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COMMUNICATIONS

ON CONGENITAL HYALINE MEMBRANES ON THE POSTERIOR SURFACE OF THE CORNEA

BY

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THE association of hyaline membrane formation at the periphery of the posterior corneal surface with abnormality of the iris stroma and normal intra-ocular tension appears sufficiently interesting as a congenital anomaly to warrant the publication of the following notes. The first two cases were seen within eighteen months of each other and the striking similarity of the second case to the first led to a search for records of the condition, with the result that I have to conclude that it is either very rare or has usually escaped notice. That the latter is probably the case I am inclined to believe, since the appearances to be described are much more easily investigated with the slit-lamp than by any other method and it may be that more cases will be discovered now that biomicroscopy has become almost a routine. Up to the present I have succeeded in discovering the condition in five eyes which have been examined with the slit-lamp, while reports of two other doubtful cases not so examined have been traced.

I wish in the first place to tender my sincere thanks to Drs. Alex Macrae and J. S. Arkle of Newcastle-on-Tyne, Dr. J. A. Ross of Carlisle, and Dr. A. J. Ballantyne of Glasgow, for having called my attention to the cases and for their courteous permission to publish them.

Case 1. E. H., male, aged 29 years.

Right eye \bar{c} $\frac{-0.5 \text{ D. sph.}}{-1.25 \text{ D. cyl. } 180^\circ}$ 6/6 (most).

Left eye \bar{c} $\frac{+0.25 \text{ D. sph.}}{+0.5 \text{ D. cyl. } 70^\circ}$ 6/4 (2).

The tension of both eyes is normal and the discs are not cupped. The patient had, at the time of his first examination by Dr. Macrae, sustained a slight injury to the *right* cornea. This healed normally. The condition of the *left* eye attracted Dr. Macrae's attention, although the patient was unaware of any abnormality. There was no history of anything wrong with the left eye at any time within the patient's memory and the anomaly is undoubtedly congenital.

Focal illumination and slit-lamp examination reveal the following.
Right eye. Iris normal except that the lesser circle is extremely near the pupil margin, and there are a few tags of vascular remnants attached to it. The eye is otherwise quite normal in appearance.
Left eye. The cornea appears slightly smaller than that of the right eye, and the pupil looks contracted on superficial examination. On more detailed examination it can be seen that gross abnormalities of the cornea, iris and pupil margin are present. The central part of the cornea is normal all through, as are the epithelium and *substantia propria* over the whole extent. In the periphery however, a semi-transparent hyaline membrane appears applied to the posterior surface of the cornea almost throughout its whole circumference. The inner edge of the membrane forms roughly a circle, concentric with the margin of the cornea and lying at about a quarter of the distance from the limbus to the centre of the cornea from it. From this inner margin the membrane extends outwards into the angle practically the whole way round, a small gap (roughly between 1/7 and 1/8 of the circumference) occurring in its peripheral part (though not in its inner edge) at 10 o'clock. This membrane is applied firmly to the posterior surface of the cornea round most of the circumference. In the lower part however it stands away from the cornea (except at its inner edge) for a short distance, forming in section a chord to the arc of the corneal curve. It is slightly granular in texture and imperfectly transparent. The inner edge is marked by irregular small masses of pigmented tissue (pale golden brown) similar to the pigmented tissue composing the anterior layer of the iris. The pattern of the iris stroma can be faintly seen through the hyaline membrane and appears in places (especially the lower nasal side) to be irregular and fluffy, the normal radial appearance being lost. In some places, chiefly immediately below, the peripheral parts of the superficial radial iris vessels come forward and adhere to the deep surface of the hyaline membrane.

The superficial layer of the iris stroma is composed of abnormally thick, coarse and sparse golden brown strands, which represent a much thickened peripheral part of the pupillary membrane. They extend right up to the pupil margin and would overlap it if the pupil were dilated. Through the gaps between these strands the deep layer of the stroma can be seen. This is paler and greyish in colour, and rather thinner than normal in that the sphincter can be easily seen through it.

