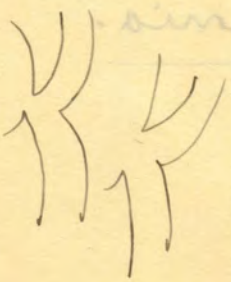
Obliteration of venous sinus - great in Elasmobranchs - reduced in the reptiles - almost gone in mammals -



anterior and post cardinals open directly into the right auricle.

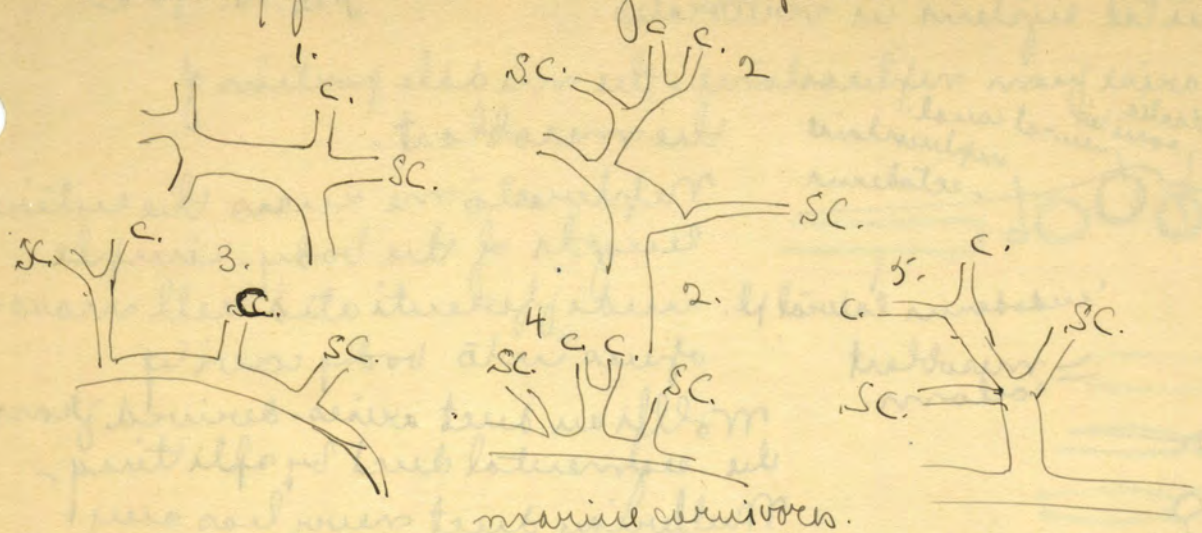
In mammals 2 sets of semi-lunar valves - at base of pul. art.





Only left arch persists in adult - record of five that arise in the embryo - some think it the fourth.

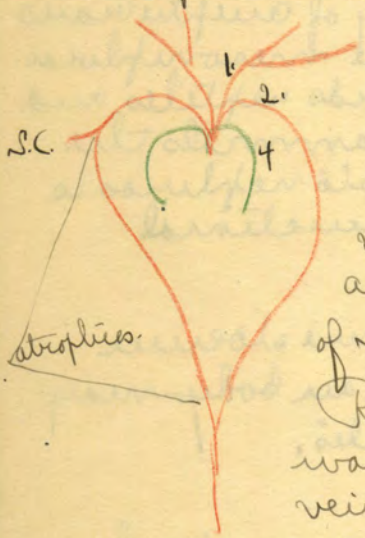
Tendency of vessels to migrate upand down main trunks



marine carnivores.

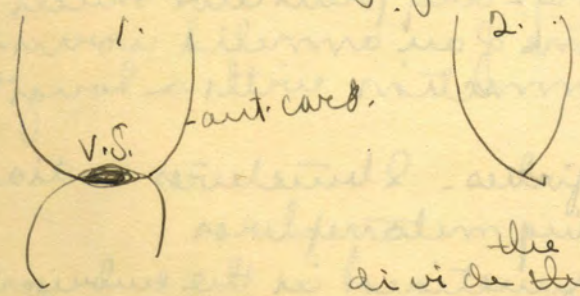
Most posterior portion of aortic arch represents Ventral aorta.

1-2-4- arches are present.



Venous system with mammals is like that of reptilia - Post. vena cava exactly the same. Cardinals disappear - replaced by azygos veins - comparable to vertebral veins of reptiles - one may atrophy.

Renal portal system - caudal portal absolutely wanting - lateral veins wanting (umbilical vein.) & system much reduced - only post vena cava present - rest all gone. Migration of anterior cardinals (jugulars) from right to left.

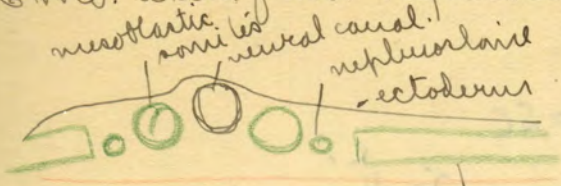


Transverse vessels develope - lower portion abdominis - and blood passes through a single trunk the anterior vena cava - after they divide they are called jugulars.

*A secondary connection which has resulted in transference of blood to other side.

Uro-genital system in vertebrates. Feb. 16. 1905

Emb. arise from nephrostome - the middle portion of the mesoblast -

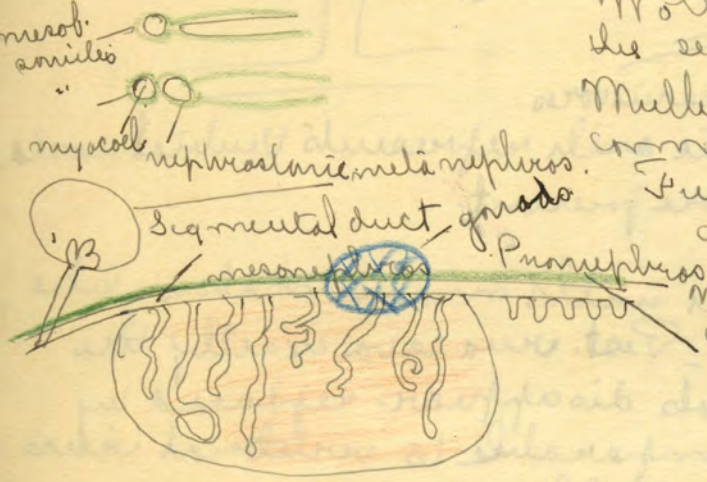


Nephrostome runs the entire length of the body - simple undifferentiated cell mass - opens into body cavity

Wolffian duct arises - derived from the segmental duct by splitting -

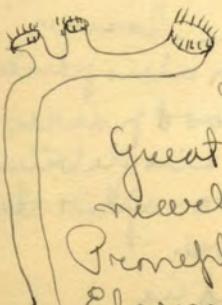
Mullerian duct never has any connection with tubules.

