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By E. Treacher Collins.

(With Plate IV, fig. 2, and Plate VIII.)

The literature on the subject of glaucoma after extraction of cataract is very scanty;* Sir William Bowman, in 1865, mentioned that "glaucomatous tension is particularly apt to come on after needle operations following flap extraction, where the pupil is small, and disposed by the integrity of the sphincter muscle to remain small afterwards, as well as to suffer at the moment from the dilating force of the needles."

He also says, "The glaucomatous hardness is by no means an indication or result of mere iritis."

Graefe,† in 1869, stated that glaucoma is by no means rare after extraction or discission; he says, "I think this succession may be attributed to two causes: secondary cataracts contain not unfrequently within the collapsed capsule remnants of cortex which after a fresh operation are liable to swell and irritate the posterior surface of the iris and ciliary organs, especially if the pupil is small, unless great care is taken; there may also be displacement of the capsule, with traction and irritation of adherent

* 'Ophth. Hosp. Rep.,' vol. iv, p. 365.

† 'Cent. f. d. Wissensch.,' 1869; translation, 'Ophth. Hosp. Rep.,' vol. viii.

ciliary processes, especially when the capsule is tough, not diaphanous, but forming an opaque membrane or presenting opaque stripes."

Mr. Priestly Smith,* in 1879, recorded a case of glaucoma following extraction of senile cataract, and in treating of the case summarizes the process as follows: "The lens is removed without rupture of the suspensory ligament and capsule; plastic iritis, possibly due to the retention of cortical fragments, sets in; the iris adheres throughout to the suspensory ligament and capsule; the portions of these membranes occupying the pupil and the coloboma are coated over with lymph. A thickened impervious partition is thus created between the aqueous and vitreous chambers; the tension rises in the vitreous chamber; the angle of the anterior chamber is closed by the advance of the partition; a certain amount of turbid fluid is imprisoned in the anterior chamber, intense glaucoma is rapidly induced."

Stölting,† in 1887, recorded a case of glaucoma following linear extraction in a woman æt. 64, in which he afterwards made a pathological examination of the eyeball. In this case there was incarceration of the lens capsule and iris in the extraction cicatrix, and the angle of the anterior chamber was closed by peripheral adhesion of the iris throughout the whole circle. "He‡ holds that the starting-point of the glaucoma in his case was a traumatic choroiditis; that the onset of glaucomatous tension was the expression of lymph-stasis between choroid and sclera; that the final result of the glaucomatous pressure was the closure of the angle of the anterior chamber."

Schlegtendal,§ in commenting on this case, urges that "the evidence in favour of the supra-choroidal œdema is fallacious; in short, that the appearances described were produced artificially after the excision of the eye."

* 'Glaucoma; its Causes, &c.,' p. 178.

† 'Archiv f. Ophth.,' vol. xxxiii, p. 177.

‡ 'Ophth. Review,' vol. vii, p. 138.

§ 'Klin. Monatsb. f. Augenheilk.,' Feb., 1888, p. 91.

Priestley Smith attributes the increased tension in this case to the closure of the angle of the anterior chamber by the pressure of a consistent vitreous against the ciliary processes, induced by a thickening of the choroid due to general hyperæmia.

In part 1, vol. xii, of the 'Ophthalmic Hospital Reports' I recorded the clinical details of four cases of increased tension coming on after extraction of cataract, terminating in complete loss of vision. In these cases the increased tension was not caused by iritis or the results of iritis.

In two of the cases adhesion of the lens capsule and iris to the extraction cicatrix could be distinctly seen. I suggested that possibly these adhesions by dragging forwards the iris had caused a blocking of the angle of the anterior chamber, and were thus probably the primary cause of the glaucoma.

Since that time I have examined pathologically ten eyes in which increased tension had supervened subsequently to extraction.

The notes of these cases, which are given in full at the end of this paper, I may briefly summarize as follows :

In nine of the cases the cataract was senile, in one probably traumatic. In five a cataract had been successfully removed from the patient's other eye without any symptoms of glaucoma having manifested themselves. In three the glaucoma came on after a needle operation. In three others it came with iritis accompanied by keratitis punctata, and the second eye in each of these cases became affected with sympathetic ophthalmitis. In the remaining four slight iritis only followed on the operation; one of them, however, knocked her eye on the tenth day and reopened the wound.

The length of time between the operation and the onset of the glaucoma varied considerably in these last cases, in one being as much as a year and nine months, and in another less than three months. In one case a preliminary iridectomy, and in eight of the cases an iridectomy at the time of the extraction, was performed. The capsules were opened

in different ways, in some the face being lacerated, in others a peripheral incision only being made. In two a portion of the anterior capsule was torn away with forceps. In one the capsule was entirely removed.

Pathological examination revealed in all the cases, except this last, adhesion of the lens capsule to the extraction cicatrix; and in this last one the hyaloid of the vitreous had come forwards and adhered to the corneal scar.

In the three cases which accompanied kerato-iritis, and in the case in which the corneal wound was reopened by a blow, the capsule had become converted into a thick membrane by inflammatory plastic effusion, and the lower part of the iris was adherent to it in its whole length.

In the other cases no such thickening had occurred, and the adhesions of the iris were confined to the pupillary margin. In all the cases, with the exception of the one in which the lens was removed in its capsule, some cortical matter had been left in the peripheral portions.

The angle of the anterior chamber in the coloboma was in all the cases blocked either by the root of the iris which had been left, or by the foremost of the ciliary processes which had become dragged forwards and held in close contact with the posterior surface of the cornea by the upper portion of the entangled capsule. The angle of the anterior chamber elsewhere was also blocked by peripheral adhesion of the root of the iris in all except the kerato-iritis cases. In these three there was inflammatory cell-infiltration of the tissue of the iris and of the meshes of the ligamentum pectinatum, also collections of round cells in small clusters on the posterior surface of Descemet's membrane. The ciliary processes were in most of the cases elongated forwards, and at the upper part of the eyes flattened by the pressure from the fibres of the suspensory ligament. The choroid in one case was much thickened by inflammatory infiltration; in two there were patches of dilated vessels, and in two of the others it was atrophied. The retina in several of the cases had cystic spaces in it, immediately behind the ora serrata; in only

one was there any detachment. The optic nerve was cupped, and showed glaucomatous changes in all except the three cases accompanied by kerato-iritis; in these it was slightly swollen and slightly infiltrated by small round cells. The vitreous in four cases had the remains of small hæmorrhages in it; in all the cases except one its consistency was thinner than normal; in some it was detached posteriorly from the retina. In the case with kerato-iritis and choroiditis it was firmer than usual, and streaked with inflammatory effusion.