The uveal border at the pupil margin is abnormally thick and much puckered. From its upper portion a curious small fluffy whitish mass with a few grains of pigment on its surface hangs free by a

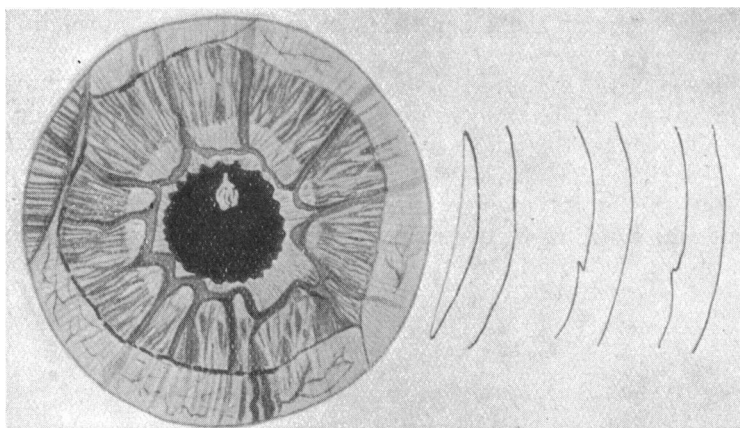


FIG. 1.

The iris of Case I, and the membrane in section.

narrow pedicle and just overlaps the edge of the pupil. It resembles a little mass of organised exudate, but since no other inflammatory signs are present and the mass has no adhesion to the lens capsule, it also is probably congenital in origin and may represent connective tissue remains. It cannot be true pupillary membrane since it is not continuous with the lesser circle, although, since this lies abnormally near the pupil margin, it is possible that it may represent a displaced portion.

Fig. 1 gives some idea (extremely diagrammatically) of the arrangement of parts. The linear diagrams show the cornea and membrane in optical section in the narrow beam of the slit-lamp. At 7 o'clock it stands away completely from the cornea, at 6 o'clock its inner edge projects as a sharp ridge, while further round it fades into the cornea much more gradually.

The outstanding features of this curious anomaly are the translucent membrane on the periphery of the posterior surface of the

cornea, the thick coarse strands of iris stroma extending to the pupil margin and the good visual acuity and absence of all symptoms.

About eighteen months after having seen this case, Dr. Ross asked me to examine a patient of his with a similar condition in both eyes. This forms Case II.

Case II. W. E. M., female, aged 8 years. This child had been referred from a school clinic on account of poor visual acuity. She has myopic astigmatism.

$$\text{Right vision} = 6/36 \bar{c} \begin{array}{l} - 3.0 \text{ D. sph.} \\ - 4.5 \text{ D. cyl. } 10^\circ \end{array}$$

$$\text{Left vision} = 6/36 \bar{c} \begin{array}{l} - 3.0 \text{ D. sph.} \\ - 3.0 \text{ D. cyl. } 5^\circ \end{array}$$

Full correction of the error failed to bring her to normal. The tension of both eyes was normal.

The right eye (Fig. 2) shows an exactly similar hyaline membrane applied to the peripheral part of the posterior corneal surface. It does not extend the whole way round however, being absent from "10 o'clock to 2 o'clock." It presents the same slightly irregular edge but this is not pigmented. At one point (5 o'clock) there is an anterior synechia of the superficial layer of the iris stroma to the back of the membrane. The deep layer of the stroma is normal

