The development of the posterior elastic lamina of the cornea or membrane of descemet / by E. Treacher Collins.

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THE DEVELOPMENT OF THE POSTERIOR ELASTIC LAMINA OF THE CORNEA OR MEMBRANE OF DESCEMET.

By E. Treacher Collins, Assistant Surgeon to the Hospital.

The development of the cornea in the chick has been described as follows* :—"The substantia propria corneæ first appears in the chick as a thin homogeneous layer lying immediately within this epithelium (the surface epithelium). Into this homogeneous layer mesoblastic cells pass from the margin, greatly thickening it, and producing eventually the regular layers of fibrous tissue which are characteristic of the cornea. No cells pass into the most anterior or into the most posterior stratum, which remain homogeneous (anterior and posterior homogeneous lamellæ of Bowman). The epithelium of the posterior homogeneous lamella or membrane of Descemet is derived from mesoblast cells, which grow in like the corneal corpuscles from the margin, and spread themselves over the posterior surface of the cornea, thus separating this from the iris and anterior surface of the lens."

With regard to the origin of the homogeneous layer which first separates the lens vesicle from the surface epithelium in the chick, and which remains ultimately as the anterior and posterior elastic laminæ, two different views have been put forward. Kessler regards it as a secretion of the epidermis, and Kölliker as of mesoblastic origin.

In mammals, this homogeneous layer has not been met with.† Hertwig says :—"As soon as the lens vesicle in mammals is fully constricted off, it is already enveloped by a thin sheet of mesenchyma with few cells, which separates it from the epidermis. The thin layer is rapidly

* Quain's Anatomy, 10th edition, vol. i, Pt. 1, p. 87.

† Text-Book of Embryology, Translation of 3rd German Edition, p. 477.

thickened by the immigration of cells from the vicinity. Then it is separated into two layers, the pupillary membrane and the fundament of the cornea."

He makes no mention as to the mode of origin of the anterior and posterior elastic laminæ in mammals.

In fœtal mice which I have examined, I find at one stage the surface epithelium separated from the lens by a collection of round cells, but no vestige amongst them, whatever, of a hyaline membrane.

The youngest human fœtal eye of which I have sections is one in which the lids have just commenced to sprout out, but where they have not yet met in front of the globe. I have no statement as to the supposed age of the fœtus from which this specimen was taken, but I have another in which the lids have met in front of the globe which was stated to be from a fœtus of the tenth week, so, presumably, it is from a fœtus younger than that.

The cornea in these specimens is seen to consist, from before backwards, of the following layers. Epithelial cells in places appearing two rows thick; immediately in contact with them, and not separated by any homogeneous membrane, layers of cells with elongated nuclei and fibres. The nuclei of these cells are very much closer together than those of the corneal corpuscles in the adult cornea, the amount of fibrous tissue between them being very much less. Behind this laminated fibrous and cellular tissue is seen an extremely thin hyaline layer, posterior to which are closely packed cells with round nuclei, showing a tendency to arrangement into two layers, the anterior evidently being the lining endothelium of Descemet's membrane, and the posterior the commencement of the antero-fibrovascular sheath of the lens. I am unable to find any blood vessels amongst the round cells, though there are many already formed at the posterior part of the lens.

In a specimen I have of a human fœtal eye of the fourth month, blood vessels are distinctly seen in the

antero-fibrovascular sheath. The posterior elastic lamina is still only seen as an exceedingly delicate line, and nothing of a homogeneous layer is yet visible between the anterior epithelium and substantia propria of the cornea.

In a human fœtal eye, said to be of the sixth month, Bowman's membrane, the anterior elastic lamina, is very distinctly seen, and the posterior elastic lamina is considerably wider than it was at the fourth month.

It is evident, then, from this, that in mammals there is a stage in the development of the cornea where no elastic membrane is present. In man, when a very delicate rudiment of the posterior elastic lamina is just discernible, it is already lined by endothelial cells, and from this time onward it gradually increases in thickness. The question then suggests itself: Is the posterior elastic lamina a product of the endothelial cells lining it?

