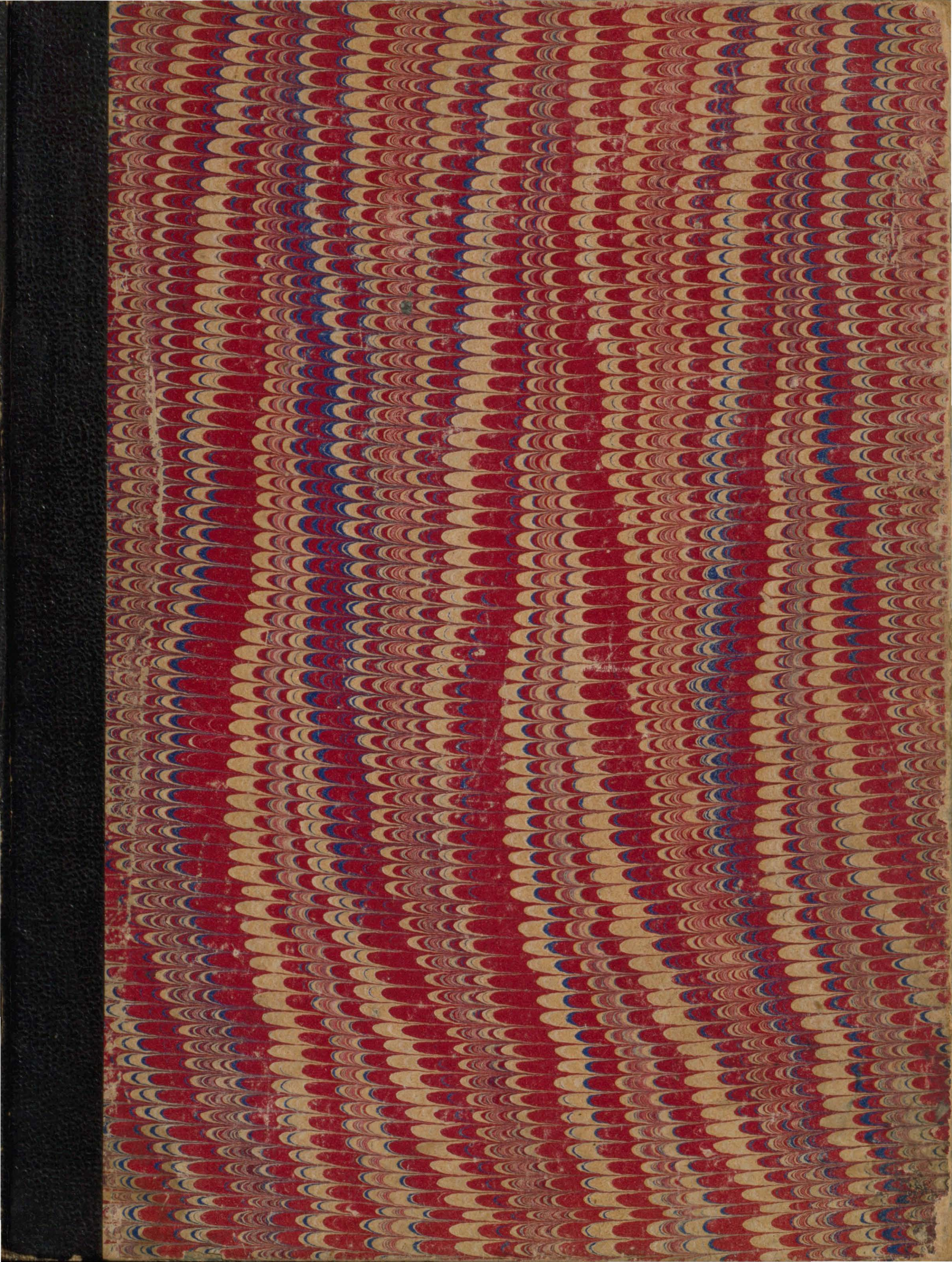

Notes on

Lectures on Embryology

by

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Lecture I

Fecundation

Fecundation produces a series of changes in the ovum, the nature and consequence of which we shall examine in these lectures and we shall follow them up to the time when in the embryo the rudiments of organs shall have completely differentiated. This constitutes General Embryology. The Morphological changes will not be dealt with, but we shall speak of the transformation of the primary tissues into the permanent which constitutes Histogenesis. First as regards the nature

Nature

of the act. This axiom may be laid down viz "that the action of the sperm is one of contact". We shall now notice some of the various theories

which have been advanced. Some romantic naturalists thought that the action of the sperm consisted in an influence of the male sex on the female organs, resulting in a reflex action on the ovaries and ovum. Others said that the sperm acts solely on the blood of the female and it on the ovum. A third series of authors held that the sperm acted on the ovum by means of an aura seminalis. The first experimental proof of the above axiom was given by Sp who demonstrated that the sperm of a frog when brought in contact with the ova, fertilized them, but if only suspended over them or seperated by a thin membrane no fertilization resulted. Another experimenter showed that if one cornu of the uterus of a Mammal

was ligated, ova never developed in it or if the oviduct was secured or the whole uterus ligatured

The second axiom is that the spermatozoa form the essential ingredient of the seminal fluid not the Liquor seminalis. Numerous observers have found the spermatozoa along the whole genital tract, in the oviduct & even in the ovary itself. They have been found in the albuminous layer which coats the ovum in the Fallopian tubes of mammals.   has seen them inside the zona pellucida in lively motion and even in the germ itself; also bundles of filaments – the tails of the spermatozoa have been detected in the ovum. When the ovum is in the uterus nothing can be found of the sperm either inside or outside. Some have

even asserted that the spermatozoa take a part in the developments of the ovum & that their function does not cease with contact. In this manner the inheritance of faculties from the father may be well explained

Circumstances. These differ in the various kingdoms In the lower vertebrata and Amphibia fecundation is outside the body. In Bird & Mammals it takes place inside, but <u>where</u> was long disputed In Birds it does not take place on the ovary but as shown by   at the abdominal extremity of the oviduct where a kind of receptaculum seminis exists and the ova are fertilized as they pass. Home showed that in the human female even without coitus ova were discharged and that at each menstrual period. The same

was demonstrated for the lower animals when in heat. Where fecundation takes place in Mammals is still disputed, but the best observers hold that it may take place anywhere from the ovary to the uterus, depending entirely at what point the sperm meets the germ. The phenomena of ovarian and abdominal pregnancy shows its occurrence at & about the ovary

