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THE

# Anatomy, Physiology, and Diseases

OF THE

# MEMBRANA PUPILLARIS.

BY

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# THE ANATOMY, PHYSIOLOGY, AND DISEASES OF THE MEMBRANA PUPILLARIS.

[*Read before the Bath and Bristol Branch, February 19th*, 1857.]

I HAVE ventured to introduce this subject to the notice of the members of the Society, for the purpose of pointing out one or two anatomical errors which, in my opinion, have hitherto existed in the descriptions of the membrana pupillaris and its vessels, and for the sake of bringing forward an opinion which I hold as to the office it serves in fœtal life, and also because I wish to narrate a few cases of disease of the eye, which I refer to the continued existence of this organ.

The membrana pupillaris, a clear transparent membrane, closing the pupil during fœtal life, was first discovered by Wachendorf, in 1738. Afterwards, Albinus, Haller, Zinn, Wrisberg, and Dr. William Hunter, described it about the same time, but no one of them with complete accuracy. It is a simple membrane, continuous with the *anterior* surface of the iris, quite transparent, and found at every period of fœtal life. The centre of the posterior surface is in contact with the anterior capsule of the lens. Dr. Jacob was the first British author who pointed out that the membrane exists until the ninth month of fœtal life; for it had been considered previously not to exist after the seventh—an error originating from the fact that the vessels cease to be permeable at that time; and consequently the membrane is almost invisible, and can only be demonstrated by great care. Tiedemann, Retzius, Arnold, and M. Portal, were also of the opinion that the membrane remained till birth.

I must call to your remembrance one or two facts respecting the iris, which it is necessary to keep in mind in order to understand the subject, and which, like other anatomical minutiæ, are apt to slip away from the recollection, unless there is something to induce us to dwell upon them.

In the fully developed and healthy iris, the vessels are posterior, and are covered in behind by the pigment or uvea: the vessels are tortuous and anastomose tolerably freely, the general direction being towards the pupil, where there is a

more free anastomosis, miscalled the "circulus arteriosus iridis minor". The human iris, freed from pigment, is almost transparent. In the very dark eye, particularly in those of the coloured tribes, there are pigment-cells scattered upon the anterior surface, in addition to the uvea behind; but, in the blue or light coloured iris, there is no pigment in front: the colour is due to the reflection of the light through the transparent iris from the uvea, the light being decomposed, and colour thus developed by the finely divided surface of the membrane; and when the pigment has been removed by washing, there is no appreciable difference in colour between an iris that was originally blue and one that was grey, or green, or light brown.

In the human fœtus, there are vessels upon both surfaces of the iris. The posterior set passes as far as the pupillary margin, and not beyond; whilst the anterior run onwards in a straight course upon the membrana pupillaris, and, turning round at a little distance from the pupil, pass back to gain another part of the membrane, but still upon the anterior surface.

In an injected fœtus of about six months, the membrana pupillaris is seen in perfection. The iris is narrow, and not fully developed; the pupil is large; and the membrane is thin, transparent, and covered with fine vessels, visible by the naked eye, particularly if it is stretched upon a white surface. (Fig. 1.)