Functional kidney of amphibians and fishes is the mesonephros. in birds reptiles and mammals the meta nephros is functional



Gonads appear as a thickening on peritoneum a little medial to the Wolffian body - may become either ovaries or testes.

Amphioxus - no segmental duct - a series of nephrostomes lying in branchial region, homologous to pronephros, probably - very primitive much like the nephrostomes of an annelid worm - never have any connection with a longitudinal duct.



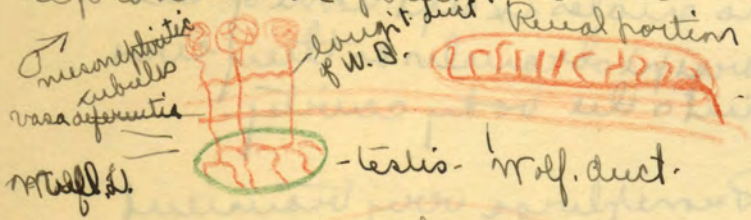
Great jump to condition in fishes - 2 nucleoles in diagram nearly all present, excepting metanephros -

Pronephros always present functional in the embryonic Elasmobranchs and Marsipobranchs. Segmental duct present in embryo - splits longitudinally into two ducts - Mullerian duct opens in funnel shaped opening

behind the heart - this carries the female reproductive material - Wolffian duct concerned in removing excreted renal tissue and male reproductive material - In female this is rudimentary, the Müllerian well developed and vice versa.

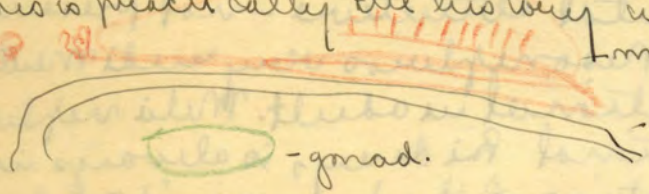
Intermediate condition. animal may become male or female - no meta nephros in Elasmobranchs -

Two distinct portions of mesonephros - a renal and a reproductive portion

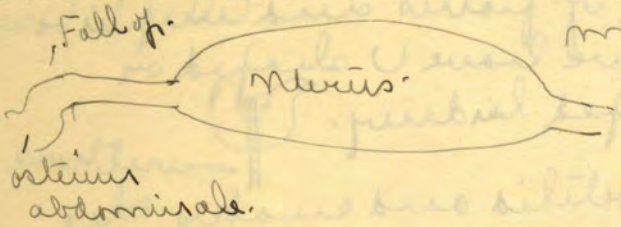


Slows well in male Elasmobranchs. Anterior portion of Wolffian duct is known as the vas deferens - tubules are spoken of as the epididymis.

This is practically the history in all male vertebrates.



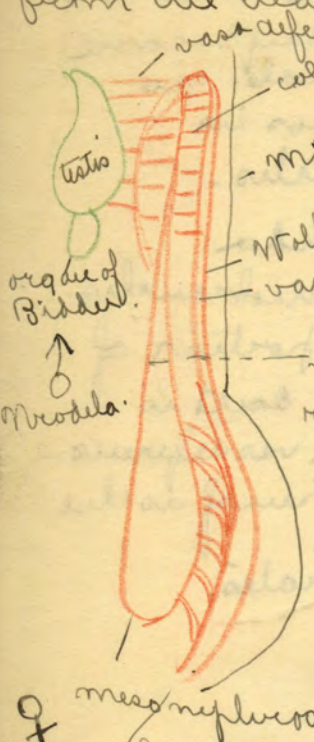
In higher forms Mullerian duct does not remain a simple tube - walls of anterior portion become glandular and enlarged - become known as the Fallopian tube - part becomes muscular and dilated - known as the uterus - or uterine area.



In Birds no special features - kidneys are long and narrow, renal and sexual portions better differentiated. In Reptiles the pronephros is very rudimentary. The kidneys are sometimes fused, the tubes are fused - a dilation formed called the urinary bladder - not homologous to the allantois bladder of higher forms.

Amphibians much as in fishes. Pronephros plain in

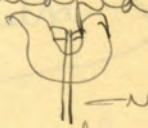
embryo but transient, lost in adults except the Apoda - where it is large with 10-14 glomeruli - but is very functional. In old individuals it is of less importance. The mesonephros is functional in all others. it extends from the heart to the cloaca.



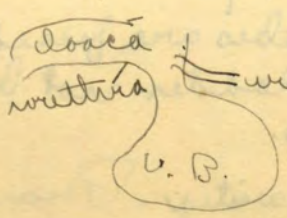
Male Rhodela shows specializations and condensations

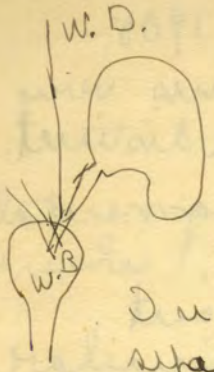
In female ova break from the surface of ovary into body cavity and pass into Müllerian tube, in no orders except some of the Marsipobranchs do they ever get into the body cavity.

Reptiles - Pronephros very transient developmental structure - not present in adult. Mesonephros very rudimentary - never functional in adult. Meta nephros is the functional kidney, is always in posterior portion of the body cavity, pelvic region. Rounded bean shaped structures, have bean ureters, not homologous to so called ducts of fishes and Amphibians. In Lacertilia we have U shaped or horse-shoe shaped kidney.



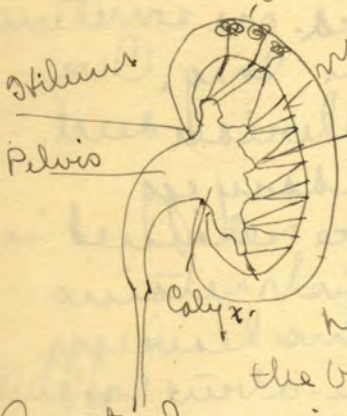
In legless Lacertilia and snakes the kidneys are long and slender. True urinary bladder develops from the posterior portion of kidney.





Wolffian duct no longer associated with conveyance of renal excretions - only male reproductive materials.
In birds no urinary bladder - otherwise same as in reptiles.

In Mammalia kidney systems still further separated. Metanephros reaches culmination of its development. Always lie in the lumbar region, usually not symmetrical - sometimes one absent and other hypertrophied.