Morphological value of the unfertilized ovum

In Teleostean fishes the ovum consists of (1) the vitelline membrane inside which two bodies exist - one large, round consisting of fat - the yolk; the other discoid placed in a depression at one pole - the germ, consisting of protoplasm, which is capable of spontaneous movement. This germ lying in the yolk is called the Blastoderm. The same arrangement

Ovum in Birds viz vitelline membrance, yelk and in it the germ

Yelk This consists of two parts 1st the cortical portion & 2nd beneath where the germ lies is a thick blunt process extending down into the cortical portion, called the white yelk

Germ consists entirely of protoplasm & is the only part of importance It contains a germinal vesicle & inside it a germinal spot. The ova of Reptiles are like those of the Birds, but in the Amphibia it is different Here there is a thin vitelline membrane and all inside it is germ through which the yelk is distributed in the form of rectangular crystals or yolk plates and pigment granules. Near the centre the vesicle and spot exist. This condition is also

met in Mammals, i.e. a thick vitelline membrane or Zona pellucida enclosing the contents, which are in Amphibia are all germ, the yolk being distributed through it

Vesicle found usually in the centre, contains a clear fluid and a spot which in mammals is often multiple

We thus see that the ova of vertebrata may be divided into two classes; the first comprising Teleostean Fishes, Birds & Reptiles, in all of which the germ is distinct from the yolk and secondly the Amphibia and Mammals in which the germ contains the yolk as granules & c. In Fishes no vesicle or spot is formed. We have thus seen the relations which the parts of the unfertilized ovum bear to one another. The germ consisting of protoplasm

-which possesses the power of motion;- the vesicle and spot may be considered physiologically as a "cell" The yelk has merely a nutritive value. The difference between the ova in the two classes is expressed by the terms M blastic which includes the first class. Teleostean fishes &c & Holoblastic comprising the second

11/1/73

Lecture II

Segmentaion

The first change which the ovum undergoes after fertilization is a division of the germ into two halves, each of which divide again & so on, until the whole is split up into a number of elements, called embryonic cells. By what means does it segment? It does it by the inherent power possessed by protoplasm in virtue of which it not only can alter its

shape — move but also divide. All cells that undergo division are amœboid move. This movement may be seen after fecundation & before cleavage begins, though many embryologists consider that the amœboid movements are the first visible effect of segmentation

Some consider the first effect of fecundation to be the development of the germinal vesicle, which, in the ripe ova of Birds, Reptiles, Batrachians & Mammals is found peripherally

Some hold that the vesicle disappears before segmentation, first getting more & more peripheral. Purkinje held that the fluid which resulted from the rupture of the vesicle played an important part in development

The power of rupture or of escaping from the ovum is supposed by some to be connected

with the amœboid movements, but no observer has seen this movement before fecundation. Another class of authors -among whom are van-Beneden & Liebig- believe & Klein thinks rightly that the germinal vesicle remains and <u>gives origin to the embryonal cells</u>. The high authority of the supporters of this new as well as the difficulty of otherwise accounting for the embryonal cells, give great weight to this supposition

Segmentation is easily studied in Batrachians. About the end of March R. temporaria deposits its spawn, ova pigmented & enveloped in a gelatinous mass

In April the common toad deposits its spawn in strings. Immediately after the deposition the ova may be seen to be not spheroidal but bolling as if they had been slightly pressed. After this it goes

through a series of contractions & expansions
These oscillations continue and become
smaller 6-7 hours after the deposit and
more extensive. From the germ grows up a
knob which is retracted, again protruded
perhaps in another place. Soon a notch
appears at one place & about it the oscillations continue. It may & does retract
often but finally gets fixed. Shortly after
a similar one appears on the opposite
pole goes through the same changes
On looking now at the upper surface a
furrow or groove may be seen, from which
secondary furrows may be observed, also
branched, called "corona plicata". One of the
secondary furrows is or becomes larger &
deeper than the other.

Earliest changes in Mamm. alive ova. First assertions may we are Bischoff's. He stated: when Mamm. ova esp. of R. & Dogs sexually attached enter oviduct, the germ gradually retracts from z. pellucid. Said that in ripe Mamm. ovum the z. pell corresponded to vitell. memb. in others & surrounded the germ. The retraction of it from zona is the first visible change. Another assertion not confirmed till now viz that germ after retraction performs rotations. He attrib. it to fine cilia wh. project (accor. to him) from the germ. He only in one case saw this rotation & till now not seen by anyone. The Mem. of this stage, viz when germ has contracted, germ vesicle not to be seen but that does not prove non-existence. It divides itself in 2 halves each is also provided with vesicular nuclei & these may be regarded as the matrix from which nuclei of all future embryonal cells derive. Van Beneden & Wolf saw two nuclei also in germ after it had contracted & before it had undergone first stage of cleavage. In this stage when

germ in two halves then exist between glair substance & Z. pellu. one or two or 3 pale fine granular spherical bodies. Bischoff took them as germ vesicle wh had left the germ before cleavage. but he gave it up afterwards. Coste who also saw them thought likewise. These bodies not only found in this stage but also in later wh germ had segmented in many cells; similar ones seen between lump of Emy cell & Z. pellucid. Blacker. matter. One of these dilemmas of Bis & Coste. He is trying to show that before germ undergoes cleavage or ovum is even fertil. it tries to get rid of the Germ vesicle. Signif of these bodies is not yet clear. During passage thro upper oviduct this germ divides & subdivides. till consists of 16 elem each of wh has a nucleus. When it enters the Cornu uteri these elements are arranged within Z. pell so as to surround a cavity to form a vesicle & that fr. elem; Baer. & calls ves. blastoderm, Coste. Bisch states that ov soon after entering the uterus shows a vesicle whole of wh consists of polyhedral cells & looks like mosaic

from the surface. In one place a mass of opaque cleavent project into the cavity of the vesicle: these masses are regarded by all as offsprings of the germ like the wall of the germ vesicle. Not yet made out what becomes of these. Bisch. thought that median ent of embryo owes its origin to them. Coste asserted the same. Bisch. in his last work altered that by saying he was not certain wh. it had much to do with it & Remak asserts it has not anything to do with the development of the embryo. Elements which form wall of germ vesicle arrange themselves in one coat while whole ovum is growing. In later stages ovum shows an opaque spot at a point. o repr the area germinativa in which the embryo appears. This is area germinativa, soon gets elongated & shows a contrast between central clear area pell & a periph opaque. ing the a. opaca. In the centre of ar. pellucida an opaque stripe appears wh. represents the same thing wh. in chick is the "primitive stripe" or axial cord