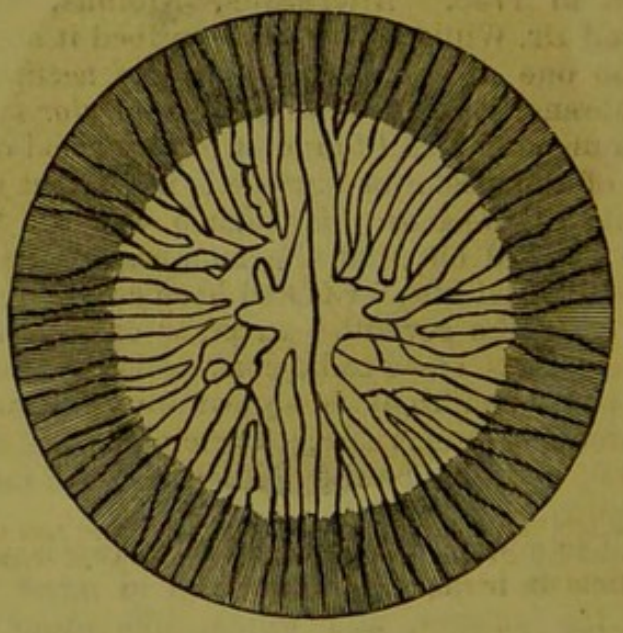

Fig. 1. The iris and membrana pupillaris of a six months fœtus. The anterior vessels of the iris are here shewn to be continuous with those on the membrane, and one vessel is seen to traverse the centre.

These vessels form a series of loops upon the membrane, and occasionally one traverses the centre. Cloquet, in his memoir

on the subject, says that there are thirty or forty distributed in this way; and Henle says there are from ninety to a hundred. The number no doubt varies in different specimens, for I have counted upwards of one hundred and twenty upon an injected fœtal iris, passing forwards to supply the membrane. I have also seen that a few vessels run from the posterior vessels of the iris, and inosculate with the arteries on the membrane. As the fœtus advances towards the termination of intrauterine life, whilst the membrane is still entire, the vessels are gradually obliterated, like the vessels of the posterior capsule of the lens, which become incapable of carrying red blood, and gradually disappear, leaving the organ perfectly transparent. I have found the membrane entire and transparent in the eyes of a fœtus of nine months; and I have once seen, in a specimen of this kind taken from a still born child, one or two loops of vessels running over the margin of the iris upon the membrane, and returning to the iris, whilst the greater part of the surface was free from vessels. (Fig. 2.) After birth, the membrane gives way, most likely from the action of the pupil; a few shreds are sometimes left, and these are gradually absorbed.

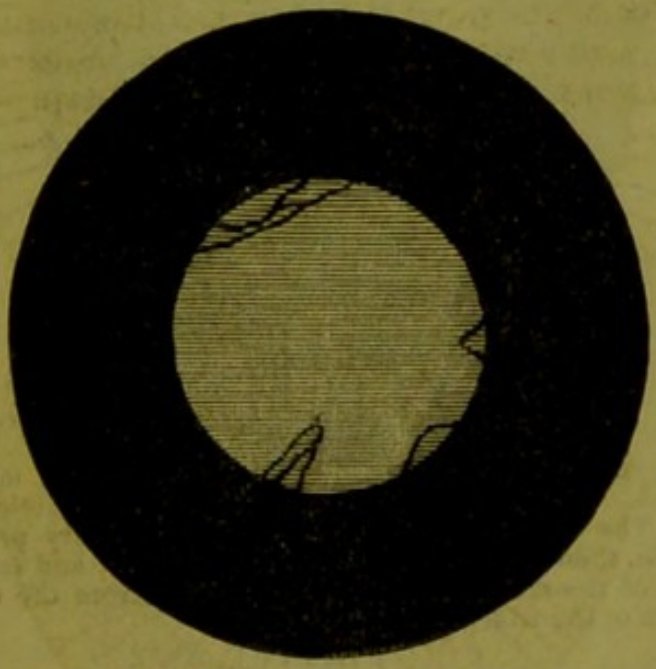

Fig. 2. The iris and membrana pupillaris of a nine months fœtus (*i.e.*, still-born, at full time). A few remaining loops of vessels are seen running from the iris upon the membrane.

In order to see the vessels properly, the iris and the anterior part of the choroid, with the ciliary ligament and body, are to be removed from the eye of a six months fœtus which has been successfully injected from the umbilical vein. The removal is done by dividing the organ into an anterior and a posterior half, removing the cornea and sclerotic from the anterior por-

tion, and washing away the pigment from the uvea and ciliary processes by gentle agitation in spirit and water. Upon examining the posterior surface of a specimen thus prepared by the aid of the microscope and a low power lens, the ciliary processes are seen full of vessels, and from under cover of them a vast number of vessels are seen to run for a short distance in a straight course (Fig. 3), and then to turn and anastomose very freely. These vessels are solely distributed to the iris, and but three or four of them pass on to the membrana pupillaris. I have seen these arteries with very similar anastomosing branches on the back of the iris in a fœtus of nine months, where the anterior vessels were but indistinctly seen.