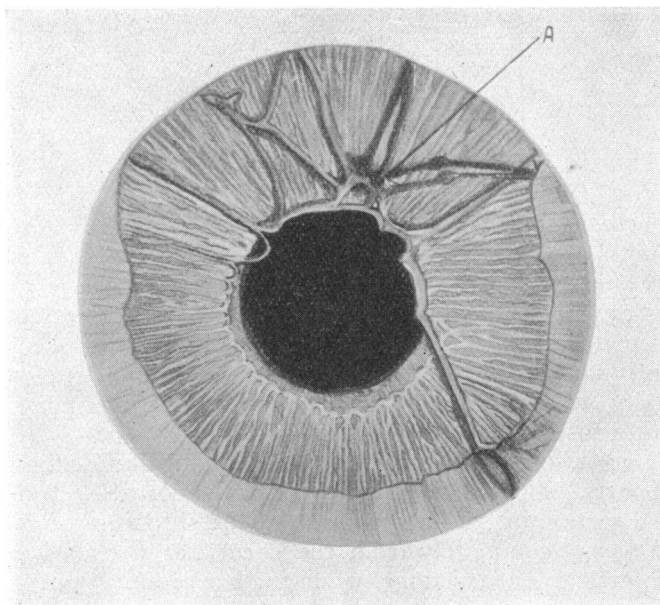


FIG. 2.

The right iris of Case II.

with blue-grey background and white walled vessels. The superficial layer however shows the same kind of abnormally coarse sparse strands does Case I. In the second case these do not extend the whole way round, the iris being quite normal from "5 to 10 o'clock," although the hyaline membrane is present here. Over the rest of the iris are very coarse, pale buff radiating strands uniting at the very coarse lesser circle, which overlaps and obscures the uveal border of the pupil. At "1 o'clock" five of these strands unite and

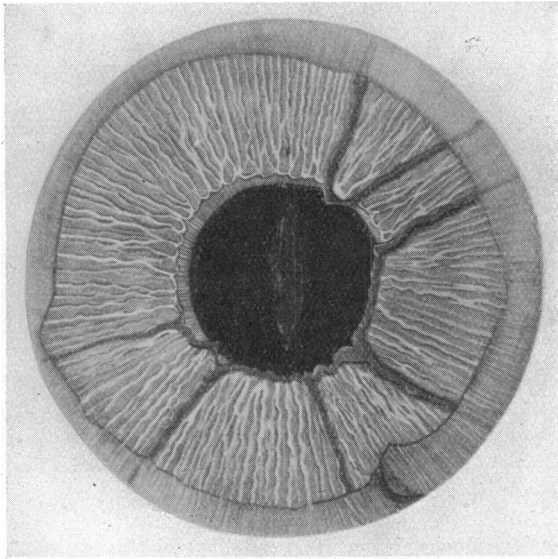


FIG. 3.

The left iris of Case II.

pass forwards across the anterior chamber to the back of the cornea. Here they adhere, two of them being adherent right to the corneal margin. These strands are seen in Fig. 2 at A. The lesser circle from "5 to 10 o'clock" is normal.

The *left* eye of this patient shows a similar but not so well-marked condition (Fig. 3). There is also a small spindle-shaped lens opacity in this eye, which may account for the diminished visual acuity, this eye being otherwise the more normal of the two. The hyaline membrane in this eye extends round the whole circumference of the periphery of the cornea, though in places it is very narrow. There is no pigment at its edge. At "11 o'clock" there is one anterior synechia of a superficial band of iris stroma to it. As in the right eye the superficial leaf of the iris shows the development of abnormally coarse strands, slightly (but not so much as in

the drawing) deeper in colour than the rest of the stroma, which is quite normal.

Case III. The notes of this case, about a child, were sent me by Dr. Arkle. Fig. 4 shows a portion of the eye as seen with the slit-lamp. In the part shown the hyaline membrane can be seen obscuring part of the iris stroma which is here adherent to it for a segment of the circumference. In this position the membrane was not adherent to the back of the cornea, but there were several other folds of it present which were definitely in contact with Descemet's membrane. Both the adhesion of the stroma to the membrane and