In wh^at relation stands this a. germ to the layers of the germ vesicle? Bis. states that the elements wh have arrange them previously in one coat separate at this spot i.e. in a. germ. into 2 coats & that this second coat grows inside the upper one all round the vesicle so that soon the wall consists of 2 coats. a. germ is marked from the main part of the vesicle by at this spot both up. & lower coats are thickened. App of a. pel. & a. opa. in the a. germination is due to presence of a third or middle which is much thinner in central than in peripheral parts. at this time the a. pell is dist. a opaq. 3^d coat may be found, whether lower as well as middle coat springs from — not quite made out. Have now arrived in man at the point where coats are dev. & rudi^ments of body so appear. Before consid. the tracing of the [illegible] or & cycle of organs must consider briefly what are the germ. cha

of the 4 Class^es of Vert in which point do they differ 1st. seen that the germ of any vertebrate anim. shows amoeboid movements before segmentat that it comes in contraction & spreading out & prolongations knobs may grow 2 seen that segment may be regarded as direct influen or in intimate relation to the amoeboid motion 3 seen that mode of segment is in all vert not the same i.e. germ 2. 4-6-8 &c till whole germ has segment into many embry cells & is mode called regular segmentation Seen that ova of Tel fish Reps & Birds contain germ as a separate body from the yolk while in Amphib & Mamm germ contains the yolk as granule [illegible] &c. called the 1st Meroblastic 2 class Holoblastic.

In former seen that only germ segments. In latter all that lies within vitell membrane segments. Say on one hand that only germ segment on that all the same.

& 2 may say that Mero ol called ova [illegible] with partial Holob ova which undergo total segm

These points form one series germinal charact-
2 series from points referring to the segm. cavity
Seen that as process of segment goes on, that in Maco
the ova germ is raised from yolk ... &
& into a true cavity, as in Holobl there does
not exist a separ. between g^n & yolk^a segmentation
cavity is established inside the germ, but in
both cases a distinct^th made between that
part of germ wh remains over the segment
cav & the other wh is formed in floor of segm
cavy, either from beginning or wh has become
to be on floor while cavity has developed
In Marsb^artic ova elements of the germ remain
on the floor of the cavy, these called formative
elements. In Holobl^cs of Batrachia one when segm cavy establ^ished
inside the elem wh are below the cavity
& project up to the other pole called also form
elem^ents Similar thing may be looked for in Mam
ova, here also in bottom of cavy large elem
wh resemble or analogue to the formative mass
only their position are not quite evident. In Mam
& ^archic ova in Natr the form elem play an imp

In Teles fish the elements of seg. cavity migrate towards periphery & form the 3 & 4 layers, i.e. the Neuro-germinal & 4 or Epithel-glandular. In same way in Batrachians form elements ~~of~~ segmental cavity are displaced & form 3 & fourth layer. In Bird seen that altho Blastoderm devel like Tel fishes there is difference in that the primitive elements wh migrate toward periphery do not form a 3rd & 4 but form the middle layer. Whence lower & middle layer in Mammal come from we don't know. May be ~~that~~ that mass of segm elements in mamm ova are important for develop either the middle or lower layer. Chief differences as regards the coats in these 4 classes are as follows. In Teleostean fish & Batrachia 4 coats. In Bird & Mamm 3 coats. Upper & 2nd coat of Tel fish & Bat correspond to up of Bird & Mammals. And in Bl of bird that from central part of upper coat the central portion of nervous system from main part the Epidermis & the epith of cutan glands

In Teleo fishes & Batr. central Nerv. system & [illegible]

developed from the 2nd cont. while epid. & epith. from

the upper 3rd cont. of Teleo fish & Batr. = the middle

of Birds & mamm. is the Moto-germ layer

forming the Muscular, connect. tissue & urogenital

organs. 4th in Tel fish & Batr. = lower in

those in Birds & Mm. = Epithelio-glandular

layer. as Mm. membr. & epith. of their gland

Terminology of old only not troubled with Mucous

layer of — as now the common layer. The Germ

layer not much to do with the serous membrane

Remak is followed in terminology. Another

diff in relat. of plurality to segmentat. cavity

In Tel f. & Batr. embryo does not devel. cent-

ral but peripherally (the cleft of Rusconi gives

between [illegible] [illegible]) In teleost fishes embryo (med.

groove) appears in the peripheral thickening, while in chick

it appears right in the centre over segment. cavity

same appears to be the case in Mammals but

in all the vert. ova Embr. bud came relation to

main part of Blasto. i.e. the Blastoderm of the small ova

in Tel fish & B. grows round the yolk & for a [illegible] [illegible]

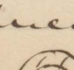
the yolk is enclosed so that it – the embryo – has below it has a sac – the yolk sac – In Batrachia a similar thing is the case, but it does not grow round the yolk. In mammal also a sac – the germ vesicle – it was not grown round the yolk but part of it has transformed itself into the yolk sac

Lecture

Good deal of the dev of organs. & will begin with Cent Nerv system. Remember and that in Such the dors of embryo reps that part wh is by the aliment or Pyramis canal, & it is parallel to the longitudinal axis of it. First thing that apps of the embry is a thickening of the 2nd or nervous layer. In a section trans to the dorsum you see it thickened and at same time seen the dorsal groove & dorsal laminae wh border it. The groove bounded by ridges of the upper layer. Lamin dorsal grow towards each other & finally coalesce & so a canal, this is the central canal of the Cent Nerv sy. The wall of the cent

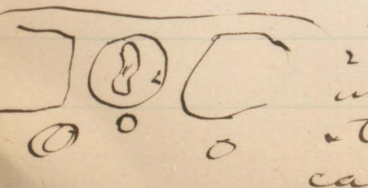
nervous system. The central canal does not close all along at the same time; 1st part wh. closes repres. a place between future head & neck, but more in the neck. From that point the fold coalesce toward the tail & head. Just before the neck there remain a point where central canal does not close & that point reps. the futn form 2 . or floor of 4th ventl. & at the tail part remains a long time unclosed. That part wh. is called brain is soon transformed into a vesicle, the canal gets distended, wall thickened & soon this vesicle becomes divided - not fur-
-ly constr. into 3, the 1st repres. anterior cerebrum. 2 the middle & 3rd the posterior cerebrum. That's all we know about it in Batrachia. Develop. better known in