Adult kidney in higher forms lobed, but adult of lower forms and embryonic forms have the kidneys lobed to correspond to divisions of calyx. Generally lie in cortical substance. Ureters open into posterior wall of bladder. In Marsupials the bladder is wholly allantoic in origin - Great change in the region of the cloaca - copulatory organs etc.

Feb. 23. 1905.

Reading notes: —

Development of teeth - dentine comes from the vascular layer of mucous membrane of the jaw - enamel from the superficial or epithelial layer - Latter dips down into the surface of the gum and forms the enamel organ or gum. rudiment of tooth Beneath the vascular areolar tissue becomes separate, forming crown of future tooth - one, two or more eminences, this is the dental papilla or dentine germ - by its change into dentine the bulk of the tooth is formed - the unossified center remains as the pulp. Hardening begins at outer surface of the apex. Enamel cells adapt themselves to dentine like a cap. Follicle or tooth-sac enclosing both dentine and enamel germ - forms - grows from within outwards - Enamel from epiblast - dentine and cement from mesoblast.

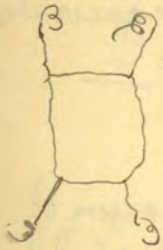
Feb. 28, 1905 -

In lower vertebrates - reprod. and excret. systems very closely associated - in higher animals also more distinct.

In female Amphioxus gonads are simple segmentally arranged bodies lying in pharyngeal heart, when ripe break into atrial cavity and are forced out.

In Marsipobranchs arrangements are similar, ova break directly into the body cavity - in some cases pass out thro' abdominal pores. in others thro Wolffian ducts.

In Elasmobranch - ovaries are far forward - one sometimes atrophied. ova are large sometimes an inch long. Ova pass into body cavity then into the Müllerian duct. Fertilization takes place in this duct. Secondary egg membranes developed. Sometimes ova are retained in lower portion of Müllerian duct. Dog-fish retains ova for a year - period very long. Other forms have egg covered by a parchment like membrane - a true egg shell.



- egg of some Elasmobranchs are viviparous - others oviparous - no other fishes have so many different modes.

In Teleosts Müllerian duct apparently wanting, its place is taken by a peritoneal fold - not homologous to tube - for that appears in embryo and then disappears. This egg tube sometimes covers ovary and passes as a continuous tube to the cloaca - sometimes only a vestige and eggs are extruded directly into the body cavity.

In fishes copulatory organs are not numerous. Vestigial in female Elasmobranchs - absent in Teleosts.

In amphibians condition is typical. Ovaries about middle of body, with eggs projecting into body cavity where they are picked up by Müllerian tube -

All are oviparous.

In Birds and Reptiles - a typical condition - oviparous - a few reptiles viviparous.

Lower end of Müllerian duct developed to secrete a more perfect egg shell - in addition to glands secreting albuminous and fibrous membrane we have glands depositing lime salts - true egg shell.

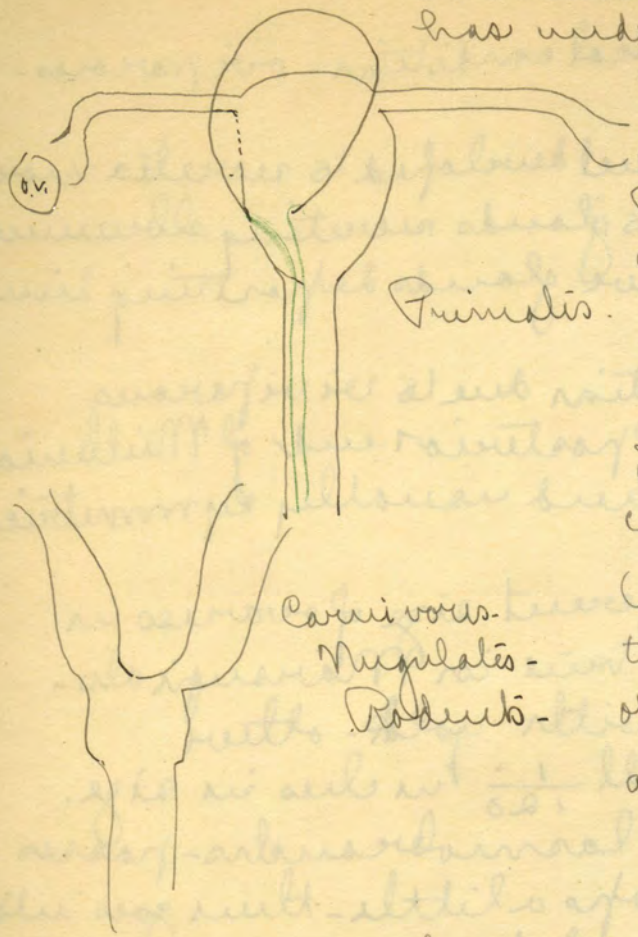
Mammals great specialization due to viviparous condition. Modification of posterior end of Müllerian ducts. Both ovaries present and usually symmetrical - at brim of pelvic basin.

In Monotremes a relic of different size of ovaries in reptiles - left usually larger - true in Marsupials. Eggs large heavily loaded with yolk. other mammalian ova very small $\frac{1}{120}$ inches in size. Eggs are produced just as in Elasmobranchs - passes into Müllerian tube - develops a little - then goes into mammary pouch where it develops.

Echidna - suggests a reptilian ancestry. Very simple condition.

In Marsupials changes will finally result in separation of Müllerian ducts from cloaca - Opossum - this shows the beginning of the fusion of the Müllerian ducts which reaches its culmination in the primates -

In Primates whole Müllerian duct has undergone a fusion which leaves only the posterior ends free.



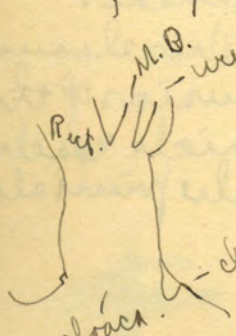
Primates.

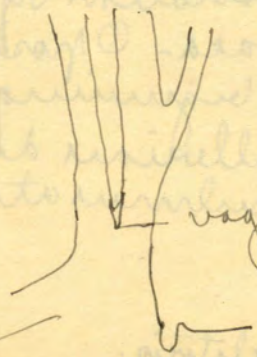
Posterior portion of Müllerian ducts gradually migrate downward and finally form a tube called a Vagina - the female copulatory organ - In Primates vagina is composed exclusively of ducts - All three tubes open originally together - but in Primates finally open separately tho' in the same area.