I have, in former writings,* attempted to show that the two other hyaline membranes in the eye, viz., the capsule of the lens and the membrane of Bruch, are the product of epithelial cells lining them, mainly on pathological grounds. Can Descemet's membrane, in the same way, be shown to be the product of the cells lining it?

I may, in the first place, point out this difference: the cells lining the lens capsule are the product of cuticular epiblast, those lining the membrane of Bruch are derived from neural epiblast, whilst those lining Descemet's membrane are generally believed to be mesoblastic in origin.

Otto Schirmer† showed that after wounds of the lens capsule the gap first became closed by cells derived from those lining the capsule, and that afterwards a new hyaline layer made its appearance, presumably the product of these cells.

When Descemet's membrane is wounded and its ends

* Trans. Ophth. Soc., vol. xii, p. 89. "Researches into the Anatomy and Pathology of the Eye," p. 13-18, and 88-91.

† Archiv f. Ophth., Bd. xxxv, ab. 1, s. 220.

have become retracted, does a new hyaline layer form in the gap left? Or, if the endothelial cells become detached, do they ever develop a new hyaline layer in front of them?

B. Gepner, jun., described, in 1890,* the case of a man, æt. 21, who had an iridectomy performed several years previously for iritis. The eye was removed on account of inflammation following a blow. A gap was found in Descemet's membrane in the region of the cicatrix, which was bridged across by a layer of hyaline membrane of the same structure as Descemet's membrane, and lined by endothelial cells.

Wagenmann, in 1891,† recorded the case of a patient, æt. 57, who, two and a half years previously, had had a cataract extracted from his eye by the modified linear operation of v. Graefe, and who, while in the hospital for operation on his other eye, died of pneumonia. The eye first operated on was removed shortly after death, and, on microscopical examination of the seat of the wound, the two cut extremities of Descemet's membrane could be seen, separated by a slightly protuberant film of tissue, posterior to which was a layer of newly formed hyaline substance lined by endothelial cells. Wagenmann has no doubt that the hyaline layer was derived from the endothelium.

Alt mentions a case‡ in which there was a considerable new formation of fibrous tissue on the inner surface of Descemet's membrane, which was covered on the surface towards the anterior chamber by a newly-formed secondary membrane of Descemet, lined by endothelium, and he says:—"I think that this case shows that Descemet's endothelium can not only form lamellated connective tissue, similar to that of the corneal tissue, but that it can form, and, perhaps, originally forms, the vitreous membrane, which we call that of Descemet."

* Archiv f. Ophth., Bd. xxxvi, ab. 4, s. 255.
† Archiv f. Ophth., Bd. xxxvii, ab. 3, s. 21.
‡ Amer. Journal of Ophth., vol. xiii.

I have examined a large number of specimens of eyes with corneal cicatrices, resulting from wounds, in order to see if I could find any in which there had been a new formation of a hyaline membrane similar to the posterior elastic lamina. I have only discovered two, and I must conclude that such a new formation is by no means a common occurrence.

My first case is that of a man æt. 46, who, 26 years previously, had received an injury to his right eye from a piece of steel; it had been quite blind 15 years; lately had become painful, and consequently was excised.

The surface of the cornea appeared rough, and there was in its lower part a faint scar. The anterior chamber was deep, and in the lower part of the iris, opposite the scar in the cornea, was a small hole. The lens was absent, and the vitreous, fluid; attached by a thin tag of grey membrane to the posterior border of the ciliary body was a small fragment of metal 2 mm. square.

On microscopical examination of sections of the cornea, the line of cicatrix can be seen passing through it somewhat obliquely. There is a gap in Bowman's membrane filled with fibrous tissue; the laminæ of the cornea are somewhat irregularly disposed, and there is a slight excess of cells. On the posterior surface, in the region of the cicatrix, the two divided ends of the posterior elastic lamina are seen turned somewhat forwards and separated from one another by fibrous tissue, while bridging over the gap posteriorly is a thin hyaline layer, which can be traced on each side of the wound for a short distance as a distinct layer in contact with the posterior elastic lamina, with which, a little further out still, it becomes blended.