Bird & Mammals

Here about 14 hours after incubat. appear in A. pellucida in place of chick an opaque stripe  wh. at near one pole thickens there the

Hence the appear of this axial cord due to develop of the central part of the middle layer. Soon after the lateral central part of upper layer thickened or its element mixed with those peripheral part of the middle. This fusion plays an important part in the determination of the term of the uro-genital tract. About 2nd or 3rd day of germ central part of upper by separated from cent part of middle. In the axial cord the dorsal groove may be seen bounded by two elevations the Lam. dorsal. They get more elevated & finally coalesce. In this way dorsal groove stops & the wall represents the central nerv system. Early differentiated. Dorsal groove is lined by the upper layer & the canal lined by a layer of cells which are derived from the upper layer. In Bird central canal has not a lining of special cells as in Batr. In Batr. it represents the epith of the central canal. The central nerv system is closed in most anterior part first, caudal to that point is slightly open at the fovea rhomboidal & same called

Ante. central vesicle forms a curvature in such a way that: the most ant. may be dividing fm ~~post~~. part & represent the ante. brain & give origin to the Corp. callos. & fornix. The post part of ant cent ves is called. Intermedcary brain & give origin to thal^{ami} optici & floor of middle central ventricle. Middle centr ves give orgn of t Corpus quadrigemina Post cent vesicle divides into Ant & post por. former posterior brain or origin the cerebellum & pons varolii. Post part of Post ves gives origin to Medu Obl. At that time when 3 vesicl have diff out 5 the curve of the head is like this  the midd cent vesicl in the highest point in the curve, & that between the middl & anter is the vertical curve Same process as in chic is in in Mammals as Baer. Remak &c in dogs rabbits & others



1 cuticular

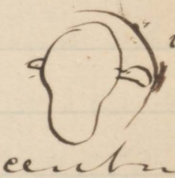
2 the wall. In chic in A the cell which lie most inter become elongated & transf. into the cyl & fill central canal. While others into grey

✓

substance of Cen. Nerv. From post part of Cen. N. Sy. wh after it has expanded upon the ganglia of post roots of spinal cord & from the ant part of the brain of C. N. S. a diff. sensl part from which spring out fibres = the roots of the motoric nerves. &. Cent Ner System gives rise to organ of special sense. Ant cent vesicle already in continual relat to organ of sight & smell. The Post cent. or 3. vesicl in intim relat of organ of hearing. Two other organs in no direct connec with C. N. system

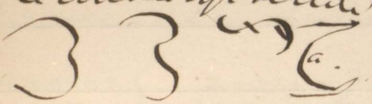
The Eye

studied in Chick & Man. & is the same in both. In a chicken the ant cent vesicl of a chick at beg of 2nd day



we see that the wall of ves. forms a prom into which the lumen of the central ves. is continued. This prom. grows up pretty rapidly & consequently ~~& com~~ a neck & a body with it. & drops the prom approach & the skin at & ups the corneous layer at that point

Upp. Eye vesicle get thickened & [illegible] a gro
in upper border of the prominence. & they grow
like those of [illegible] the Eye. towards & get perfectly sep
arated. the thicken part which after rep the
lens. which This part thicken the Ey. vesicle shows
a depr. which corresp t the thickening & grows
as the thickened part be more separated. & then
transformed into the secondary Eye vesicle
"secondary eye vesicle"



The inner coat of which appears
gives origin to the Retina. the ext.
coat give origin to the Uvea or ~~Choroid~~. The second eye
vesicle united with the cerebral vesicle by a neck
& it represents the Ner. Opticus
Some diff in Rabbit. Not a single layer which
covers the prim eye ves as in chick, there are
two. the Cer. Ves. in Rab devel from a special
layer which is sep from the upper one = the Nerv
ous layer. Lens does not devel in the Rab from the
upp. but from the nervous layer. The grow & growth
of the fold in the sec eye vesicle
In Bird the lens. In Rab it devel from nervous
layer. The transform of the second into the primary
eye vesicle is the same in Rab as in chick

Lecture VI

Int. the layer of prim. opt. [illegible] vesicle wh. consist of two coats, the ext. = pigm. layer or uvea. the inter = the retina. Now the lens devel. from the corneous layer in Bir. from the Nerv layer in Batrach. Lens has at a vesicular shape, ante. thin post. thick wall & a cavity. soon after it has cut loose from the corneous layer. the cavity disappears & the post & anter. walls coalesce. Fig. dia. shows this. ante. wall made up of polyhedral cells & ass. w. columns with elongated ones. which become transform. into lens fibers: the polyhedral ones = the epithel. of the anterior capsule of the lens. At the poles of the meridian. are the points at wh. the polyhedral cells transform. into lens fibers. A point insulated by Kolliker. Find that vitreum devel. at same time as lens. Remak showed not but after it. Authors who studied the develop. before him assumed that transfor. of young eye ves. into the secondary was due to the develop. of the vit.

humour. After lens develops & after it has filled out that space. the C. vitreum develops & it develops little all these parts from the middle coat.

From the element which surround the primary secondary vesicle all these develops 1st corpus vitreum a process from these cells grows thro. the coat of the secondary eye vesicle  a process passing thro. a cleft in the secondary eye vesicle & projects into its interior. [illegible] & fills out the whole cavity & is the Corpus vitreum then have two coats of second eye vesicle & between them the Corpus vitreum. ~~The cleft~~ projects from the [illegible] of lens to middle of eye

Choroides developed next of elements of middle coat. From circle part of that new formed membrane. grows up a process between lens & cornea layer, that represents the iris. [illegible] which grows up from it = Corp. ciliary of cleft through C. vit. has given remains as a cleft & cannot be found in iris as it develops much later. Not yet settled whether the pale stripe found on lower surf. of eye ball frequently is a cleft. Bar. [illegible] & is not a cleft only a thin non pigmented & due to the capillary vessels, abnormally exist in the eye

as coloboma but doubtful if it has anything to do with it. In every eye you will find a clear slope at lower surface of eyeball & represent the choroidal cleft of the embryo. After choroid & iris separated, there appears another coat on upon the sclera & the ant border of it grows in the same way as iris between cornea layer & the lens & the proper cutis of the cornea. The ant epith of the cornea except that part of corn layer which lies over the lens. Whence does the capsule of lens develop from? Some say the middle layer but capsule already to be found when in. nothing of middle layer can be seen. In earlier stages of the devel of lens it may be found & is a mere excretion from it