External genitals -

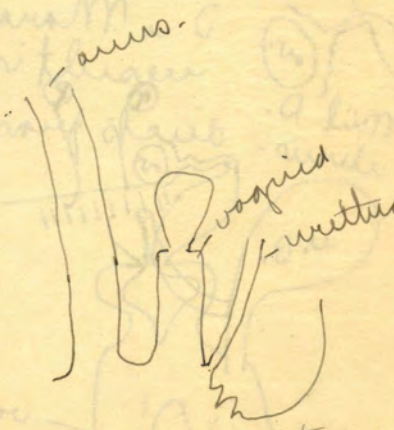
Carnivores.
Ungulates -
Rodents -

- Two horned uterus - present as an abnormality in human beings!





Marsupials.



Primates.

Male reproductive apparatus.

Male gonad or testis arises as does the ovary - at first is indistinguishable -

Amphioxus - paired gonads - sexual products extruded into atrial cavity and forced out.

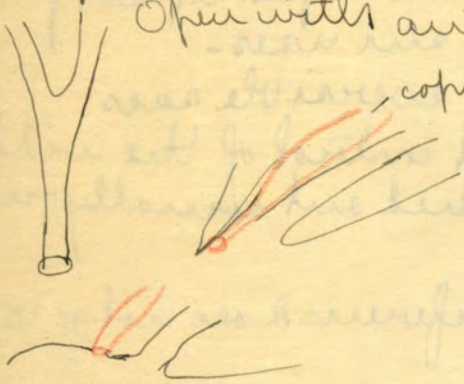
Elasmobranchs - Müllerian duct disappears. Mesonephros has lost its renal function and transmits male sexual products to exterior. Epididymus - convoluted end of duct.

Vas deferens - ducts which normally convey are absent.

Wolffian ducts - and a fold of peritoneum takes the place -

Open with anterior end of anal fin.

- copulatory organ - produces internal fertilization.

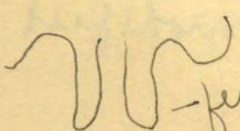


In Elasmobranchs there is a copulatory organ - the mesial edge of pelvic fin. Copulation always takes place by agency of anal or pelvic fins - no penis.

In Holocephali male has a clasping organ - large during breeding - contained in sacs at base of pelvic fin - fastened in pelvic fin of the female during copulation - holds her firmly -

- male

In Amphibians no copulatory organ - others exist like that of Elasmobranchs - mesonepheros better developed.

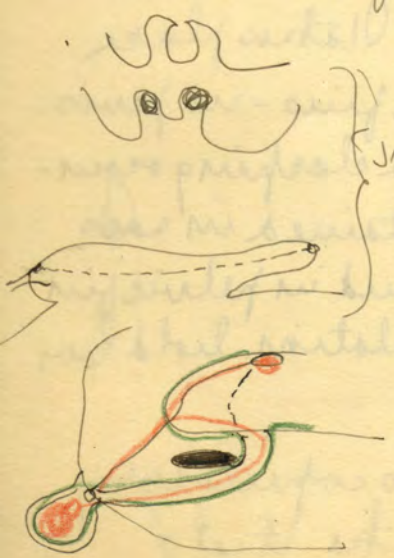


- female -

In some the sperm is gathered together - surrounded by a secretion and extruded into water - Females gather them up - Nereids -

Organ of Bidder - lies close to the kidney - sometimes contains a well developed ova - ova have been found in the testes - Perhaps Amphibians were parigenetic - maybe an hermaphrodite - Really unknown what use is.

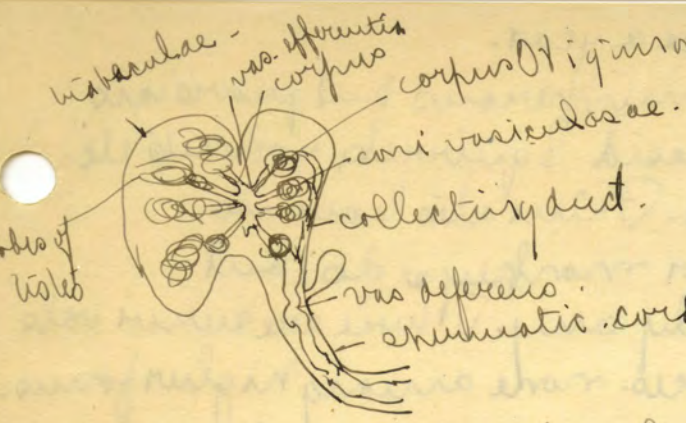
Reptiles - a marked change - all forms except Sphenodon have a copulatory organ - Mesonephros more differentiated. Posterior ends of Wolffian ducts modified - Sperm also carried by them to exterior - Turtles and crocodiles have penis well developed - a pair of ridges containing a complex of blood sinuses - Snakes and lizards have a pair of eversible sacs situated at corners of anus - under control of the will - Squamata have erectile tissue - pushed out usually only one at a time.



Turtles and crocodiles - vas deferens does not go to end of penis.

In Mammals this process is carried to a greater extent - Testis descend to a position in a fold of the integument outside the body - folds are called the scrota - Cause of migration not known - a poorer position for gland - not well protected - Canal completely closes in some animals - in others like horse - elephant etc - it remains open and testes may be drawn back into body -

Anterior end of mesonephros modified



March. 2. 1905.

Copulatory organs absent in lower forms - fishes have modified fins but not a true copulatory organs. Reptilia beyond Rhynchocephalians have true organs.

Thickening of tissue in cloaca, corpora cavernosa.

Mammals have the organs well developed - present in embryo whether male or female. A series of folds and ridges form on genital ridges different in male and female.

In Echidna penis and clitoris are always in the cloaca in placentalia & marsupials it is extruded.

Labia majora and scrotal sacs are homologous. Labia minora and prepuce are homologous.

External genitals are modifications of tissue surrounding the primitive reptilian cloaca.

Three essential parts - a pair of ventrally placed rods of tissue, the corpora cavernosa, glans penis.

Glands associated with external genitals - prostate gland at base of urethra - necessary to life of spermatozoa - 2. Cowper's glands. 3. Glands of Bartolin & Littre homologous to one of the preceding - Preputial glands - have an odor-active during rutting season.

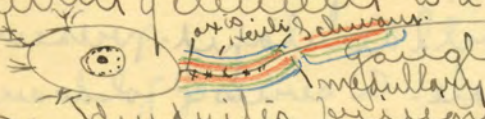
In invertebrates animal reproduces but once and dies, in vertebrates the reverse is usually true. Marine vertebrate Pleuronectes - salmon - breed but once but produce an enormous number of germ cells, millions of them.