In considering the pathology of these cases I may first point out that the occurrence of increased tension does not seem to have been due to any inherent tendency to glaucoma in the eyes of the patients themselves. In five of them the other eye was operated on successfully, no increased tension manifesting itself. It must have been something which occurred in connection with the individual operation which brought on the train of symptoms that followed.

It is very striking that we have here eyes with the lens absent, from which a portion of the iris has been removed, where the anterior chamber is shallow, and yet in which the tension of the eye is greater than normal. What is it then that has not only taken the place of the aforesaid structures, but has also rendered the eye tenser than it should be? We might imagine this new factor to be—

1st. A new growth springing from the choroid.

2nd. Hæmorrhage situated either in the vitreous, between the retina and choroid, or between the choroid and sclerotic.

3rd. An accumulation of fluid between the choroid and a detached retina.

4th. Inflammatory thickening of the choroid with or without effusion into the vitreous.

5th. An accumulation of the intra-ocular circulating fluids.

In none of the cases which I have examined was there

any choroidal neoplasm. In four only were there the remains of small hæmorrhages in the vitreous. In only one was the retina detached, and that to quite a small extent. In one the choroid was thickened by inflammatory exudation ; in that case also the vitreous was infiltrated and firmer than normal. In all the other nine cases it was thinner than usual, and in some detached posteriorly. In nine of the cases, then, the change in question chiefly consisted in an accumulation of fluid in the vitreous or between the hyaloid of the vitreous and retina. Was this accumulation the result of increased supply or of obstructed outlet ?

In nine cases there was an adhesion of the lens capsule, and in one of the hyaloid of the vitreous to the extraction cicatrix in the cornea. This adhesion might bring about two results : 1st, by the drag set up on the ciliary processes it might cause irritation and increase in the amount of fluid secreted by them ; 2ndly, it might by pulling forwards the iris cause approximation of its root to the posterior surface of the cornea, and so block the outflow of fluids through the filtration area. As I have before mentioned, there was such blocking in all except the three keratoiritis cases.

In the cases in which the glaucoma came on after needling, the adhesion of capsule to the extraction scar must have existed since the removal of the cataract, but the increased tension did not occur until after discission of the capsule had been performed, in one case not until after the second discission, and three and a half years subsequently to the original operation. Microscopical examination of the cornea in this case showed two scars with attachment of lens capsule to them. The second needling had possibly caused a fresh adhesion and still further advance in the position of the capsule, and consequently of the iris. In another case a small prolapse of the vitreous through the needle puncture in the cornea was observed.

Moreover, the irritation induced by needling would

tend to cause increased secretion from the ciliary processes; and as Graefe suggested, the remaining cortical lens matter would be liberated and thus permitted to swell.

The study of these ten cases, then, leads me to believe that the adhesion of the lens capsule to the corneal cicatrix after extraction of cataract predisposes the eye strongly to a subsequent attack of glaucoma; that in some cases this adhesion combined with an entanglement of the iris is alone sufficient to light up an attack; in others it requires additional irritation, such as is caused by the operation of discission or an attack of kerato-iritis.

Before proceeding to the treatment of these cases I should like to draw attention to the frequency with which they occur. Thus from the commencement of 1885 to the middle of 1889 there were at the Moorfields Hospital 1405 senile cataracts extracted; of these nine were lost from glaucoma, or ·64 per cent.

The preventive treatment might readily lead me into a discussion of all the details of the operation of extraction. I will content myself with saying that several of these cases show that slowness in the re-formation of the anterior chamber favours adhesion of the capsule and iris to the wound. That operation and that after-treatment, therefore, which is most likely to produce a rapid healing of the wound, will be least likely to be followed by this complication. The leaving of large quantities of cortical lens matter and the use of needles for the operation of discission, which are not sufficiently conical to plug the wound and retain the aqueous I believe also favour its occurrence.

The treatment of these cases when once the glaucoma has started, from what I have seen, is most unfavorable. In several cases the patients did not present themselves until vision was completely lost. In others paracentesis, sclerotomies, curette evacuation, and suction of the remaining soft lens matter have been tried, but unsuccessfully. In Stoelting's case six operations were performed for the relief of the tension without the desired effect

being produced. In only one patient have I seen the glaucoma permanently relieved by an operation, and that is in the case which has been shown in the next room. In this patient, as in the other cases, there was an adhesion of lens capsule to the extraction scar. The glaucoma followed on a needle operation two months after the extraction. Paracentesis of the anterior chamber failed to relieve the tension. An iridectomy was performed outwards; an incision being afterwards made in the lens capsule, a bead of vitreous then presented and was cut off. Microscopical examination of the cornea in one case in which sclerotomy had been performed showed the scars of both the extraction and the sclerotomy; the latter was not nearly peripheral enough to have opened up the angle of the anterior chamber, which in this case was blocked by the foremost of the ciliary processes.

Case 1. *Glaucoma coming on a year and nine months after extraction.*—Maria M—, æt. 50, was admitted to Moorfields Hospital on December 10th, 1883, with a complete cataract in her left eye and an immature one in her right.

The left was removed by a modified Graefe's extraction the following day. The operation was uncomplicated. Some soft cortical matter remained behind. Slight iritis and ciliary injection followed on the operation, also some conjunctival irritation and supra-orbital neuralgia. Ultimately she obtained good vision, and was able to see to sew and read. About a year and nine months after the operation the sight began to fail rapidly without much pain. She had had no injury to the eye, and was unable to account for the failure of sight in any way.