Ear older Embry look regarded that ear devel as a vesicle from central nerv system. known for long. that it grew from it as a vesicle = Auditory ves.. Huschke. shows grows not from C.N.S. but from the common layer. At end of second day appears on the wall outside hind brain vesicle. a there a small pit

and at that time already, 3 cerebral arches are formed & attains height as seen in each arch a pit is seen. it gets deeper & separates from the covering of embryo. Fluid a depress

Remak described these pro. And vesicle remaining as here until it remains a vesicle. Afterwards then grows out from C. N. Sys. a cord which is hollow = the Ner acousticus. which derives from that part of the posterior vesicle or after brain. And vesicle elongated from elongated club shaped & that pointed part divided down & outer .. from the other part which is upper & posterior a process grows out which is the rudiment of the vestibule & the other end the rud. of cochlea Vesicle changes. Vestibule gets clear in other process Semicircular canals develop from the vestibule. Cochlea grows in length surrounded itself in as to form a spiral shell of And vesicle so of all the part derived from it upon us of the epithelium of the. the membranous & bone all from the surrounding element of the middle cup. In Batrachia devel of and vesicle does not take place from cornea but from the nervous layer as the lens

Inner coat in Bird ner & corneous lay rep second only that what in Bird only the Corneous layer

Olefactory organ

when anter pit & lens grow near before & below it the eye a smaller one the olfact pit. It does not grow up into a vesicle, but stays as a pit the bottom of which is a thick coat derived from the upper layer. & it rep only the epithel. Toward the pit a cord grows out from the anter brain

A slight diff between Bird & Batrachia. In them there app also a pit lined by 2 coats of a center of the nerv & of the corn layer, the prim thicker. afterward they get fused & repr a very thick membr which lines the pit. Also here the corn layer [illegible] & lens all from the middle coat

Fig 2 front view of head of Embr of chick of 2nd & 3rd day. "Huschke who put dorsal eye vesic and that eye vesic develop by lower part of brain vesicle & then a secondary one pr & so explain the phenomenon of Cyclops"

Teleostean Fishes

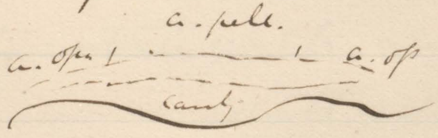
a want of knowledge. Some asserts eye & lens in same way as Bird. Of stage there nothing

James Bovell MD MRCP

Even of C. N. System [illegible] but [illegible]. Some of all the animals. About 17-18 day appear in action the med. groove between two [illegible] dorsal. But first medulla appears as a solid process according to Klein and that the [illegible] canal develop in this process as a cleft.

Lecture vii

Third layer in Blas of birds comes from the elements of [illegible]. End of 1st day that part of middle layer formed wh belongs to a. pell.. 24-30 hours peripheral part of middle layer is formed. How? The formation of that part of Bla wh. he call peripheral part of middle layer in development of that part His bases his theory



That part of yolk on wh Bl lies = yolk ring

1st day of incub changes in segm. cavity and white yolk. In 1st day segm cavity expands gets broader. by raising a part of the yolk on which the Blasto lies

This forms the dome of segm. cavity. We find now that the matrix has cells not vesicular like elements & shiny bodies .. & they remain always the same. i.e. the granules, they seem to blend between pure albu. & fat. These then look like vesicular structures, a membrane, clear contents & clear shiny body. but they are not cells. Before segm. cavity formed it was like the ordinary white yolk He said that they are cells, as this regards them & say that the Blastoderm not lie simply upon the "dome" of seg. cavity but is closely mixed up with clear spherule yolk. this says that Bl. only one layer and sub-germ proc. which meet growing broadly & a second layer is formed in this way. This in A. pellu. In A. opaca when the sub-germ proc grow into the white yolk and then become united with their meshes white yolk lies. These of yolk ring gets transf. finally into true cells & finally go as prod. the primary fund. migrate further & form to vessel. lymph glands &c. this is that.

Another argument. Parablast is the white yolk

yolk

His has failed to show that these elem are cells & exist no such union between element of a. opaca & yolk sing. Bl. remains always separated from the yolk. No subgerm process goes into the yolk thro^does^ the peripheral part of the middle cont of Bl develop? It develops from the remaining element at the floor of segment cav

Periph part of middl del same way as independent from formative element derivation of the Blastoderm. After periph part of middl cont from 12.30 hours after incubation there appears in a. opaca a sinu^ous^ red line ^called. vena or sinus terminalis^ appears which divided the area into two, that part which lies inside the sinus ter is a. vascul.. outside is the a. vitellina or yolk area.

In A. P. we have 3 coat. In A. vas. only two uppe coat. & part of middle. in A. vitell. only upper coat. Called A. vas. fr. most of 1st bl. vessels devel op in it.

Now the organ develop fr. middle coat; First med. prim. count. in a thicken in upp part of up coat. In that central part of Bl.- area lined in it a differential called pla in the midd coat. this part of it diff into two a central cord the Nota cord and proto-ver- & lamin laterales. The part beside the noto- cord are the protovert. extend fr. them the main part of middle coat of a. pellucida is called Lamina lateralis. Soon after the Notocord ~~the~~ appear. the proto-vert appear projecting ~~of~~ main part of middle coat. The Protovert become separated or show the constant in long. axis. these produce appear so called protovertebra From the surface they look hexagonal bodies same part four near portion of head end. behind these others appear. These are called protovertebr. They are never separ from main part of middle layer

The chorda dorsalis then is it first app. an
and spinal swelling. ~~[illegible]~~ It is the first organ
wh. has differ. in the embryo. Lam. lateral
soon sep. into two lam. & between a cleft. wh. rep-
ments the pleuro-peritoneal cavity; the part abt.
is the pleura & the portion = the peritoneal cavity.
That part wh. lies above the cleft - called Haut-
muskel platt. (skin. muscle coat). Allen calls
it ventral lamina. That part wh. lies below
is that of Remak. Intestine fibrous layer
wh. forms as.   Allen calls it Lam
serosa serous coat: That divides int. an
upper thinner & lower thicker. not only limited
to the a. pell. but also in the part provided
w. bl. vas. & there are upper thinner & deeper
thicker which repr. the proper vascular coat.
Great error as to what is vascular coat.
All seemed to think it account of chief lying mostly
in the middle coat. It is then asserted, that
The periph. part of the serous lam. = the vascular
lamina.