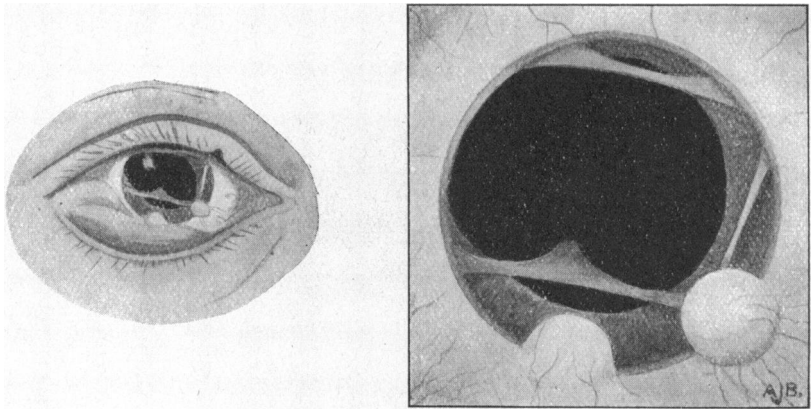


FIG. 5.

The right eye of Mr. Ballantyne's case.

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the ending of this above and below (in the drawing) as a narrow strand have their counterpart in Case I (upper outer segment in Fig. 1). The main difference from the other cases appears to be relative normality of the iris stroma and the absence of the coarse strands seen in the superficial layer. There were no signs of injury or inflammation.

Case IV. This, Dr. Ballantyne's case, has already been published in the Proceedings of the Royal Society of Medicine³ from which Fig. 5 and the description which follows have been taken.

The eye was that of a female infant, six days old, who was brought to the Glasgow Eye Infirmary on account of swelling of the lids. In addition to a small coloboma of the lid, two conjunctival dermoids and a sub-conjunctival lipoma, there were certain intra-ocular abnormalities. These are not entirely comparable with those of the cases described above but present certain interesting

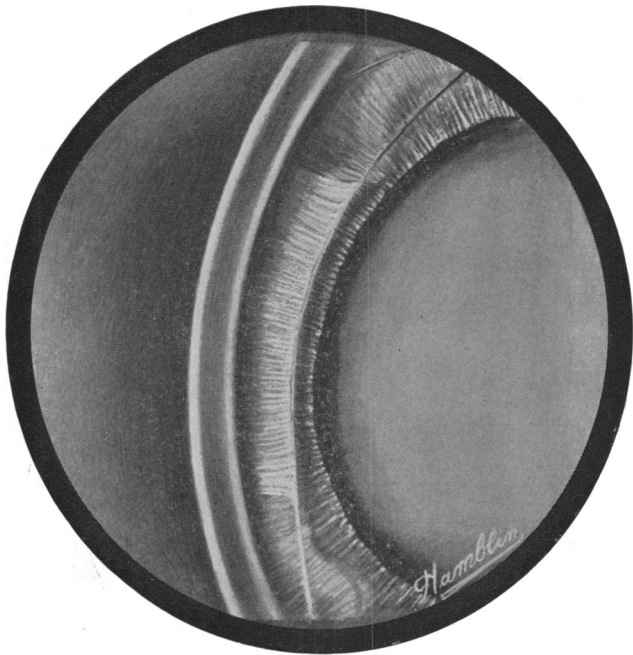


FIG 4.

A portion of the iris of Case III seen with the slit-lamp.