The endothelium from the posterior surface of Descemet's membrane, has, in the preparation of the specimen, become somewhat displaced, but it can be seen to form a continuous single row of cells all over the posterior surface of the cicatrix continuous with the single layer elsewhere.

The second case is one of which I have already published a good many details in these Reports.*

The patient was a man æt. 44, who came to the hospital with absolute glaucoma in his right eye, and suffering great pain. An iridectomy was performed. Five months later, the pain still continuing and the patient refusing to have the eye excised, an optico-ciliary neurotomy was done. Two years after this, and $2\frac{1}{2}$ years after the iridectomy, the pain returned, and the patient then consented to have his eye enucleated.

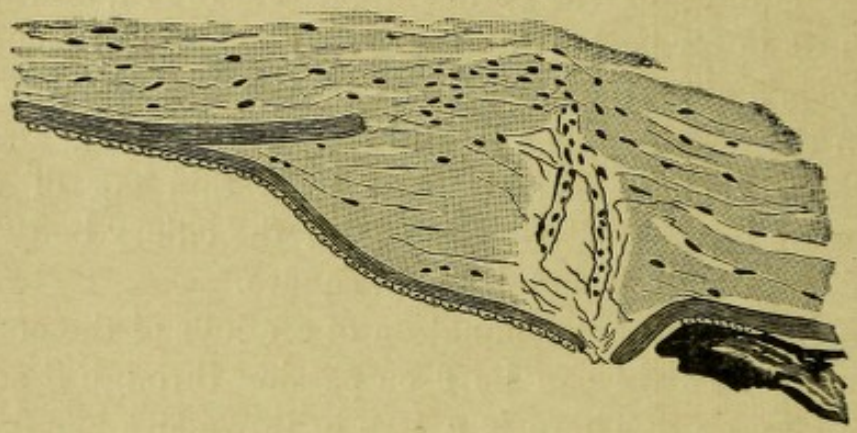

Figure showing new-formed hyaline membrane on posterior surface of cicatricial tissue in Case 2.

Microscopical examination of the cornea in the region of the operation, shows a broad band of cicatricial tissue with small blood vessels coursing through it. The divided ends of Descemet's membrane are found widely separated, the more peripheral end is curved a little backwards. Between the two ends there projects backwards some new-formed fibrous tissue, which, at one part, is dense and laminated, resembling closely normal corneal tissue. Some of this new-formed fibrous tissue extends for a short distance inwards toward the centre of the cornea behind the posterior elastic lamina.

On the posterior surface of the dense new-formed

* Vol. xiii, p. 200.

laminated fibrous tissue is seen a thin hyaline membrane of the same structure as the posterior elastic lamina, to which, on the inner side, it becomes united at an acute angle. It is evident that in the recent state this thin layer of hyaline membrane was lined by a single layer of endothelial cells continuous with those lining the posterior elastic lamina. In the specimen, the endothelium has become displaced backwards from the hyaline membrane.

On the inner surface of Descemet's membrane are sometimes seen little hyaline nodules, indistinguishable in structure from that membrane; they may be compared with the hyaline nodules so frequently met with on the inner surface of the membrane of Bruch, which, however, are usually much larger.

These latter nodules are apparently the product of the pigment epithelial cells of the retina, and the following reasons tend to show that the nodules which form on the inner surface of Descemet's membrane are formed by its lining endothelium. First, it is unlikely that an inert basement membrane should give rise to outgrowths; it is much more probable the active endothelial cells should undergo some change which would result in the production of these hyaline masses. Secondly, these nodules are only met with on the surface of the membrane where the cells are situated. If they were thickenings of the membrane itself we should expect to meet with them on both surfaces.

If, then, it may be assumed that under some abnormal stimulus the endothelial cells lining the posterior elastic lamina are capable of producing nodules, or a layer of a substance indistinguishable in structure from the elastic lamina, it seems fair to assume that the elastic lamina itself is originally developed from them.

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