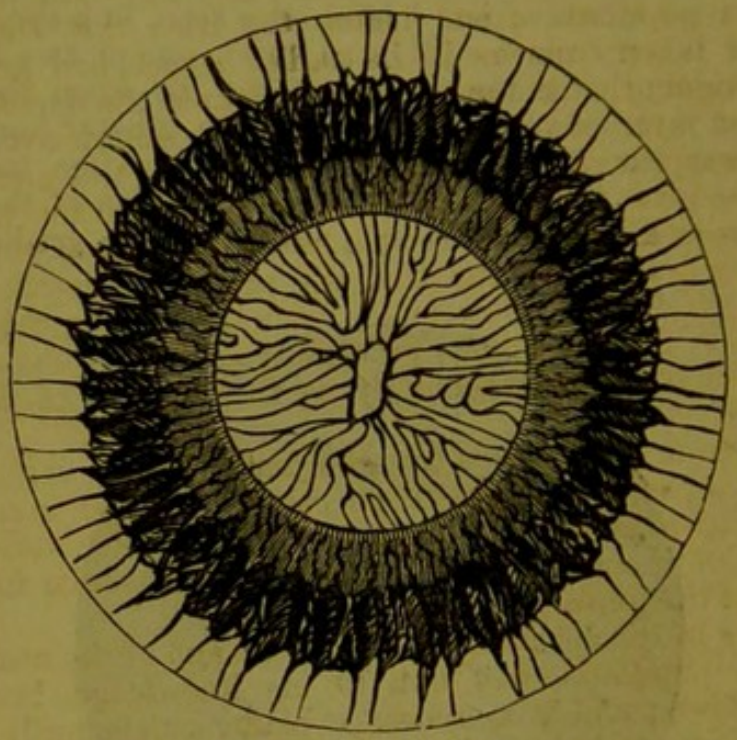

Fig. 3. The anterior half of an injected fœtal eye (six months) seen from behind. The pigment, the cornea, and the sclerotic, have been removed. The straight vessels leading to the ciliary processes are seen outside, then the posterior vessels of the iris, and in the centre the vessels of the membrana pupillaris coming from the other (anterior) surface of the iris.

There is no doubt that the disappearance of the membrana pupillaris occurs at different periods in different cases; for I have often searched for it in vain in a nine months fœtus, and found the pupil perfect and open: in other words, it sometimes disappears before birth, and sometimes at that period. I have also found it present in one eye, and absent in the other.

In a fœtus of a few weeks, no trace of an eye is to be seen; but, at six or eight weeks, it is visible as a small transparent gelatinous body. In the third and fourth months, the exterior of

the globe is completed, and the choroid is almost entire, but still there is no iris; but, in the fifth month, the latter membrane is first visible as a narrow blueish or brown ring. The iris is formed subsequently to the choroid; and, as soon as it is to be demonstrated, a membrana pupillaris may also be seen. A writer in Von Ammon's *Zeitschrift* says that the membrana pupillaris is present when there is no iris and no corpus ciliare, in a fœtal sheep. The vessels of the iris, choroid, and ciliary processes, are distinct. As time goes on, and the development becomes more complete, the pupil becomes narrow, until, at the ninth month, it is very narrow, and the colour of the iris is tolerably distinct.

Taking all these points into consideration—viz., that the membrana pupillaris exists before the iris; that the latter membrane is very narrow in its earlier stages, and gradually becomes wider; that the cause of the colour is the deposition of a posterior layer of pigment; and that the anterior vessels of the iris disappear at the same time as those of the membrana pupillaris—I am inclined to come to the conclusion that the use of this membrane is to form a substratum upon which the iris may be developed; and that the posterior vessels spring from the great arterial circle to form the iris, as others do posteriorly to form the ciliary processes; and that these are the arteries which exist permanently as the arteries of the iris during life.