features. In the first place there was a large coloboma of the iris up and out, a condition not present in any of the other cases. Secondly, there were definite signs of intra-ocular inflammation, namely, keratic precipitates and an aqueous flare, no signs of which were present in the other cases. This may possibly be related to the fact that this patient was by far the youngest of the series. One cannot deny the possibility of the presence of intra-ocular inflammation in the other cases at birth, since they were not examined. Thirdly, three bands of hyaline tissue stretched across the anterior chamber from angle to angle, two of them attached to the spot occupied by one of the dermoids, which overlapped the cornea. One of the bands was also attached to the back of the cornea near its centre. The bands were translucent and lay on a plane anterior to the iris and in no way resembled persistent pupillary membrane. The appearance of the eye is seen in Fig. 5. These bands appear to have been of the same nature as those in the other cases, but differ from them somewhat in their arrangement, since their inner and outer edges are straight and do not tend to follow the limbal curve. Ballantyne, in his summing up of the unusual features of the case, refers to Van Duyse's article in the French Encyclopaedia of Ophthalmology. He quotes from this cases of combinations of congenital anomalies, such as the association of lid coloboma, epibulbar dermoid, and dermo-lipoma, which is well known, and of (rarer) coloboma of iris and lid, and coloboma of lid with intra-uterine irido-choroiditis. Ballantyne says that in one of Van Duyse's cases there was corectopia, a thin plaque of tissue was attached to the posterior surface of the cornea and from this there were filaments passing to the iris beyond the lesser circle which he looked on as part of the pupillary membrane. There is some resemblance here to Ballantyne's case, but the bands on the back of the cornea do not seem to bear much resemblance to pupillary membrane. The most important point made by Ballantyne is the presence in his case of foetal cyclitis which cleared up under atropine and dionine.

In addition to Ballantyne's case, the records of two other doubtful cases have been found. These constitute Cases V and VI.

Case V. Described by Stephenson⁴ in 1908. This case occurred in a five months old baby in whom examination was somewhat difficult. It was unilateral, the affected eye having a slightly smaller cornea than the other. There was a small oval pupil in the upper nasal quadrant at the junction of a dull, washed-out looking iris and an arcuate strip of tissue of a light blue colour which occupied the upper and inner part of the anterior chamber. This "appears to lie in a plane somewhat anterior to the iris tissue and may even be on the posterior surface of the cornea. The impression . . . is that it overlies the iris and that if it could be

removed, iris tissue would be found behind it." At the extreme periphery a narrow zone of iris could be seen. The eye was not examined more in detail and no mention is made of the structure of the iris stroma. The case is not exactly comparable with mine for three reasons: (1) The membrane was more opaque than in my cases. (2) It did not extend to the periphery of the cornea, and (3) the pupil was excentric.

Case VI. The second doubtfully comparable case is that described by Coats⁹ in his Hunterian lecture in 1910. He deals exhaustively with the microscopic appearances of the highly abnormal microphthalmic eye of a six days old child with multiple congenital deformities. He describes a long-meshed membrane lying on the anterior iris surface and continuous both with the pupillary membrane (in this case abnormally adherent to the cornea) and with the loose tissue in the corneo-iridic angle. He considers that it bears some resemblance to Stephenson's case, and says, "Microscopically the fibrous tissue was continuous with the pupillary membrane whereas clinically the tendinous character of the sheet differs entirely from the appearance produced by persistence of that structure. Further investigations are evidently required, but unless it be a layer separated off from the cornea I know of no other structure from which a membrane lying on the anterior surface of the iris could be derived."

Thus we have in all of the eyes so far described the presence of an abnormal hyaline membrane on the posterior surface of the cornea. In three of the eyes there was also an abnormally coarse anterior layer of iris stroma (pupillary membrane layer) adherent in places to the hyaline membrane. In all of them the deep layers of iris stroma were normal, and in all the tension was normal.

The first two patients show the following differences. In the first the condition is unilateral, in the second bilateral, and in the first the refraction is slightly hypermetropic and the visual acuity normal and in the second there is myopic astigmatism and diminished visual acuity, though this may depend on the patient's youth and on the presence in one eye of a lens opacity.

If any explanation of the condition is to be attempted it is obvious that in view of its undoubted congenital character two points must be considered.

1. The possibility of a similar condition arising from any cause in post-natal life.
2. The possibility of a purely embryological explanation.