Either part or not are touched the lam. lateral
a slight groove. both little a clear line from
surf. From this devel. of the a part important for the urogenital tract very
the Wolffian duct. Remak pt. a ment. that
in this groove a cord wh. cord after become separated
~~x~~ forms the Wolffian duct. Not yet settled whether
it devel. from the middle coat at all. The Wolff.
duct gives origin to whole genital system & kidney
we know that these are epithel. structures & know
that epith. does not develop from middle
coat. His therefore was in a hurry to say that
this cord develops from the upper layer. His
says that at this part ~~of~~ wh. p. you can see
a groove from the upper layer. He changed
his opin. & said it devel. from the middle
Waldeyer says also that it devel. from the
middle & explains its epithel. nature. Remem-
ber we have upper layer was mixed up with
central part of middle layer. The axial cord
may contains in diff depths not only cells
from of mid layer & it may owe its elem
ent to the upper layer because

The chief point is that Wolff did not develop p. [illegible]
the layers

Lecture VIII

Last dealt in mid layer in chick & an. germ. spinar. Ch. div. protover., lamina lateralis. wh. latter gets into L. vent. & lower L. serosa. between them a cleft = pleuro-peritoneal cleft. Where L. later. is continu. with prot. ver. - is the cord. of Wolffian body. The lam. ventriales with corneous layer - transf. into the amn. wh. L. serosa & corneous layer keeps the peritoneum toward the yolk. Only the L. late. & corne. grow up like a fold = am. wh. Serosa & epithel. - placed keeps on surface of yolk. Ch. dorsal cord is wholly is common in neck with axial. 1st ch. only of poly hed. elem. closely packed, when chord gains in thick. & length then cells become transf. into vacuole element so that on transverse section thro' ch. find something like a reticular arrangement wh. at one point posses a nucleus.

Second point - Proto-vertebrae. Soon after their appearance note a central clear part, in cent. clear tissue, in periph. small & nuclei compr. this central point gets transf. into a cavern. or spong. tissue & in this stage seem as if they wanted contain a cavity. these then exh. lamina called Muscular lay. & give origin to all muscles of the skeleton. Remem. always head in central ner. cord & corneous layer. While this diff. into a nervus lamina & main part takes place. this wholl not or ... part grows in down over the central nervous sys.

beneath corneous layer. this repr. Lam. dors. superior = the skin of the dorsum. besides from that Lam. origin. the membranous part of the vertebral column especially the primary vertebral arches. From that part of Proto-vert. wh. lie beside the cent. N. syst. develop the roots of the nerves of cord and spinal. & the spinal ganglion. The P-vert. even grow also all round Ch. dorsalis & that wh. has grown round represents the bodies of the vert. bones. See that from the P. vert. develop Muscul. Lamina. vert. arches bodies of vertebrae. spinal gan. & roots of spinal nerves. Lam. lateralis, split in L. vent. & L. ser. some part of L. vent. & L. ser. belong to embryo, all which lie in A. pellucid become into a part of the amnion. Have only to deal what been with that part wh. belongs to the emb. If imagine at the stage wh. emb. raised fr. blastoderm.. the L. Ner. inf. consist of ventral lamina & that part of corneous layer wh. covers it. When L. N. inf. an imp. growth takes place into it. & also wh. origin. in the P. vert. wh. began to grow in all all parts of the emb. & also into the L. ventralis. Also of L. vent. sep. in 2 layers external & internal, wh. border the pleuro-peritoneal cleft. between these two layers. the proto-vert. grow.

Fm these four layers foll. develops. 1st lay. forms the = bone skin – gl. [illegible] pol. Mus. lamina, gives muscle of limbs & body. 3 layer wh. origin f. int. p. of P. v = cartilages, bones and. to the nerves. Fm 4th layer forms in chest the P. costalis in abdom, the Peritoneum parietale. Assumed that the skin & muss of dorsum develop [illegible] of that Mus. lam. of P. v. grow together w. over the C. Ner. syst. & after that grow backwards: but is disproved. It develops from Z a. vert. superior. Rem. of middle lay. b. to de the Wolff. b. & serous lamina. Wolffian body Fold in neck & first part a cord appe. wh. P. v touch the Z. lateralis. It solid. & after transf. in a tube the body that = Wolffian body. its tube & g. first part = Wool. duct. As Amn. fold develops. as same organs also & these gr. between P. v & Z vent. gets closed. & Wool body gets nearer towards the median line. Prim kidney is an outgr. of the Wool body but has the same struct. as the adult ones. It has only a transit. value as the true kidney develops after fr. a different layer, the prim. one fr. the epithel. and glandular layer. Kept Prim kidney disapp. there grow out f. Wool. body partly the ovary or the testicle. besides the W. duct another one appe. – Muller's duct in Males it disapp.

Wolffian the Wolf duct - vas def & vesicl. seminale
& parepidymis. In fem Muller duct ogn the ovid.
uterus & part of vagina. Also in males it does not disap
p. in the vesica prostat is the remn of Muller duct
= the Ut masc. Head as part wh is perf
sepn from main part of Bl. then the tail between
also that the head perf 2 sorts of curvatures
apex it then bent down it bend with it small back turn
so a curvt is formed. Cephalic lamina = P. be of the
head first do not up in the 2a. lamina & this
part begins to grow downwards & forwards so that there is
formed a curv due to the curv of head but also the bend
of the Ceph lamin down & forwards. The curv = the Oesoph
[illegible] curv. & subsequent to it called. fossa card-
iaca in wh the Heart appears

<u>Heart</u> devel as a cord wh is solid then becomes
a tube. See in when des the Histolog. how the [illegible]
of the Heart develops. Now call it that it is as a solid cord
that it is surrounded by the serous layer. The Ceph
lam grow down & forw in the neck part - these Ceph
lamina join in median line nearly as the 2 [illegible] super. form
& form the walls of chest & abdom. No abrupt line of dis

duct.. As the ventr. lum. in the chest & ab. is the Ceph. goes down the split. [illegible] in a groove & gets deeper & deeper till a closed canal is formed, then the intes. canal is closed. First part closed is at the neck & is closed when the heart appears. & last part has pleuroperit. & is fr. before the walls of the chest is formed. I said that the Heart develops as evag. of the serous lamina [illegible] a certain point.