As the embryo advances towards maturity, the vessels are elongated, and more pigment is deposited: in other words, the iris increases in width; and the process is probably assisted in later months by contraction of the orbicular muscular fibres at the edge of the pupil.

This view of the development of the iris, and of the use of the membrana pupillaris, has not, to my knowledge, been before laid down; and it moreover explains satisfactorily to my mind certain pathological conditions which I will briefly describe.

The disease called "central opacity of the capsule" is well known to all ophthalmic surgeons of the present day, and has been tolerably accurately described in books upon diseases of the eyes. It is a white opaque spot in the centre of the anterior capsule (Fig. 4), without any connexion with the pupillary margin of the iris. There is sometimes a corresponding opaque spot upon the cornea, and sometimes upon the posterior capsule also. It occurs in those only who have suffered in their earliest infancy from an attack of *ophthalmia neonatorum*, or the purulent ophthalmia of newly born infants, and commonly comes under the notice of the surgeon accidentally. There is little or no dimness of sight; but the prominent symptom is an involuntary oscillating movement of the eyes, rendered necessary by the central position of the

opaque spot, that a complete image of the object may be impressed on the retina.

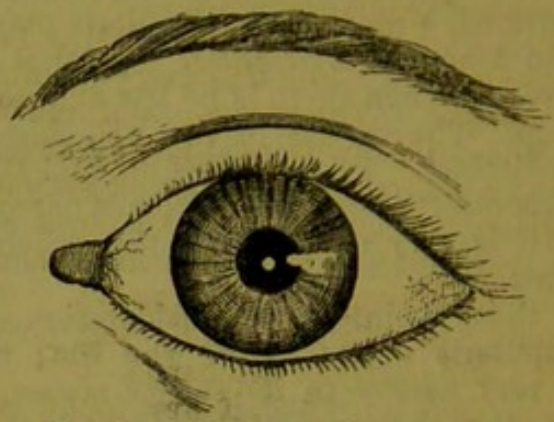

Fig. 4. Central capsular cataract.

The following cases are among those which have come under my own notice.

Case I. Richard Mathews, aged three weeks, was admitted at the Bristol Eye Dispensary on the 17th of December, 1834, labouring under acute purulent ophthalmia. It commenced upon the third day after birth, and had been allowed to run on without any particular treatment until the time of his admission. There was an ulcer upon the centre of each cornea, of considerable depth, giving an appearance as if the iris were protruding. The appropriate treatment was adopted, and the child gradually recovered from that time.

Sept. 18th, 1844. The boy is now 10 years old. He has a light corneal opacity in each eye, and a minute spot of opacity upon the anterior capsule of each lens. He is in the City School, and can see to read well.

Case II. Rosina Cole, aged two weeks, was admitted June 7th, 1843. The attack of purulent ophthalmia commenced upon the third day after birth. The left eye only was affected. Upon her admission, there was a large opacity upon the lower part of the left cornea: the discharge was profuse. The mother had purulent vaginal discharge. Under the usual treatment she recovered.

August 2nd. The eye is free from inflammation. A large white superficial opacity covers the lower part of the left cornea. There is a small white opaque spot upon the anterior capsule of this eye.

Case III. Charles Doyle was admitted on the 16th of May, 1849. There was a small central capsular opacity in the right eye. The child had suppurative inflammation when three days old, and the mother had vaginal discharge. No treatment was adopted, and the sight did not appear defective.

Case iv. Mary J. Price, aged one month, was admitted on the 10th of September, 1855. The right eye had been affected for three weeks, and the cornea was entirely opaque. On the 29th of November, the opacity was very much lessened, and there was a central capsular cataract.

Case v. Ellen Bancroft was admitted May 1st, 1853. Both eyes had always suffered. She was five years old. The corneæ were slightly opaque. There were well marked oscillatory movements. The child saw to read large letters. It was near sighted, and had a central opaque spot on each capsule.