The first point opens up the question of the new formation of hyaline material in the eye under conditions of chronic irritation. This is quite well known to occur and has been described in both glaucoma simplex and in chronic iridocyclitis. Such hyaline formation does not, however, entirely correspond with that present

in the two cases. According to Collins and Mayou¹ it is more often found in cases of infantile glaucoma (buphthalmos) than in glaucoma simplex of adults. They state that "A new formation of a hyaline membrane on the anterior surface of the iris may be produced beneath its layer of endothelial cells." This appears to be continuous with Descemet's membrane round the angle and in the adult cases to extend over the peripheral anterior synechiae. It therefore seems to be produced by the mesoblastic endothelial cells. No mention is made in this connection of the presence of a second hyaline deposit on the back of the cornea, neither is any indication given of whether the presence of the hyaline tissue should be regarded as cause or result of the rise of tension. Its presence in infantile glaucoma (where the possibility of its antenatal formation can hardly be denied) makes it slightly more probable as a cause.

With regard to its occurrence in chronic iridocyclitis, Herbert's paper² should be studied *in extenso*. He used selective staining with acid orcein on the anterior parts of chronically inflamed eyes, and sought to establish the fact that pathologically separated cells (especially epithelial cells) tend to produce cell membranes stained by orcein and sometimes coalescing to form sheets. He showed a photograph in which "the *limitans externa* of the ciliary body ended in a glass membrane network representing the periphery of the iris dilator . . . a glass membrane connection of the ciliary muscle with the ligamentum pectinatum could be readily traced." He also states that free epithelial cells may wander forward and lead to laminated hyaline material on the corneal side of the angle. A gap is usually left between this and the commencement of Descemet's membrane, which is not overlapped by the new tissue. In some cases however, this is not so. Herbert says "In cyclitis laminated tissue in the anterior chamber lacks the dense glassy appearance and the staining characters of glass membrane, and it may be found extending up beyond the middle of the back of the cornea. As is well known, it may be covered by a fairly thick single layer of dense new hyaline tissue exactly like Descemet's membrane In cases where the new tissue lying on the back of the cornea had evidently been laid down in successive stages, inner coverings of glass membrane have been found upon each accumulation of laminated tissue, so that in section Descemet's membrane appeared to divide possibly more than once as it passed down." In these cases, however, there was definite inflammation and the hyaline tissue was mainly present over the lower part of the cornea, namely, in the area of the majority of the cyclitic deposits. There is no mention of any inflammatory case in which it extended all round. In the discussion following Herbert's paper, Collins described a case of buphthalmos in which Descemet's membrane extended on to the anterior surface

of the iris and also a case of congenital anterior synechiae in which the iris strands were covered with a prolongation of hyaline material from Descemet's membrane. It is well known that the lens epithelium can produce hyaline material under irritation as also can the pigment epithelium. It therefore seems possible that both epithelial and endothelial cells in the anterior part of the eye can produce hyaline material under stress of inflammation.

In the cases under consideration in the present paper, however, there seems very little evidence that the abnormal membrane on the back of the cornea could have been so produced. In none of the cases except Ballantyne's was there any trace of precipitates, nor were there any posterior synechiae of the uveal border in any case. The anterior synechiae and the abnormal portions of the iris stroma involve only that portion of the mesoderm concerned in the formation of the pupillary membrane, and it is difficult to imagine an inflammation of this alone, although it is of course possible. One can say with some certainty that a similar condition to that described does not arise during post-natal life, but the presence of precipitates in the one case makes it possible that foetal inflammation may still be the determining cause.

Secondly, the question of a purely embryological explanation arises. If one wishes to consider this, one realises at once that only the broad term "aberration of development" will in any way describe the condition. No postulation of an arrest at any foetal stage will help, since at no time after its formation is the pupillary membrane adherent to the cornea, nor is this covered by peripheral hyaline tissue in normal development.