On examination of the eye there was found to be slight deep-seated congestion. Haze of the cornea. Entanglement of the iris in both angles of the cicatrix. Deep cupping of the optic nerve. V.=perception of light only. **T. + 1½.**

The eye was excised on October 16th, 1885.

Pathological examination.—Eyeball somewhat altered in

shape. Its vertical transverse diameter increased relatively to its horizontal. At the upper part in the equatorial region is a rounded bulging of the sclera. The cornea is steamy, the extraction scar at the upper part white, flat, and firm-looking. On section it is seen to be at right angles to the upper part of the cornea. The iris above has been removed well up to its periphery. The lower part looks normal, it is not bent ; the root is in apposition, but not adherent to the cornea. There is a small collar of lens matter lying against the periphery of the iris posteriorly, adherent to it and the ciliary processes everywhere, except at the lower part, where it is a short distance off. The ciliary processes are dragged upwards by the membrane in the coloboma, which passes forwards and becomes attached to the corneal cicatrix. The vitreous is clear but fluid in greater part. There are no hæmorrhages in it. The hyaloid membrane is very distinct, it remains adherent to the inner surface of the retina. The retina is *in situ*. The optic disc is cupped, not extensively or deeply.

Microscopical examination.—There is a slight depression on the surface of the cornea at the seat of the extraction cicatrix, and a small amount of round-cell infiltration about it. Adherent to the cornea in this situation by some fibrous tissue is the anterior capsule of the lens, and also in some sections the iris.

The root of the iris at the lower part of the anterior chamber is for some distance in contact with the posterior surface of the cornea, and in this part is much atrophied. The angle of the anterior chamber above in the situation of the coloboma is blocked by a small piece of the root of the iris that has been left, as well as by the foremost of the ciliary processes. The ciliary processes are small, and at the lower part very much elongated. The capsule of the lens contains between its layers peripherally a small amount of cortical matter, composed of irregular hyaline masses and nucleated fibres. The whole of the nuclear zone has been left, and some new lens-fibres have probably been formed since the removal of the cataract.

There is no inflammatory infiltration of the iris, ciliary body, or choroid, nor is there any dilatation of the vessels of the latter membrane.

There are some cystic spaces in the retina immediately posterior to the ora serrata.

Case 2. (Plate VIII, fig. 1.) *Glaucoma following extraction within three months of the operation.*—Ezra M—, æt. 62, had a cataract removed from his right eye in October, 1886. Subsequently with his glasses he was able to see $\frac{6}{18}$ and J. 1, and has continued to do so up to the present time.

On April 23rd, 1887, a mature cataract was extracted from his left eye, a corneal section being made upwards and a small iridectomy. Some soft lens matter was left.

Seven days later, the anterior chamber had re-formed; the conjunctiva was much swollen and injected; there was some iritis.

On May 27th, the day the patient left the hospital, the eye was quiet, but he still had some photophobia.

On July 22nd, three months after the operation, he returned with slight injection of the eye; some haze of the upper part of the cornea in the neighbourhood of the scar; an anterior chamber deeper at the lower part than at the upper; an entanglement of the inner angle of the iris in the cicatrix, and T. + 2. V. = $\bar{c} + 10\frac{3}{60}$. Paracentesis of the anterior chamber was performed, but the tension soon returned.

On January 26th, 1889, he had photophobia of both eyes and great pain in his left; no perception of light. T. + 3, and hardly any anterior chamber. It was then enucleated.

Pathological examination.—The cornea presents a bulging cicatrix at the upper margin, most marked on the inner side. There is some yellowish infiltration around it, also nebulæ in other parts.

The anterior chamber is very shallow, and contains a yellow mass at bottom of it.

Only a small portion of the iris is absent above, its root is adherent to the posterior surface of the cornea in its entire circumference. The angles of the cut iris on each side are adherent to the corneal cicatrix, as is also the lens capsule, which is thus drawn forwards through the coloboma. There are some remains of lens substance within the capsule at the lower part and at the sides.

The vitreous is detached from the retina at the posterior part of the globe. It contains a small hæmorrhage at the outer side. The retina and choroid are *in situ*, the optic disc deeply cupped and excavated.

Microscopical examination.—The line of incision in the cornea is some distance from its margin ; there is some small cell infiltration around and superficial to it, also some between the layers of the cornea near its centre. The upper part of the anterior layer of the lens capsule passes into the gap left in Descemet's membrane at the line of the incision. The upper portion of the posterior layer is only separated from the anterior by some inflammatory cells and fibrous tissue. The lower portions of the lens capsule, which contain between them some broken-up lens matter, are attached to the posterior surface of the cicatrix by some fibrous tissue. In sections opposite to the coloboma a large portion of the root of the iris is still left ; this is in contact with the posterior surface of the cornea, being contained in a space between it and the upper part of the lens capsule. In sections passing on one side of the coloboma there is a staphylomatous condition of the corneal cicatrix, to the inner surface of which the iris is intimately adherent, its stroma being much atrophied, and in places its uveal layer alone remaining. The root of the iris at the lower part is also attached to the posterior surface of the cornea, thus narrowing the angle of the anterior chamber ; there is some cell-infiltration around this attachment.

The choroid contains a patch of dilated vessels near the posterior pole of the eye ; elsewhere it appears healthy.

The retina has several small cystic spaces in it, just behind the ora serrata.

Case 3. *Glaucoma coming on twelve months after extraction of a traumatic cataract in its capsule without iridectomy.*—Martin C—, æt. 65, was admitted to Moorfields Hospital on March 26th, 1886. He had had a cataract, which was probably traumatic in origin, extracted from his left eye elsewhere eighteen months previously. He had not had any trouble with the eye until six months previous to his admission, when it became inflamed and painful. He had had no fresh injury to the eye which would account for this. On examination of his left eye it was found to be slightly injected; there was some haze and superficial roughness of the cornea; there appeared to be a coloboma upwards the pupil was dilated. It could not be certainly made out whether there was any adhesion of the iris to the cornea or not. V. = hand reflex. T. was normal. V. of R. eye = $\frac{6}{12}$, Hm. $1\frac{6}{6}$. There were no changes in the lens of the right.