2 6/2/73

Lecture.

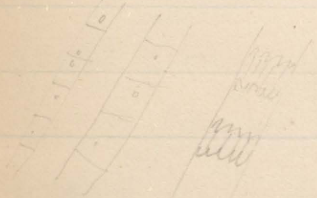
1839 Schw. said that all tissues dev. fr. cells & showed that embryonal cells get elongated and after split off into fibrilla tissue - connective tissue. Henle. opposed he said that fibrillar tis. devel. from inter-cellular subst. ing, found simil. cells also in clear inter-cell substance wh. give origin to conn. tissue, (that in 48.) In 42. Valentin said in certain stage cell dev. into spindle & branched cell & their processes inform one single fibril of the fibrillar tissue. So these doctrines with few mod. to present time quarrell with each other & it is not yet settled. Until 60 many monographs which always con. Virchow in 1850 came forward with his doctrine the contra. believing fibres & cellular tissue.

more marked Virchow changed his opinion 2 - 3 times but afterward he contradicted Sch. theory & became allied Henle that it did for whole cell. Donders thought that the power of the branched ~~[illegible]~~ cells become elastic & not connect tissue fibres. In 61 Schultze in Müller Archiv. viz wh. not corresponds to title "Muscul corpus & what is to be called a cell". In this he put down that "every intercell subs is derived from cells = protop the ways that conn tissue fibr ~~as~~ as well as any intercell subs is a transform of protop. but not in sense as of protop itself becomes a conn tissue but in sense as of the proto element posses the formative action by means of wh a tissue is formed from the protoplasm. So fibrillar tissue not only on the surface but also within cells. Any cell may produce any quantity of fibrillar tissue without exhaustion if supplied with nutriment. Brücke did not agree, acc to him ev conn tissue fibril is derived from one cell. Skin of embry. or of the umbil of spind cell. can be traced to origin of spherical form. At certain time tends to spindle shape cell. each lengthen till all protopl has grown out into immense length. Any a swelling in course of one fibr. Nuclei disappears. Henle changed in 67 & says Brücke is right. Three recent ones. Rollet and

says that fib tissue devel fr intercell substance which has often been des as trans of conn tissue cells & into fibr as in myxomatous tissue & bundles as in omen develops as rings. he says that they develop as circles & spindle elements between them. Against that Stricker says in myx tissue of lymph in embry cells transf into bundle of fibrill tissue. each one into a bundle of fib. Wald. says same as Stricker. Schwann & makes a comp between Mc Sch & Schwa. Klein says his view of Rolletts prim that all cell prof for devel of fib fr cells are not strong enough to disp what is to be seen that a clear subst collect between the cells & afterward a fibrillar bun. Prof. (Other) . is in rabb & guin pig not pull g in foes infraorbit a myxom tiss & is suppos fr develop of fat-tissue in this you find large cells wh appear spindle shaped because you found the spindle they are only the profile views of large flat plates of protoplasm wh is of fibrillar structure. The presence of these cells unite. (2) The num means of sub trans into a spong, sub in pregn. found in it many cells. gland tub imbedded in a hyal matrix. hardly a conn tiss bundle to be seen but spindle shaped and branched cell gran about the nuclei about other parts fibrill & the cells form a net-work. [illegible]

Wm [illegible] Wm Osler [illegible]

can be followed for far. not always [illegible] again with a process of a cell never in our [illegible]. Same in the [illegible] reflexa. stellate cells & fibrillæ [illegible] forming a net work. (3) A very young bird shows only spindle cells granular & [illegible] older shows between them delicate pale bundle of connect tissue. Tendons of young animals even [illegible] bundle between cells have a [illegible]. [illegible] which is [illegible] to an animal 2-3 weeks after birth. From here [illegible] till they get fully thickened [illegible] along the same. cells flatten. [illegible] plate lying in the bundle. Bundle of the [illegible] are [illegible] in the [illegible] in [illegible] & cells [illegible]. [illegible] plate.



Cartilage devel. is complete in. Embry. cells become sharper outlined & appear between them a delicate hyaline sub. & [illegible] = hyaline matrix. All cart. devel. as hyaline one. Question as to origin of matrix. 2 doctrines. 1 [illegible] that the matrix which arises around the cell is only the thickened

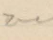
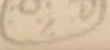
ment of the emb. cart. cells. 1st an excretion of the cells
(2.) is that the hyal. is part transf. of cellular substance
Partly of doubt, mine that all intercell. is transf. of cell
substance made the concern that there proof as well
for this. Quality of the of intercell. matrix in develop
for inter cellular subst
is only one viz. the size of cells remains always the
same. Also, so called intervert. cartilage is in
close contact with the perich. & periosteum. Except that
part of tail in rodents. Here you find cart. cells
in hyal. matrix & then come bundles of periost.
the conn.ed tissue corpuscle. be come continuous with
the cartilage cells, as there is a direct continuum
betw. the matrix & the intercellular sub. of the connective
cells. If you follow this early stage the conn. of the
older cells remain in same condition. <u>Bone</u>
dev. intracart. intramem. or subperiosteal
most devel. intracartilaginous, as shown (Sharpey
still some from membranes. Bones of arm intra
membrane. Whether intracart. or intramembran.
always grows in thickness subperiosteally. Develop
of cart. takes place as follows. Matrix of cartil
takes up inorganic elements from outside which
is deposited in the intercell. matrix as it

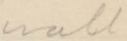
Then there are lime deposits = cartilage formative cells proliferate. divide when at same time deposit is again absorbed & in this way cavities are formed wh. contain along a [illegible] cell. Offshoots [illegible] cells; also it contains vessels and as this goes on the whole cartilage is transformed into a spongy sub. with lacunae filled with the vascular element & trabeculae partly by [illegible] & partly calcified cartilage as calcification does not go on with same rapidity as the vessel. The subst. wh. fills the lacunae = medullary sub. These cells in the lacunae, lie more or less regul. on the trabeculae of the spongy sub. giving polyhedral cells with one or two or more nuclei & these called osteoblasts fr. they play an imp.