Case vi. Ellen Price, aged five weeks, was admitted on the 2nd of September, 1853. Both eyes had been affected with suppurative inflammation for four weeks. The right was opaque, apparently in the lens. The left cornea was clear. There was still some puriform discharge.

On the 1st of October, 1856, it was found that the patient had a corneal opacity, and a large deposit on the capsule of the right eye, near the upper part of the pupil.

Case vii. Amelia Essay, aged 34, was admitted on the 29th of October, 1856. Both eyes were affected, and the sight was becoming worse. The opacity, which existed as a central spot, was becoming more obvious. This patient could not remember that any account of purulent ophthalmia, or of any inflammation of the eyes, was connected with the state of her sight. Her mother was operated on for cataract by Mr. Estlin.

Case viii. Upon searching among the records of the operations performed by Mr. Estlin, I found the case of this last patient's mother. Sarah Oakinfeld was admitted as a patient at the Eye Dispensary, with some imperfection of the sight, and central opacity in each capsule, of the size of a large pin's head; but no rapid deterioration of sight was occurring. Some time afterwards, the lenses became more generally opaque (exactly as occurred subsequently in her daughter's case), and vision became useless. The eyes were operated on by needle; and, after two operations, the right became quite clear from the absorption of the lens; and the other became amaurotic, in consequence of the irritation produced by the presence of the cataract in the anterior chamber, having escaped from a laceration in the capsule.

Case ix. John Leaman, aged ten days, was admitted on the 21st of August, 1839, suffering from purulent ophthalmia. The left eye was entered in the book as having the cornea sloughed; and the note, which is in Mr. Estlin's handwriting, says, "There was a burst of aqueous humour while examining it." The other eye was tolerably clear.

I saw this patient again a few months ago, when he was nearly 18 years of age; and it is a matter of considerable interest to notice how the eye had recovered itself during the time that had elapsed, leaving permanent signs of the actual

mischief produced by the inflammation. There is a corneal opacity in the lower and inner part of the eye, with a distorted pupil, which has been drawn down to the point where the rupture took place. There is a spot of opacity upon the capsule of this eye, of about the size of a small pin's head; it is also situated rather to the inner part of the eye.

Case x. Elizabeth Lease, aged nine months, was admitted on the 10th of September, 1856. The right eye only was affected. She had purulent ophthalmia three days after birth. There was a small corneal opacity, and a small central capsular cataract. The left eye was perfect. No treatment was adopted.

In most of the works on ophthalmic diseases this peculiar condition of the capsule is referred to general inflammation, or increased vascularity of the eye, spreading from the more superficial membranes in the cases of severe purulent ophthalmia; but no kind of explanation or reason is given why there should be a deposit of this peculiar appearance and position, instead of cataract in the ordinary form.

The most accurate description has been published in a thesis by Dr. Beck, printed at Leipzig in 1830. The author says that the general congestion and increased activity of the circulation in the whole of the eye having prevented the usual obstruction to the course of blood in the arteria centralis retinæ and its branches upon the posterior capsule, which takes place ordinarily at birth, the consequence is thickening and deposit upon the posterior capsule from the artery itself, and upon the anterior capsule from the branches which he considers to be distributed to this part of the eye; and with this opinion Von Ammon coincides.

The formation of the posterior opacity by the arteria centralis retinæ, as described by these authors, is very reasonable and intelligible, and is undoubtedly the true state of the case; but the attempt to attribute to the same cause the production of the deposit upon the anterior capsule fails most completely upon anatomical grounds, for there are no vessels to be demonstrated upon the middle of the anterior capsule. I believe that the following explanation will be found satisfactory with regard to the anterior opacity, and will account for the introduction of these cases in the present paper.