In spite of treatment the eye continued painful. It was excised on March 28th, 1886.

Pathological examination.—Left eye, T. n. There is some epithelial haze of the cornea, large vessels run into it at the nasal side up and out. There is a small scar in it near the upper margin, but not concentric with it. To this scar there is a large adhesion of the pupillary edge of the iris, also of the hyaloid membrane of the vitreous. The iris at the lower part is thick and narrow; the angle of the anterior chamber is not markedly narrowed. The lens is absent, and no trace of its capsule can be seen. The vitreous is clear, but fluid in greater part. The retina is not detached. The choroid shows no changes. The optic disc is deeply and widely excavated.

Microscopical examination.—There is a depression on the surface of the cornea at the seat of the extraction cicatrix; some blood-vessels between the anterior layers of the cornea course down to it: there is no infiltration of inflammatory cells about it. On the posterior surface of

the cornea, the pupillary margin of the upper part of the iris is adherent to the scar. The hyaloid of the vitreous also, after passing through the pupil, has become attached in the same position. None of the iris has been removed. The upper part of it at its periphery is for some distance adherent to the posterior surface of the cornea; it is then free for some distance, and finally becomes attached again at its pupillary margin, as mentioned. The tissue of the iris in this part is somewhat atrophied, but there is not any inflammatory infiltration about it.

The lower angle of the anterior chamber is but slightly narrowed. There are no inflammatory changes about the ciliary body or choroid.

The fibres of the suspensory ligament on either side of the section end on a level with the hindermost of the ciliary processes. A portion of the vitreous can be seen passing forwards from its attachments to the pans ciliaris retinæ on both sides, and becoming adherent to the cornea; it contains a few scattered small round cells.

Case 4. (Plate VIII, fig. 2.) *Extraction of cataract; wound reopened by a blow ten days after operation; glaucoma.*—Caroline C—, æt. 64, admitted to Moorfields Hospital May 16th, 1889. She had had a cataract successfully extracted from her left eye in the previous March. Her V. with $\frac{+12}{+2 \text{ cy. horizontal}} = \frac{6}{24}$, and with $\frac{+16}{+2 \text{ cy. horizontal}} = \text{J. } 10.$

In the right eye she had a nearly complete cataract, and V. = fingers at 3 ft. The following day it was extracted under cocain, the section being made upwards at the sclero-corneal margin. A large iridectomy was performed, and the capsule opened with forceps, a portion of the anterior capsule being removed.

Eight days after the operation some iritis was noted, and much opaque matter seen in the coloboma.

Two days later she knocked the eye, and the wound

reopened. After this the anterior chamber was a long time in re-forming, and there was considerable injection and chemosis of the conjunctiva.

On the date of her discharge, June 24th, the following note was made—"Much less injection. No pain. Very shallow anterior chamber. Less swelling of lids. Pupil half wide and slightly drawn up. Much opaque matter in pupil."

She returned September 16th, 1889, exactly four months after the operation, with much injection of the eye, no anterior chamber, a misty cornea, T. +2, and only perception of light. A curette evacuation was performed, and a good deal of soft lens matter came away, but the tension was not relieved and the eye became painful. It was excised on October 1st, 1889.

Pathological examination.—There is considerable epithelial haze of the cornea. The extraction cicatrix starts and terminates at the sclero-corneal margin; the centre is in the cornea. The anterior chamber is exceedingly shallow. The coloboma upwards is large, no posterior synechia can be seen. An opaque membrane fills the coloboma, the relation of which to the extraction cicatrix cannot be satisfactorily made out macroscopically.

The posterior pole including the optic disc has been cut off in the removal of the eyeball, so that the relation of its tunics and the condition of the vitreous and optic nerve cannot be ascertained.

Microscopic examination.—The line of the extraction incision in the cornea has some small round-celled infiltration around it and a considerable mass immediately beneath the epithelium covering it. On the posterior surface of the cornea in this region a break is seen in the continuity of Descemet's membrane. The upper free extremity of the anterior capsule passes into this break, and is lost in the organised inflammatory tissue situated there. A large portion of the remainder of the anterior capsule is absent. Its lower part can be seen behind the lower limb of the iris. The posterior capsule is only

separated from the anterior (where the latter is present) by some collections of small round cells. Between the free extremity of the lower limb of the iris and the line of the extraction cicatrix the posterior capsule is adherent to the cornea by a mass of fibrous tissue. The iris has been removed almost up to its root above ; the small piece that remains together with the first of the ciliary processes is locked by the lens capsule into close contact with the filtration area of the cornea.

The tissue of the lower part of the iris is thickened by infiltration with inflammatory leucocytes. There is slight constriction of the angle of the anterior chamber below. The ciliary processes, especially at the upper part, are much flattened by pressure from the fibres of the suspensory ligament.

The vessels of the choroid are very much dilated in parts ; there is not any inflammatory effusion into it.

Case 5. (Plate VIII, fig. 3.) *Glaucoma following a needle operation three and a half years after extraction.*— Christiana G—, æt. 62, came to the Moorfields Hospital in February, 1882, with a nearly mature cataract in her left eye and an incipient one in her right.

A preliminary iridectomy was performed on the left ; soon after the operation she knocked the eye, and some ciliary injection and tenderness followed.

In May, 1882, the left cataract was extracted. The iris became adherent to the lips of the wound.

On October 24, 1882, her V. $\bar{c}+15 = J.\ 16$; there was a fine membrane in the pupil, which was needled, without, however, any improvement in vision being effected.

In June, 1885, the right cataract was extracted, a satisfactory result being obtained.

On October 27th, 1885, nearly three and a half years after the extraction, a second needling operation was performed on the left eye.

The next day the T. was +2, the anterior chamber very shallow, and the conjunctiva chemosed and congested. The

cornea was punctured and the aqueous allowed to escape. The pain was relieved, but the T. still continued +2.