Higher vertebrates produce few ova, but produce a great

number of times, usually just once a year.
In Mammalia ova still has numerous but provisions for care of young greatly increased. Squirrels, rodents etc. have definite breeding seasons. Primates have no definite breeding season, lower monkeys do, but Catarrhoid apes have scarcely any. There are survivals of this trait among savage races. more among higher forms.

Sensory structures and nerves. March 7, 1905.

Nerve elements - differentiated portions of tissue that transmit nervous impulses. arise from medullary plate. Transmitting element is a cell with a fibre known as neuron.



breaks up - dendrites branching all into connection with other neurons - Sheath of Schwann - a fatty substance around fibre - outside this a sheath of delicate hyaline substance, outside this the sheath of Henlin.
Breaks in sheath, forming nodes. all may be present or some absent, in grey matter medullary sheath is absent - as it is entirely in Amphioxus.
Capacity for regeneration - cut nerve - proximal end stimulated gives response - others not - as soon as nerve is cut the sheaths draw back letting axis project - the distal part, especially the axis cylinder degenerates. while proximal part grows rapidly - may enter old sheath - nerve regenerates rapidly.


- ciliature on end of nerve

Axis cylinder has two structures. Some say it is solid with small canals containing a fluid structure. Other view is that the fibrillae is solid and intervening matter is fluid. These fibrillae whether solid or liquid are actual conducting which impulses travel -
Myelin may be dissolved out by alcohol

leaving a delicate skeleton, which is called the neurokeratin sheath. The sheath of Schwann is a delicate membrane its sheaths, may be destroyed by alkali - neurolemma.

Space between sheaths of Schwann and Henle filled with lymph. Henle's has long nuclei. These are the most specialized fibres - O thus have no sheath of Schwann - non - medullated fibres have other two sheaths - sympathetic system. Naked axis cylinder in grey substance of cortex - fine fibrillae material at end of sheathed cylinder.

Ganglion cells are centres of nutrition - central activity and growth of nerve elements. (1) cells in dorsal branch of spinal chord - other goes perhaps to sympathetic system.

1. cell - uni-polar

2. Bi-polar cells characteristic of invertebrates found in spinal chord of all vertebrates.

Bi-polar cells.

- another form common in spinal chord.

Multi-polar or pyramidal cells.

Two views of development of nerve fibre - one says that it is a direct out growth of embryonic nerve blast - Another says that nerve is built up of a series of cells - nodes represent places where cells were separated - first view more probably correct.

There are the essential structures-
Man refers all sensations of body & external world.
Not radiation - really not hot. Can completely
understand only our own sensations - interpret others
sensations in terms of our known-
Senses of vertebrates correlated with certain physical
and chemical conditions, fordevable substances and
imfordevable- Senses of Vertebrates-

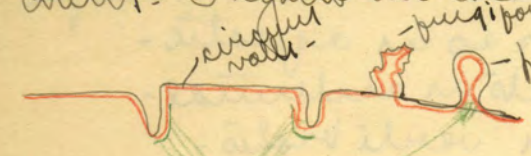
I Perception of fordevable substances.
1. Chemical activity -
a. Undifferentiated chemical sense. = Protoplasm.
b. Gustatory sense. = Taste organs
c. Olfactory sense. = Olfactory organs -
2. Physical activity
a. Contact and impact.
a'. Single contacts. = tactile organs - sense of touch.
b. Vibratory contacts = hearing. auditory organs.
= thermic = thermic organs.

II Perception of imfordevable substances -
1. Light = optic organs.
2. Heat and cold = thermic organs.
3. Electricity and magnetism -

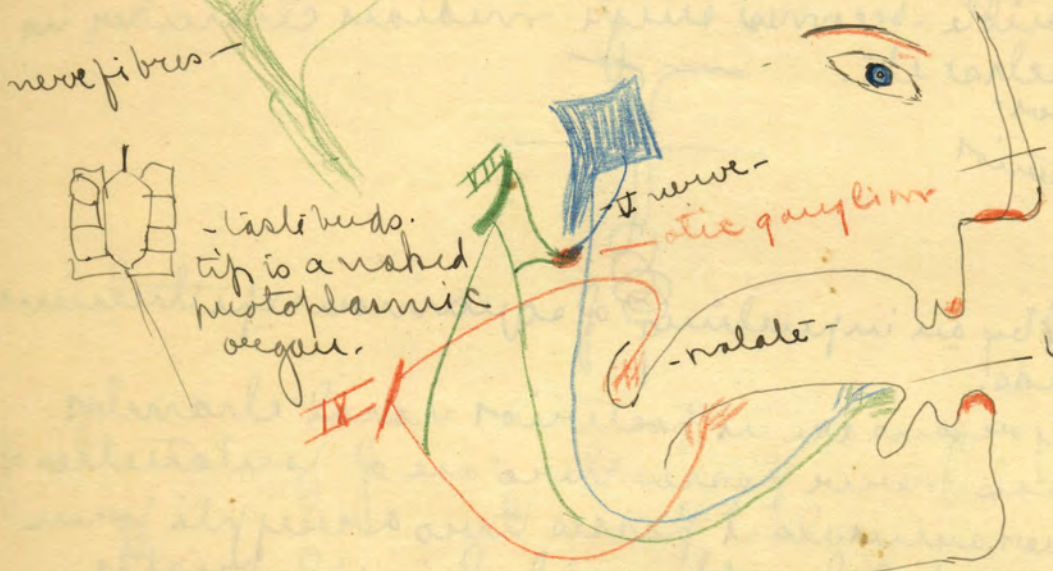
Organs of chemical sense.
Undifferentiated chemical sense - characteristic of lower
animals - in higher animals is differentiated. Certain
elements in blood. leucocytes - possess this sense - respond
positively to chemical stimuli. eliminated undesirable
elements from body.

Sense of taste - simplest of senses.

In lower vertebrates taste organs consist of free nerve terminations - Special sense develops in higher forms. Difficult to work with. really do not taste many things but smell them - Organs all located upon the tongue -



papilli. Gustatii are spread over these four papillae - richly supplied with nerves.



Innervated by V - VII and IX nerves - Sensations in anterior end of tongue are largely touch and heat - posterior IX nerve gives true taste -

Each taste bud is complicated.

Nerve fibres in tongue much mixed - sensory - motor etc. difficult to work out.

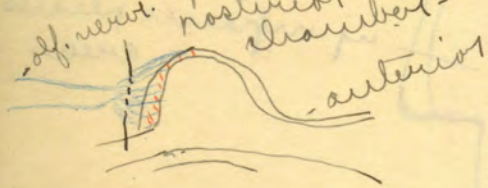
True taste buds cannot be stimulated except by a chemical in solution - Sense is a purely chemical reaction.