All that one might possibly suggest as an embryological explanation is an abnormality (increase in amount and undue persistence) of the post-endothelial tissue which forms the *Anlage* of the pupillary membrane and anterior layer of the iris stroma. This post-endothelial tissue, which is marked in rodents but always very poorly developed in man, can be seen at the 12 mm. stage in human embryos (Fig. 6). It forms a loose mass of cells (mesodermal) applied to the back of the cornea round the periphery, and also, in fresh specimens, applied to the lens. It subsequently separates from the back of the cornea and extending over the front surface of the lens (possibly following a directional membrane already formed by condensation of the mesostroma in this region) forms the pupillary membrane. Deep to it a wedge of mesoderm grows in later with the extending margin of the optic cup to form the deeper part of the iris stroma. It might therefore be suggested that if this post-endothelial tissue remained too long in contact with the periphery of the cornea it might lead to the formation of hyaline tissue here (possibly mesostromal in origin) and also to abnormality of the pupillary membrane, since it also forms the basis of this. Indeed abnormality of the

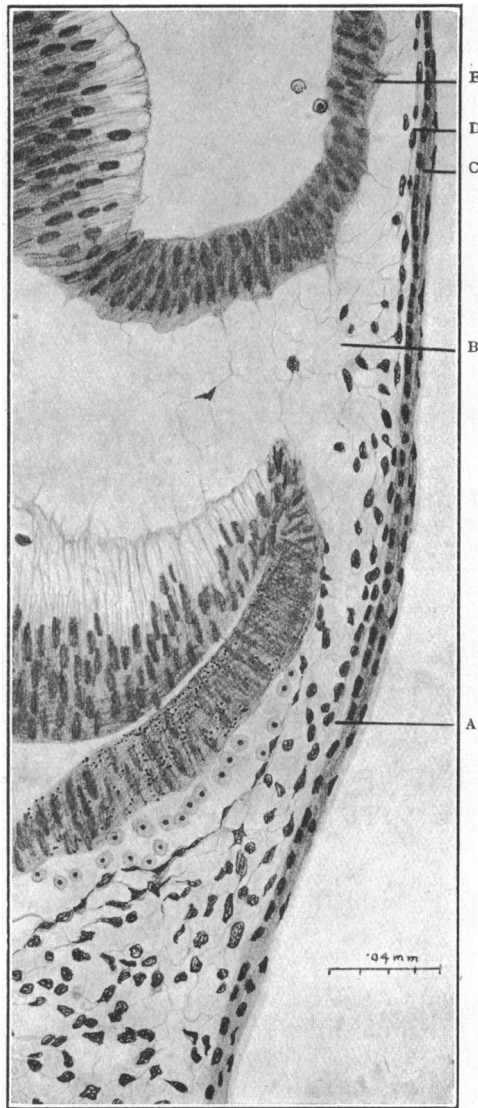


FIG. 6.

Cornea, lens and margin of optic cup of 12 mm. human embryo.

- A = space between epithelial and endothelial cells.
- B = post-endothelial tissue.
- C = epithelium.
- D = endothelium.
- E = lens vesicle.

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post-endothelial tissue is known to occur, as in cases of congenital anterior synechiae and of imperfect differentiation of the angle. In these cases, however, the abnormally placed tissue usually resembled rather fluffy iris stroma and did not look like a hyaline reduplication of Descemet's membrane.

In conclusion one can only say that the condition is congenital and that it is in all probability due to an abnormality of the post-endothelial tissue occurring at and after the 12 mm. stage. The initial cause of the aberration and also the reason for its assumption of the peculiar appearance described must remain obscure, although the possibility of foetal inflammation acting as the initial cause must be admitted.

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HOLES IN THE "POSTERIOR HYALOID-MEMBRANE" OF THE VITREOUS—REPORT OF A CASE

BY

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FEW circular central apertures in the vitreous have been reported in English ophthalmic literature. Therefore the following report is given.

The patient was a married woman, aged 30 years, who appeared to be exceptionally healthy, robust and free from septic foci. Her only illness had been a serious, though obscure, upset during the first few years of life. With a +9D. Sph. a delicate vertical membrane was visible in the left vitreous with a central aperture through which the optic disc could be clearly seen. This aperture was 1.5 disc diameters, but six months later it had definitely increased in size. Temporal to it there was a much larger circular hole which was tilted so that its nasal margin was seen with +7.0 D. S. and