On April 4, 1887, it was noted: Both angles of iris adherent to cornea; membrane in pupil also adherent to cornea. No perception of light. T.+2. The eye was excised the next day.

Pathological examination.—Left eye T.+2. There is epithelial haze of the cornea, its substance being quite clear. There is a white linear scar at the upper part. Vitreous clear, of slightly thinner consistency than normal. Retina and choroid appear normal to the naked eye. Optic disc deeply cupped. The iris above has been removed quite up to its root. There is some opaque lens matter at the upper part of the coloboma, and also behind the iris below. The cut angles of the iris are firmly adherent to the cornea at the scar, also a thin membrane stretching from the lower pupillary border of the iris, upwards. The periphery of the iris at the lower part is adherent to the cornea, blocking the angle of the anterior chamber.

Microscopical examination.—Two scars are seen in section in the cornea, one not far from the upper border, well healed, passes obliquely to the axis of the cornea. The other, more vertical, is situated internal to the first, and appears to be the more recent of the two, there being more round-cell infiltration about it. The anterior capsule of the lens is adherent by fibrous tissue to both these cicatrices, and passes backwards from them behind the lower limb of the iris. The pupillary border of the latter has some adhesions to it. The angle of the anterior chamber at the upper part is blocked by the foremost of the ciliary processes, which is dragged forwards and held in contact with the cornea by the adherent capsule. The iris here has been removed quite up to its root. There is a broad adhesion of the root of the iris to the posterior surface of the cornea below. There is no inflammatory infiltration of the ciliary body, iris, or choroid. The ciliary processes are dragged forwards and elongated.

The optic nerve is not very deeply excavated, but the cup reaches to the margins of the disc. The nerve-fibre layer of the retina has not undergone much alteration except at the optic disc, where it is thin and atrophied. The other layers of the retina show hardly any changes. The central vessels of the optic nerve have very thick walls. The optic nerve itself shows very marked glaucomatous degeneration.

Case 6. (Plate IV, fig. 2.) *Glaucoma following a needling operation, a year after extraction of cataract.*— Henry H—, æt. 66, had a cataract extracted from his right eye on January 2nd, 1885; he subsequently with glasses obtained V. $= \frac{6}{12}$ and J. 1. On October 19th, 1886, the cataract was removed from his left eye. The section made was corneal, and in making it the iris fell in front of the knife; both it and the capsule of the lens were cut; some opaque cortical matter was left behind. The anterior chamber was slow in re-forming, and on October 25th some soft lens matter was noticed in front of the iris at the lower part of the anterior chamber. On the 28th of the same month he had an acute attack of gout. On December 31st, 1886, his V. $= \bar{c} \frac{+11}{+ 1{\cdot}5 \text{ cy. } 35^\circ \text{ down and in}} \frac{6}{12}$ partly.

On October 6th, 1887, he returned to the hospital with some deterioration of vision in his left eye, it now with the same glasses only equalling $\frac{6}{60}$. The tension was fuller than that of the right. The following day the capsule was needled, after which there was a small prolapse of vitreous through the needle puncture in the cornea. This last operation did not improve his vision, he had some pain in the eye, and the sight gradually failed altogether. He attended at the hospital in July, 1888, and could then only tell light from dark with it.

The pain became very severe, the eye became stony hard and absolutely blind; it was excised on February 5th, 1889.

Pathological examination.—There is a general haze of the cornea. The scar of the extraction incision is well within the cornea at the upper part; those of the two needle punctures in the periphery, on each side.

There is a broad adhesion of the iris to the extraction cicatrix in the outer half of the globe. A small portion only of the iris has been removed. The angle of the anterior chamber is narrowed below by the approximation of the root of the iris to the posterior surface of the cornea. The lens capsule stretches across the whole posterior surface of the iris and passes forwards, being incorporated in the anterior synechiæ. The vitreous is clear, rather thin in consistency; there is the remains of an old hæmorrhage in it. The retina is detached for a short distance. The optic disc is deeply cupped, the cup having overhanging margins.

Microscopical examination.—There is a small amount of round-cell infiltration along the line of incision in the cornea, and some new vessels are seen in section in it. The root of the iris which has been left is attached to the corneal cicatrix, and some fibrous tissue also unites the anterior capsule in the same position. The root of the iris is thus held in a space bounded by the posterior surface of the cornea anteriorly and the anterior capsule of the lens and fibres of the suspensory ligament posteriorly. The filtration area of the cornea is blocked on both sides. There is a considerable collection of broken-up lens matter in the peripheral parts between the two layers of capsule. The retina immediately behind the ora serrata shows several spaces bounded by stretched bundles of Müller's fibres. There are adhesions between the pupillary margin of the iris and the anterior capsule of the lens. There is no inflammatory infiltration of the tissue of the iris, ciliary body, or choroid. The ciliary processes above are much compressed by the fibres of the suspensory ligament.

Case 7.—*Glaucoma following a needle operation after extraction of cataract.*—Mary Ann H—, æt. 70, was ad-

mitted to Moorfields Hospital on May 10th, 1887. She stated that three years previously a cataract had been removed from her left eye at the Westminster Hospital. She was unable to see after the operation, but does not think she had any inflammation in the eye. It was, she says, subsequently needled, after which it became very painful and tender.

On examination there was seen to be general haze of the cornea, the cicatrix of an incision in the upper part, some blood-vessels piercing this cicatrix. A coloboma of the iris upwards, the angles of the iris being adherent to the corneal scar. Some blood on the anterior surface of the iris, and some posterior synechiæ.

No fundus reflex could be obtained. There was no perception of light, and T. was + 2. The left eyeball was excised the following day.

Pathological examination.—Eyeball of normal size. Scar in the cornea well healed and flat. Iris absent at the upper part, below adherent to the cornea at its periphery, and at its pupillary margin to the remains of the lens capsule. A considerable amount of cortical lens matter left. Vitreous fluid in great part, some blood-clots in its anterior and lower part. Retina *in situ*. Optic disc extensively but not deeply cupped. Choroid apparently normal. Ciliary processes not evidently atrophied.