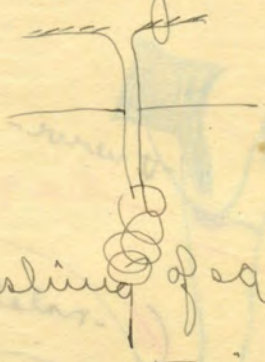
Lower forms have less gustatory sense - present however in all vertebrates even Amphioxus -

organs in these cases are simple spindle cells - end distally in a conical projection (naked proto plasm.)
Sense of taste of worms —

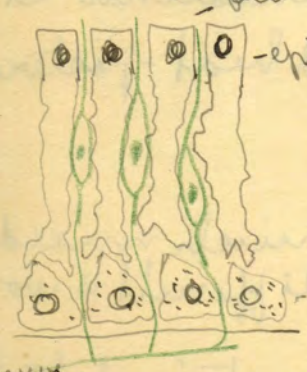
Mch. 9-1905 -

Sense of smell -
In lower animals sense of smell and taste merge. in all vertebrates except Amphioxus the sense is well developed - more acute in terrestrial forms. less so in aquatic - Localized in nasal chamber - in insects in antennae - maxillary palps etc - but not so in vertebrates -
Nose arises as double - becomes single median chamber in Marsipobranchs etc -





Chamber lined by an inpushing of squamous epithelium with rich glands.
Sense of olfactory organs are in posterior nasal chamber.
In lower animals nerve passes thro' one of foramelles of skull - in higher animals it passes thro a cryptiform plate - development of the ethmoid. Simple bristle cells - olfactory cells are the terminations of the olfactory nerves. Olfactory organs adapted only to perception of a certain class of chemical - aromatic oils - extremely volatile - perceived in extreme dilution - Have a bruzine base.



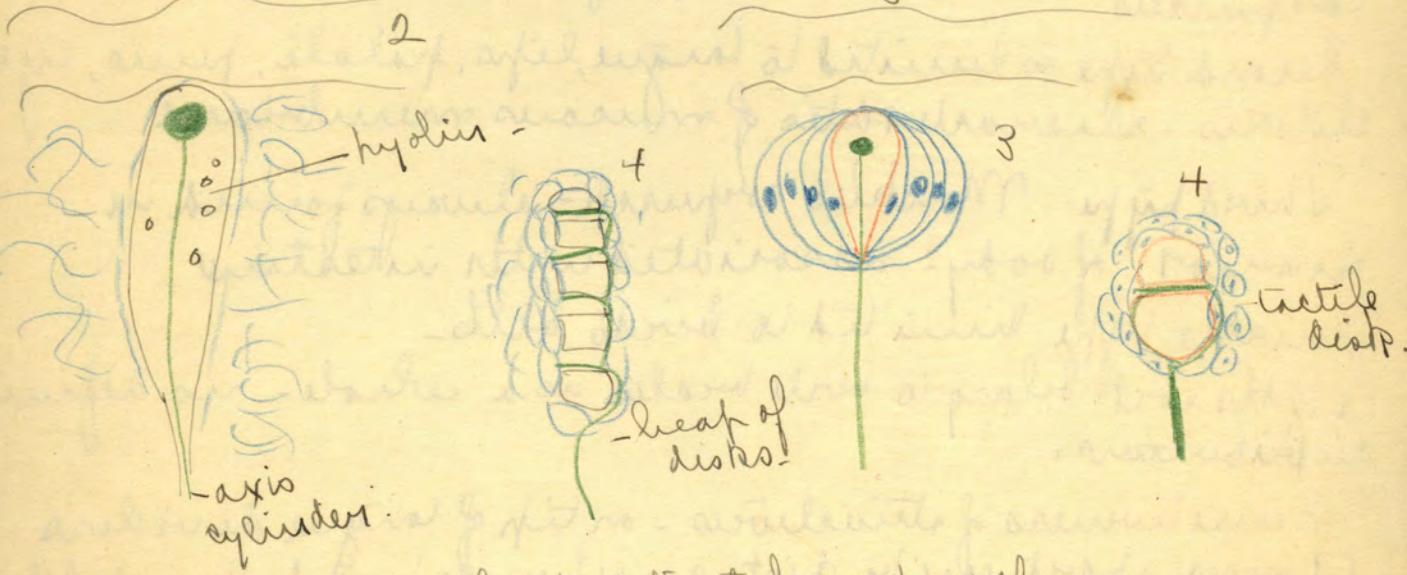
Nature of chemical derivation of a chemical or physical sense. probably the former.

Organs for contact perception - Simplest among the invertebrates - simple bristle cells. Complicated among vertebrates - located in dermis - tactile corpuscle (ends of

Not much difference in size and structure between arteries and veins in Amphibians.

Capsule runs back and becomes contains with nerve sheath. filled with granular substance - an axis cylinder runs up into it breaking up. with bud shaped ends. In palms of hands about 15 of these in every sq. mm. of the integument - most common.

End bulb - a long sausage shaped organ. axis cylinder enters it and terminates in a large bulb.



Ns nucleus in an oval shaped tactile corpuscle.

Tactile disk - highest type is a heap of leaf a dozen or more of these together. Numerous in dendritic portions of bills of geese, ducks and other aquatic birds.

Tactile cell - found in the epidermis - lies about

middle of epidermis in stratum lucidum.

Ecclid free nerve termination - characteristic of cutaneous -

First type is in hands - soles of feet etc - as many as 500 eg. mm. in integument of finger tips - limited largely to these places - but also on back - eyelids - lips and genital organs.

Goldschneider - cut his own finger to study these tactile corpuscles.

Second type is limited to tongue, lips, palate, penis, eye clitoris - characteristic of mucous membrane

Third type. Merkels corpuscle - always found in interior of body - associated with intestine -

Fourth type limited to birds bills -

Fifth sort belong to vertebrates as a whole - no definite distribution.

Sensitiveness of structures - on tip of tongue dividers 1.1 mm. apart can be dist. as separate points. Sensibility does not change with age.

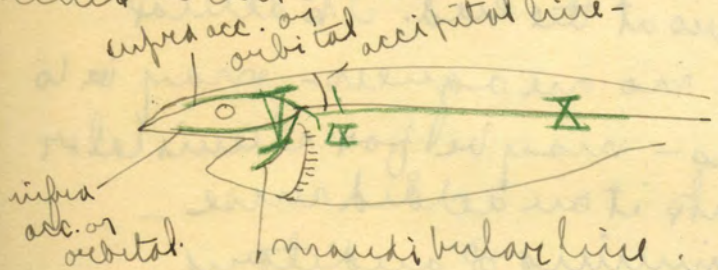
Eg. occupation etc may make integument tougher and less sensitive.