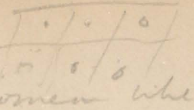
Histogenesis

Acc to Koll. in Bl. of chick about end of 1st day appear cords wh form. syncytial network, then in middle cords & an of peripheral cells. central cells → blood corp. peripheral = cells of later vessels Remak. only in the a. vasculosa. there are not central cells in these cords. Cords of a pellucida only of cells wh all become cells of walls of vessels A. vas called by him Blood area. A. pellucida cells first only form walls. All oo form colourless corpuscles. they prolif. nuclei divide & cells split that after some nuclei gets homogeneous till whole into the homog. yellow substance → thus prolif of the primary $\overline{oo}$ corp & transform into colour in all stages in ~~first~~ 8 & 9 days except 1st day when they only begin. When deal with middle coat. His says subgerm. process of blas. grow into the white yolk form a mesh work in meshes of wh. elements of white yolk lie. These elements of wh. yolk repr. real accord. ← His the elements of or development of $\overline{oo}$ corp & vessels. & he says blood part of wh. yolk wh. penetrate the blastoderm. separate

diff fr main point & from it one lamina — the upper ones — is separ. wh represents the vascular lamina & that they appear as cords of cells in that vascular coat & the cell of wall are derivat. of whole gell. at first solid. soon a clear space ~~[illegible]~~ = the lumen of future vessel. The theory in wh the vess. app as cords of cells is not generally assumed. Schwann. in 1838 gave a system of cells & accord, that capill develops fr embryo cells. which branched & unite form tubes by coalescing. But now Protoplas in all cells. gran. vesic. nucl. & dep clear tub, Schwanns theory upset — & Stricker modified as follows. He said in tail of tad. num cells (amoeboid by compar. diff stages of develop we find in later sty they get fixed. spindle shaped & branched. This cells become hollowed vacuolated & then get protoplasm cells wh contain granule & smaller clear cavity filled with a fluid. Branched cells form a net-work & when vacuole or cavity become continuous thus we get a net work of tube with dilat & constrict. the wall = protop. & = prim. protop. of cell bod. This assertion corroborate by 1/2 doz. obser. Eberth, Kolliker, Henle, &c.

could not agree that. Except when Eberth & Auerbach
could show it was made up of nucleated plates. So Strick
could not be right accord. to Eberth & Auerbach. who also tried
to show that they divide for a number of cells. Stricker is
right. Shall return to it again. We know no acc. of Remak
& His ad. bo caps develop [illegible]. Asan. says in
blast of chick in 1st day, or 2. on surface view.
in A. pell. vesicle. appear diff in size & shape. the walls
of them made up of cells. of spindle shape & smaller
important. 1st for wall. 2. bo caps. 3 inter-
vascular tissue. The spaces betw. the vesicle. no open
wall they represent the future vessels. So that vessels
develop with out wall in the tissue. cell of wall free
deb. int. bo caps. Others grow toward centre of the
vesicles, & a net work = after intervascular tissue
Later stage. Vanassef agrees with Remak
Klein's views. Middle lay. cle. for form clean [illegible]
be in flow of prep. say. other segments. There frame
clear. of exam. blas at that stage. in surface view
in A. pell. the following  large element with
large shining gran. . other fine gran. here other are
much.  other ones grow with many nuclei.
Subst. of them both much which are involved get diff into
[illegible]  each [illegible] nuclei at first yellow

often vy distinctly yellow. In the periph part: pale.
when central part diff into darker cell, then a periph
pale protop. filled with [illegible] oo. Wh have dev-
eloped endogenous. Other branches or spindle
shaped cells in wh same changes occur. The
vesicle called Endothelial vesicle. The walls
develops as foll. (Filam grow fr the periph of the vesicle
In an. pellu mostly such endothelial elements. Wall of
these capillary tubes is nucleated protoplasm
They all develop in endogenous, the walls of which vessels rem-
ain as wall of the vesicle. Stricker has asserted
that in inflam. corn. at a certain stage that large
 filled with yellowish blood elements;
s the walls become continuous with new formed vessels
Blood cysts accord. to Rokitansky formed pathologically
New form in given in adult of cap. vessels always
capil devel. fr cells. solid elements of vacuolation
accepted for all parts. How is it that wall of
adult caps = number of elements. 
When proto cell has devel into a vacuol cell
wall has nuclei wh finally become regularly
arranged. 1st only one nucleus. as vacu grows
they become more apart: till in regular interval
of masses in the protopl substance a diff takes place. One

in masses albuminous  resp. of cross lines on the
If examine the blood of cornea while inflam. of rabbit then a
masses always clear & the youngest vessel nearest
the centre are protoplasm. & are solid, & the lumen
of the vessels project into these masses, &
thro the whole cell. which different has been shown. Are
Capillaries are then always developed from solid protop.
the wall of which afterwards differentiates into cells called endo
thelial cells. and in such state or cap. develops
endogenously by red cells a colourless cell after branching
into coloured cells. All vessels at first like capillaries
are or very many branching into a no. of capillaries. in
same way as primary capps have formed of solid pro-
cesses growing out from their wall & afterwards
hollowing. & also branching into a loop, of dimension
of non formed clear. & grows in length & breadth — a second
growth of vessels —. Not necessary that all vessels in certain
space have developed primarily one has perhaps
and all others by growth of already formed tubes
Connective tissue, elastic & muscular of vessels derived from
[illegible] part of middle coat. Lymphatic
vessels are ascert. by Kolliker in tadpole tail
they do not like or capill. [illegible] by him they develop
from a number of cells [illegible] that from the lym

may a priori assume that this is the case for lymph
vs. [illegible] vessels , Klein says in adult state
in some part always a new format. of ly. vessels
& same in inflammat. as the bl. vess. are. The
devel. of lymph vessels in this tissue same as similar
of bl. vess. viz cells of connect. tissue become vacuolated
the wall made protoplasm which was part the body
of the branched cells. a ~~no.~~ of such enlarge. get prom-
inences, & they elongate & coalesce, so a tube the
wall of wh. = protoplasm. Diff betw. new form
& dev. of lymph. & bl. ves. in adult or infl. state
is . bl. capill. gene. ~~develop~~ have from
the begin. an elong. form. while ly. capill. for
long posses a vesicular form. Glands. 2 assertions
Bolchat. said that develops where a network of ly
ph. vessels formed, & from the wall of the vessels.
adenoid tissue grow. up. a reticulated tissue occup.
by cells. Recently. Saloni says they develop from
walls of bl. vessels especially of arteries. a reticulum
grows out from their wall the meshes of wh.
are occupied by lymph corpuscles