Microscopical examination.—The line of the incision in the cornea is very oblique. Some blood-vessels are seen cut across in it, and some small collections of round cells. Adherent to the gap left in Descemet's membrane at the posterior surface is the anterior capsule of the lens. This passes backwards through the coloboma; the pupillary margin of the lower part of the iris is in some sections adherent to it. A large quantity of degenerate cortical lens matter is seen between the two layers of lens capsule. There are two collections of red blood-corpuscles in the anterior chamber, one at the upper and one at the lower part. The peripheral portion of the iris below is adherent for some distance to the posterior surface of the cornea.

The iridectomy has been a fairly peripheral one; the small portion of the root of iris that is left is held in contact with the cornea by the entangled capsule.

The iris, ciliary body, and choroid are atrophied; they are not infiltrated with inflammatory cells. The ciliary processes are small and flattened. There is a large collection of red blood-corpuscles situated just over the lower part of the pars ciliaris retinæ.

Case 8. (Plate VIII, fig. 4.) *Extraction followed by choroiditis, kerato-iritis, glaucoma, and sympathetic ophthalmia.*—Joseph B—, æt. 64, was admitted to Moorfields Hospital February 1st, 1888. His left lens was completely cataractous; in his right there was an anterior polar opacity. He had always been a healthy man; had had rheumatism once in his feet.

On the day after his admission the left cataract was extracted through a sclero-corneal incision, an iridectomy being made upwards. The patient had a severe cough after the operation, and got some iritis; the pupil, however, was kept widely dilated with atropine. About six weeks after the operation there was a small hæmorrhage into the anterior chamber, and the eye became more irritable and painful. The next day the hæmorrhage into the anterior chamber had increased. It was now half full of dark fluid, and the tension was +2. Paracentesis of the anterior chamber was performed, which relieved the tension.

On March 20th, four days after the paracentesis, forty-six days after the extraction, some kerato-iritis commenced in his right eye. The keratitis at first was striated, no dots appearing till later.

On the 22nd his left eye was excised.

Pathological examination.—T. + 2. Conjunctiva at limbus thickened. No bulging of sclerotic. Cornea smoky, scar at upper margin well healed and smooth. On section it is seen to be nearly at right angles to the corneal surface. From it a dense thick membrane stretches downwards and is continuous with a collar of lens substance which remains

adherent to the posterior surface of the iris. In the anterior chamber there is a small quantity of partially decolourised blood-clot. From the membrane in the pupil there are fine yellow threads stretching back into the vitreous, the whole of which is opaque and too firm. There is no blood in it.

The ciliary processes do not appear swollen. Retina and choroid are *in situ*. Optic disc (?) slightly swollen.

Microscopical examination.—The cornea at the seat of the extraction cicatrix is thickened. The anterior capsule of the lens passes into the cicatrix, where it becomes much twisted and surrounded by inflammatory cells. Between the two layers of the capsule at the lower part there is some degenerate lens matter. A considerable amount of inflammatory exudation glues the posterior surface of the iris to the anterior capsule. Between the pupillary margin of the iris and the extraction cicatrix a membrane stretches, composed of both layers of lens capsule lying in contact with one another, a thick layer of red blood-corpuscles and organising inflammatory tissue on its anterior surface. There is inflammatory thickening of the tissue of the iris. The iritic angle below is widely open. There is a considerable accumulation of small round cells about the root of the iris and in the meshes of the ligamentum pectinatum. On the posterior surface of Descemet's membrane also are small patches of round cells. Above the iris has been removed quite up to its periphery. The angle of the anterior chamber is, however, here blocked by the commencement of the ciliary processes, which are drawn forwards and held closely in contact with the posterior surface of the cornea by the entanglement of the upper portion of the lens capsule in the extraction cicatrix.

There is considerable inflammatory effusion into the ciliary body and choroid; the latter is much thickened. Scattered small round cells are seen in the vitreous. The optic disc is swollen, and there are patches of inflammatory cells between the fibres of the optic nerve.

Case 9 (Plate VIII, fig. 5). *Extraction of cataract, followed by kerato-iritis, glaucoma, and sympathetic ophthalmia.* —James P—, æt. 63, admitted to Moorfields Hospital on December 28th, 1885, with a commencing cataract in his right and a nearly mature cataract in his left eye.

The left cataract was extracted, a corneal section and iridectomy being made upwards and the capsule opened by a peripheral section with the point of a Graefe's knife. Some soft matter was left.

Sixteen days after the operation the wound had not closed, though there was a good anterior chamber. A quantity of opaque matter filled the pupil. The nozzle of Bowman's suction apparatus was introduced through the unclosed wound, and some of the soft lens matter sucked out.

He returned to the hospital on March 26th, 1886, three months after the extraction, with increased tension in the eye. A sclerotomy was performed with a keratome. There was some hæmorrhage into the anterior chamber, and subsequently iritis, the increased tension, which had been temporarily relieved by the sclerotomy, returning. The right eye became irritable, and the left eye was excised on April 9th, 1886. On April 14th keratitis punctata and iritis developed in the right.

Pathological examination.—T. + 3. The cornea is hazy all over, but especially at the lower half. No dots can be made out macroscopically. Near the inner margin is a small, circumscribed solitary patch of bright red blood, deep in or behind the cornea. There are two scars at the upper part of the cornea, which are white and opaque. In the lower (more central one) a dense band of lymph is healed. This stretches from the scars upwards and downwards, the upper part being adherent to the back of the cornea, the lower part passing behind the iris, which is adherent to it. It is probably in part the remains of the lens capsule.

The vitreous is shrunken and detached, except at the optic disc posteriorly. The retina and choroid are

in situ. The optic nerve-sheath behind the eyeball is much dilated.