Mucous organs are exceedingly sensitive - no measurements. Organs close together are innervated by same nerve - hence points must be some dis tance apart to be felt as two -

	Man - 39 yrs.	Boy 10 yrs.
Tip of tongue	1.1 mm.	1.10 mm.
Digit - tip.	2.30 mm.	1.70 mm.
2nd. finger "	4.2 mm.	3.9 mm.
1st. "	5.20 mm.	4.1 mm.
palm of hand	5.80 mm.	5.80 mm.
fore arm	45.1 mm.	33.8 mm.
upper arm + back	67.7 mm.	40.00 mm.

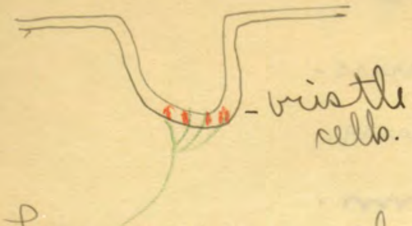
Type in mesoderm associated with intestinal movements and not very sensitive.

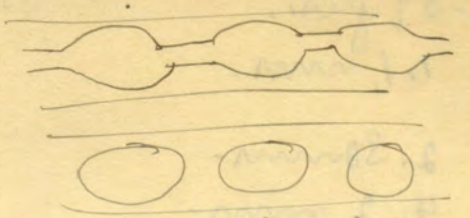
Structures in fishes, vertical in Amphibians, organs of the lateral line - described as canals running in integument lined with mucous and containing sensory pits.



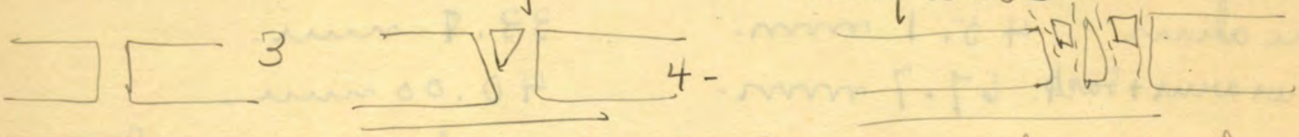
Lateral line present in all fishes - occipital usually present, but others may not be visible.

Cross section canal is visible - filled with mucous secretion. Bristle - mesoderm, also recall those of Amphioxus and those of a number of fishes. This is first stage there are in vaginations places containing cells with it





Leaves round opening into which water can enter. In Amia they soon divide — as many as 4 or more may arise.

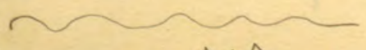
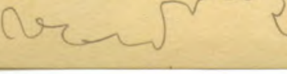


Allows vibrations to enter but hinders entrance of foreign matter — not all supplied by same nerve. V - IX and X nerves go to different branches of it.

System best developed in fishes but persists in Triton. Present in embryos and larvae. Appears with breeding season and disappears at the end. Its actual function is unknown — but no one agrees — may be to receive molar vibrations — may be for chemical or thermic state — others think it an added sense — may be a remnant of beginning of auditory system which arises in close conjunction with it.

Vibrations with short wave lengths — Auditory organs —
E. P. Allis. Vol II Journal of Morphology.

March. 14. 1905

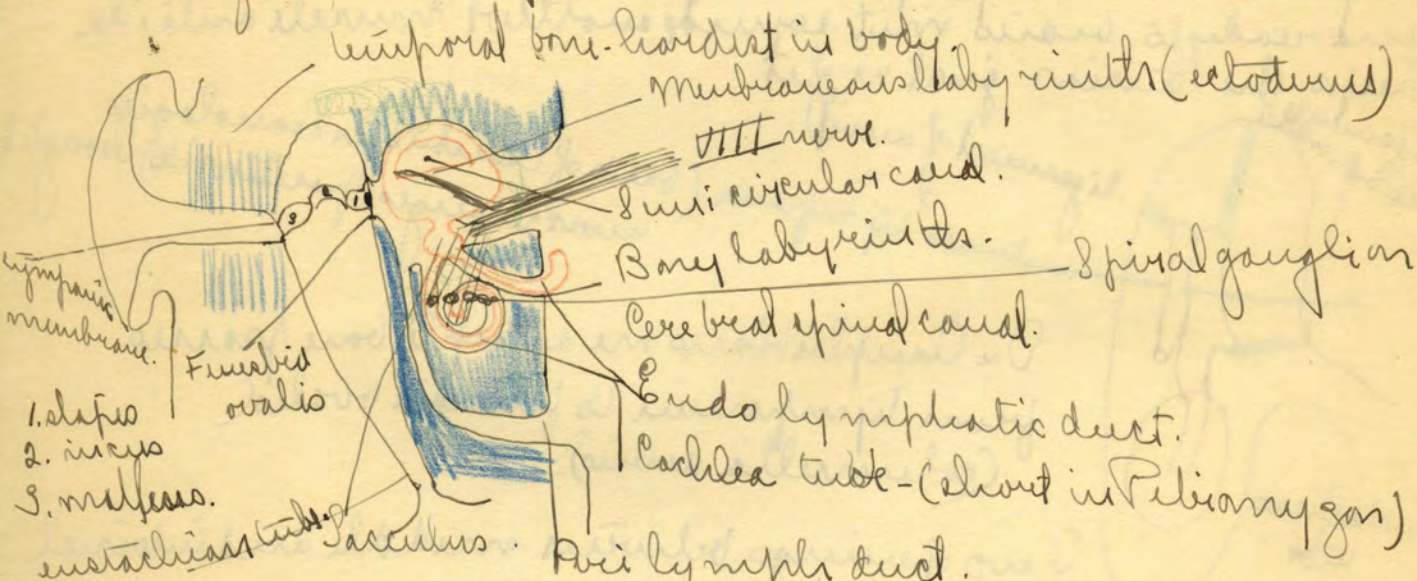
Perception of air vibrations —
Auditory organs run down into Arthropods — but are exceedingly simple in lower forms. Stimuli differ from those of other organs, consist of alternating waves of condensed and rarefied air. Two kinds of stimuli — a sound
 wave or musical tone — and noises —
 — one rhythmical — others not so.

Length and duration of individual waves very different - 24 to 1056 vibrations appreciated by average ear.

Present in lowest forms except Amphioxus. In Manxi fibranchs a well developed internal ear embedded in cartilage of tympanic region - window the fenestra ovalis. Waves reach ear by vibrations thro' skull - no organ for the purpose - the ear answers for organs of equilibration - Amphioxus has no such.