I have already shown that at the termination of the ninth month of fœtal existence the membrana pupillaris still exists, and is, to a certain degree, supplied with vessels; whilst in some cases it is entirely wanting at that period. It is obviously impossible that the membrane and its vessels can disappear instantaneously; and we can easily understand how the highly increased vascularity of the whole eye, which is so obvious in the ophthalmia neonatorum, can cause the reappearance or redevelopment of the vessels which had so recently

become obstructed, or can prevent their becoming obliterated, as it probably also does in the case of the arteria centralis retinæ and its capsular branches. We must also keep in mind the fact before mentioned, that the centre of the membrana pupillaris is in contact with the anterior capsule of the lens. The subsequent adhesion of these parts is an almost necessary consequence of the inflammatory process, which has thus spread from the superficial parts of the eye.

The remaining stages are easily understood: the eye gradually recovers from the inflammation, and becomes capable of bearing exposure to light; the membrana pupillaris is ruptured, and disappears as usual; but the central portion is still adherent, and remains an indelible spot upon the anterior capsule.

This explanation of this morbid condition of the anterior capsule of the lens meets every difficulty of the case, and appears to me to be the only way in which we can at all intelligibly account for this peculiar deposit. The posterior opacity may arise, as Beck and Von Ammon have described it.

The following case is one where the entire membrane existed after birth in an opaque condition, and where an operation failed to give sight.

Case xi. Thomas Stone, aged fifteen months, a poor weakly child, was admitted in August of last year. The pupils were of about the size of pin holes, filled with opaque matter, adherent to the iris. Belladonna had no action. He obviously saw the light, but the eyes were small and rather soft.

Aug. 8th. I introduced a fine curved needle through the cornea, and tried to drill a hole in the right pupil, and but partially succeeded. I then passed a straight needle in from behind, and drew back the opaque membrane which filled the left pupil, and it did not rise again. The child was cutting its teeth, and had swollen and suppurating gums on the third day after the operation. The gums were lanced, but on the fourth day it was heavy and dull, and on the fifth it died. No *post mortem* examination was made.

I have met with the following case of extreme rarity, which, if my idea of the pathology of this central opacity is correct, will illustrate the disease, as well as one point in the early development of the eye which I have brought forward, viz., the existence of the membrana pupillaris before and independently of the iris.

I have before mentioned that the choroid is early formed, that the iris and the ciliary body are the results of a fresh effort (as it is called) of the "nisus formativus"; and we know that in certain rare instances the iris is entirely wanting, although it is probable that the membrana pupillaris exists. The case which I am going briefly to narrate is one of con-

genital absence of the iris (or irideremia), where there was, by coincidence, also a central opacity of the capsule.

Case xii. A child was admitted at the Eye Dispensary about ten years ago with complete absence of the iris. It was six months old, and was brought because it was supposed not to see. The posterior chambers were fully exposed, and presented the red reflecting glare round the edge of the lens, usually seen in these cases; in the left eye there was a central spot of opacity upon the anterior capsule, which gave a very peculiar appearance to the eye. The mother was healthy. The child disliked the light, and shrank away from it. I saw it again after a considerable time, and found that it had become a little more used to the light, but otherwise its state was the same.

The following question will most probably occur to my hearers: If inflammation of the membrana pupillaris and its adhesion to the capsule are the cause of the central cataract, and if the inflammation of these parts is merely an extension of disease from the superficial membranes of the eye, why do we not more frequently see central cataract, when we so frequently see cases of acute purulent ophthalmia in newly born infants? The proportion of cases of acute purulent ophthalmia in infants to the entire number admitted to an Eye Dispensary or Hospital is probably about one in sixty; whilst the proportion of instances of central cataract is about one in several thousand cases. In reconciling this great disparity, we must remember that for the production of such a result as this deposit, there must be a coincidence of at least two distinct conditions. The inflammation must be unusually severe even for these cases, and it must have attacked the eye soon after birth, with a tendency to spread to the internal parts; and, secondly, the membrana pupillaris must be entire, and some vascular connections with the iris must remain. Now, when we combine the probable rareness of this latter condition with the chances which this individual has of suffering from purulent ophthalmia, we shall be able to understand the cause of the very great comparative rareness of the central capsular cataract.

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