Microscopical examination.—The two corneal wounds are firmly healed. The most peripheral one is very oblique; it contains some lens capsule in its inner half. The two almost meet at the posterior surface of the cornea. The iris is firmly adherent to the mass of inflammatory lymph in the pupil. This passes up to the cornea at the site of the scars. There is inflammatory infiltration of the pupillary half of the iris, and the uveal layers are considerably disturbed. The angle of the anterior chamber is not blocked. There are small collections of inflammatory cells on the posterior surface of Descemet's membrane, and a good deal of small-cell infiltration about the ligamentum pectinatum and root of the iris. There is no very evident swelling of the ciliary processes. In the lower part of the capsule is some degenerate lens-matter.

Case 10. *Extraction; iritis; iridotomy three and a half months later; glaucoma; kerato-iritis; sympathetic ophthalmitis.*—Edward L—, æt. 63, was admitted to Moorfields Hospital on January 17th, 1884. He had previously had a cataract successfully extracted from his left eye. The day after his admission the right cataract was removed; the operation was performed under an anæsthetic, which the patient took very badly. An iridectomy was done upwards, and a piece of the capsule removed with forceps; the pupil was left nearly clear. Slight iritis, which soon quieted down under treatment, followed on the operation.

The patient was readmitted to the hospital on May 8th, 1884. There was then slight injection above the cicatrix, the pupil was somewhat updrawn and filled with a grey membrane; his V. = fingers at four inches. T. n. An iridotomy was done, the iris being cut transversely just below the pupil; some vitreous escaped. The next day he complained of pain in the eye, and the T. was +. The

third day after the iridotomy there was some haze of the cornea. The pain and tension continued, and on the eleventh day keratitis punctata was noticed. Five days after this keratitis punctata appeared also in the other eye, together with some injection.

On November 30th, 1885, V. of R. = hand reflex only; there was general haziness of the cornea; the pupil was closed, and the iris had a small hole in it below the pupil.

An incision as for iridectomy was made with a keratome, when a large quantity of fluid vitreous escaped. After this the tension of the eye became minus. It was excised on December 8th, 1885.

Pathological examination.—Right eye, T.—1. Cornea slightly hazy all over; at the lower part there is a small amount of blood between its layers or closely adherent to its posterior surface. At the upper margin is the scar of the extraction incision well healed; firmly adherent to its posterior surface is the lens capsule, which contains a small amount of lens-matter in its periphery.

There is a coloboma upwards quite blocked by a dense-looking membrane. Below this is an elongated transverse pupil, the result of the iridotomy. Across this stretch two bands of opaque greyish membrane. The iris in the situation of the coloboma has been removed quite up to its root. Elsewhere it is thin; the ciliary processes are slightly atrophied. In the lower and outer part of the vitreous just behind the ora serrata is a small hæmorrhage. The vitreous itself is atrophied and detached posteriorly except at the optic disc. The retina is *in situ* and exhibits no changes.

Microscopical examination.—The tracks of two incisions can be seen in the cornea; the upper is more oblique and has more small-cell infiltration about it than the lower; it is probably the more recent. The cornea is here much thickened. Its fibres appear as though they had been teased out, spaces being left between them. Into the gap in Descemet's membrane on the posterior surface a mass of organised inflammatory tissue together with the pos-

terior capsule of the lens and some of the fibres of the suspensory ligament pass. This is continuous with a membrane composed partly of fibrous tissue, partly of lens capsule, containing in places some degenerate lens-matter which runs backwards behind the iris, which latter is firmly attached to it. The pupillary extremity of the lower part of the iris is separated from the remainder of the iris by some distance, *i. e.* where it was cut in the iridotomy. Between these two pieces of the iris the above-mentioned membrane becomes very thin, only a few strands being left. The iris has in one part of its substance a nodule composed of a mass of inflammatory cells. There is a large accumulation of round cells in the angle of the anterior chamber at the lower part, and also between the fibres of the ligamentum pectinatum. On the inner surface of Descemet's membrane there are several small collections of round cells. The angle of the anterior chamber at the upper part in the situation of the coloboma is blocked by the remains of the root of the iris, which is held in close contact with the posterior surface of the cornea by the fibres of the suspensory ligament, which are drawn forwards and are adherent to the cornea. The ciliary processes are flattened and stretched ; there is some inflammatory infiltration about them. The choroid is markedly atrophied, but nowhere infiltrated. The retina shows some cystic spaces immediately behind the ora serrata.

Case of glaucoma following a needling operation after extraction of cataract. (The patient was shown at the meeting as one in whom a cure had been effected by operative measures.)—Sarah C—, æt. 60, was admitted to Moorfields Hospital on January 9th, 1889, with nuclear and polar opacities in both lenses. V. in each eye $= \frac{3}{60}$.

A preliminary iridectomy was performed on the right, and on January 14th the same operation on the left.

On February 25th the right cataract was extracted ; in the meantime the lens had become more opaque. The operation was uncomplicated, a peripheral incision in

the capsule being made. The following day there was considerable swelling of lids and conjunctiva ; this gradually subsided in the course of the first week.

On March 7th some posterior synechiæ were noticed at the lower part, but the pupil dilated widely under atropine ; a small hyphæma persisted.

On March 13th T. was stated to be ?+. A membrane in the pupil was needled on April 29th ; three days later there was haziness of the cornea and swelling of the conjunctiva and lids. T. + 1½. It was then observed that there was an adhesion of the lens capsule to the extraction cicatrix.

On May 4th, T. being + 2, a paracentesis was done, but the tension was only temporarily relieved.

On May 6th an iridectomy was performed outwards and an incision made into the lens capsule, which was adherent to the extraction cicatrix ; a big bead of vitreous presented and was cut off.

Subsequently to this last operation there has been no increase of tension, and the eye has remained quiet. V on May 29th, 1889 = $\bar{c}\ \frac{+13}{+3\text{ cy. }60^\circ}\ \frac{6}{18}$, and $\frac{+16}{+3\text{ cy. }60^\circ}$ 8. J.

In conclusion I have to thank Mr. Lawford for his kind assistance to me in the production of this paper ; many of the eyes I have described were originally examined by him, and he kindly permitted me to make use of his notes.

(*January 30th*, 1890.)