Man and mammals.

Position of ear exactly the same in all vertebrates.

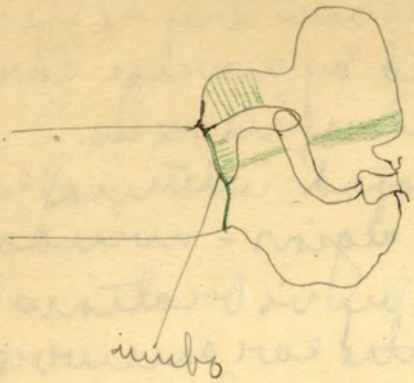


Perilymphatic duct serves to keep spinal fluid in equilibration - as does the Endolymphatic duct.

Middle ear a portion of hyo-mandibular arch.

Middle ear

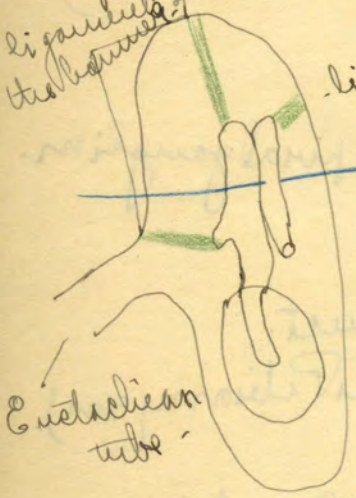
Mechanism of the middle ear a arrangement for transmitting sound from external world to the fluid of the inner ear - Ossification of the skull in higher vertebrates renders that method of hearing impossible.



Upper portion of ty membrana very delicate and easily ruptured - T muscle ty tympani keeps the ty membrana tense and ready to vibrate with sound, another muscle outside keeps the tension just right.

ligament of incus.

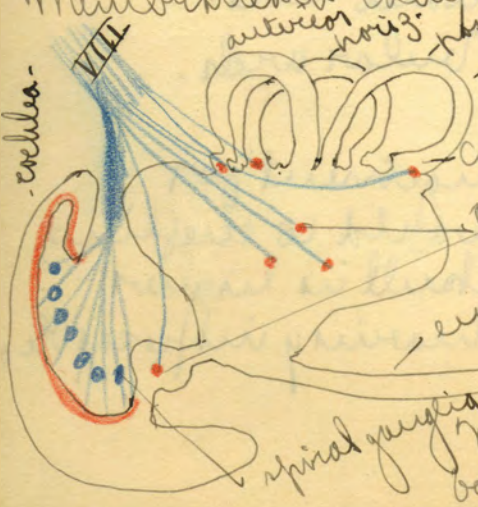
tensor ty tympani (basis of Cambridges homologies never changes position in thought)



In Amphibians are simple bone passes from ty membrana to fenestra ovalis (columella auris)

Two openings between middle and internal ear fenestra ovalis and fenestra rotunda -

Membranaceous labyrinth.

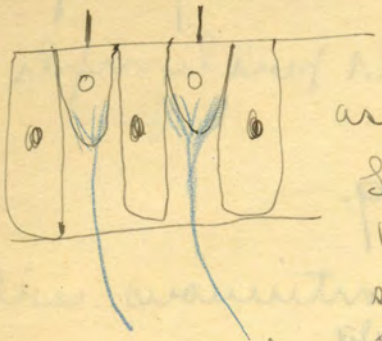


Represents any of any vertebrate with some changes in cochlea and canals.

Ampullae are always supplied with bristle like definite sensory nerves.

Maculae vary in number and position found in saccules - good nerve supply

Ampullae, macculae, spiral ganglia and cochlea are most important to us.



- same as all other sense cells - directly associated with function of equilibration

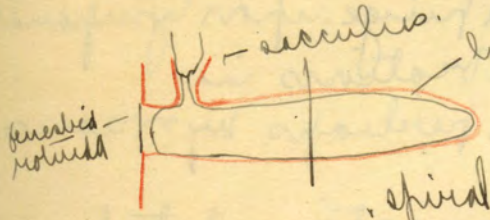
Small calcareous concretions which tumble about in ampullae - almost suspended in the fluid. (otoliths)

- ampulla

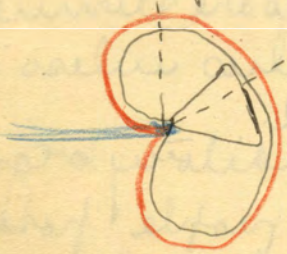
Elasmobranch with semi circular canals severed can not equilibrate itself.

Cyclostomes closely related to if not actually derived from lateral line system.

Cochlea - definitely the organ of hearing, if nerve going to this be severed no sound can be perceived - has nothing to do with the equilibration - Extremely complicated -

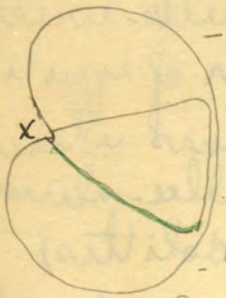


spiral ganglion.
lamina spiralis.



March 16, 1905-

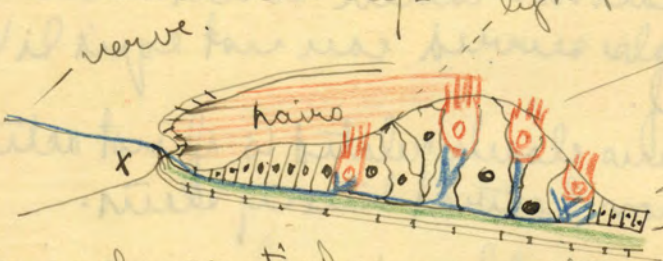
Cochlea - definite seat of auditory sense. Cells concerned with function of equilibration - cochlea very complicated.



- Scala vestibuli - filled with perilymph.

- Real organ of hearing.

- Helicotrema - more or less continuous with the brain cavity - lymph cavity



- ends - thelial cells.

Four rows of essential sensory structures in the auditory organs. inner and outer hair cells - inner and outer cells. 3600 - 3800 - 12,000 -

Number of fibers in basalar membrane 24,000.

Method of stimulation - vibrations impinge upon tympanic membrane, pass across bones, set up vibrations in perilymph which are transmitted, perhaps by means of the hairs, to the sensory cells.

With a given tone only certain cells are stimulated, tuned - sound produces no stimulus unless it comes to a certain cell tuned to this sound.

Noises probably affect the whole auditory organ.

Range of sounds - Not all animals or people possess the same number of cells nor same ability to hear sounds. Insect sounds often inaudible to human beings.

Auditory organ exceedingly complex - associated both with hearing and equilibration. Diseases very important.