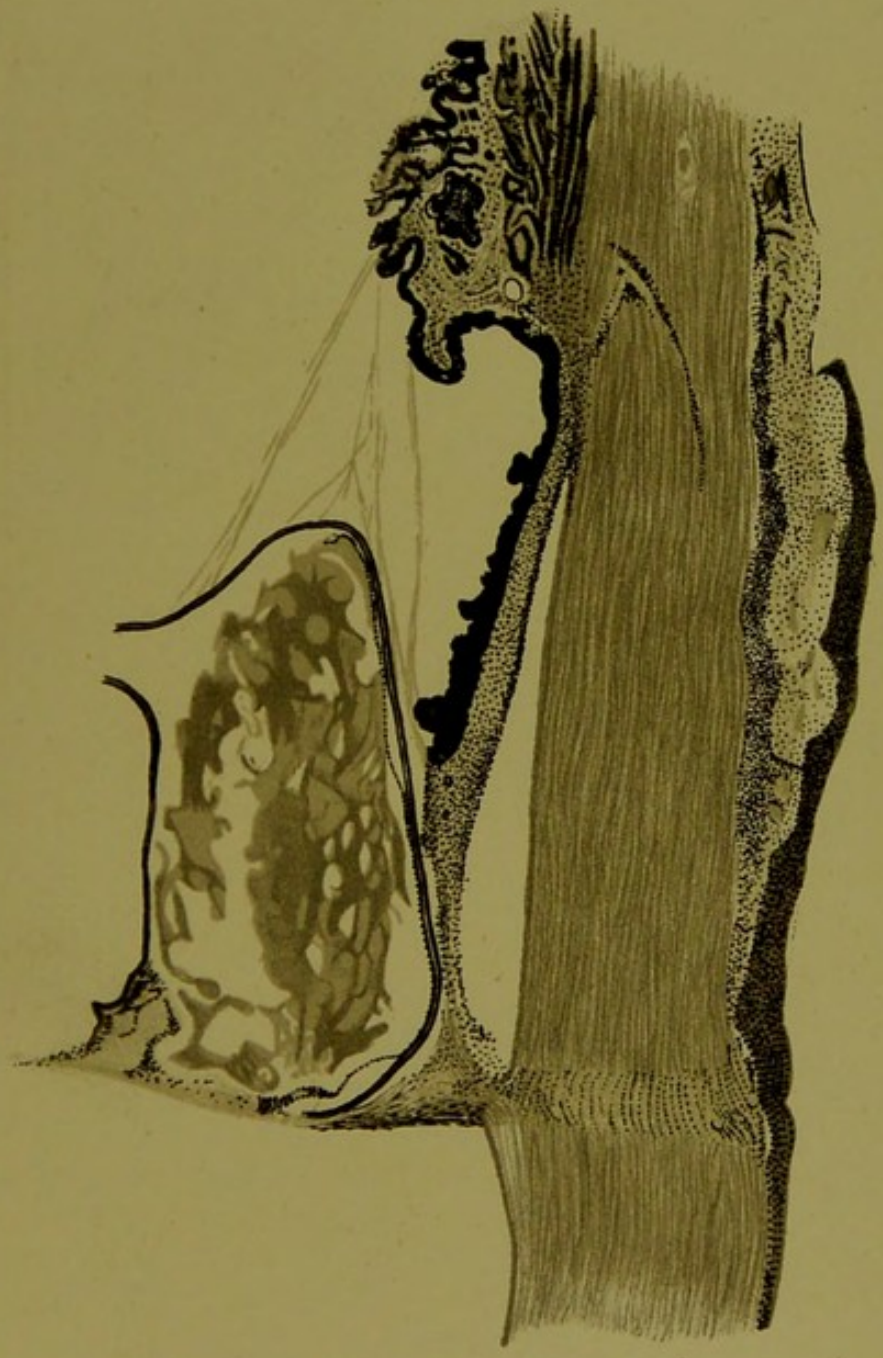

Fig 2.

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DESCRIPTION OF PLATE VIII.

Illustrates the Microscopical Appearances of the following cases in Mr. E. Treacher Collins's paper on Glaucoma after Extraction of Cataract:—Fig. 1, Case 2; Fig. 2, Case 4; Fig. 3, Case 5; Fig. 4, Case 8; Fig. 5, Case 9 (p.).

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Fig. 1.

Fig. 2.

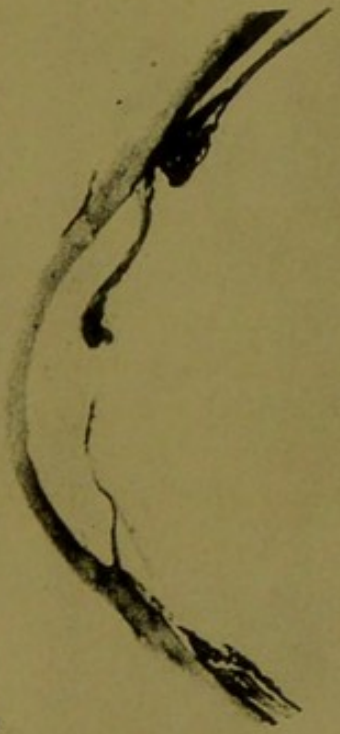

Fig. 3.

Fig. 4.

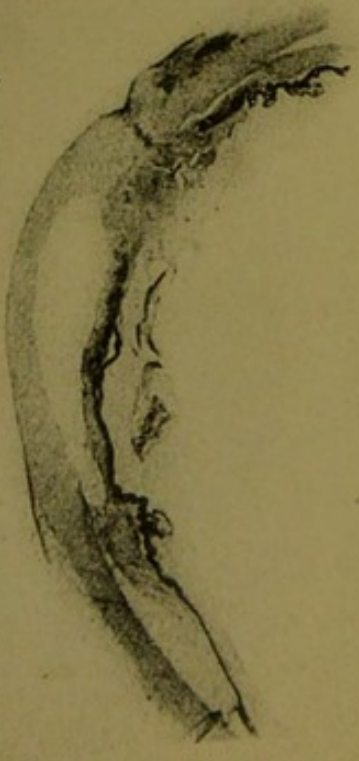

Fig. 5.