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E. TREACHER COLLINS,

Curator of the Museum.

[*Reprinted from the Royal London Ophthalmic Hospital Reports, Vol. XIII, Part II, December*, 1891.]

LONDON:
HARRISON AND SONS, ST. MARTIN'S LANE,
Printers in Ordinary to Her Majesty.

1892.

ON THE OPERATIVE TREATMENT OF GLAUCOMA.

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This paper is based upon the pathological examination of 23 eyeballs which had been operated upon for glaucoma. Some of them were originally examined by two former curators of the Museum, Mr. Milles and Mr. Lawford, and I have made use of their notes in the detailed account which I give of each eye. For the specimen and notes of one of the cases I am indebted to Mr. Tweedy, the patient having been operated upon by him in private. In 20 of these 23 eyes an iridectomy had been performed, in 2 a sclerotomy, and in 2 an optico-ciliary neurotomy, one subsequently to an iridectomy. Of the 20 in which an iridectomy was performed—

13 were excised on account of the return of tension, in most accompanied by pain.

3 because they excited sympathetic ophthalmitis (Nos. 5, 13, and 21). In two of these the tension was increased at the time of excision.

1 on account of the escape of the lens and prolapse of the ciliary body. (No. 20.)

1 on account of wound of the lens accompanied by inflammation and pain. (No. 22.)

1 for hypopyon keratitis ten years after the operation, during which time the tension had remained normal. (No. 19.)

And 1 for iritis and pain, the tension having been normal for a year. (No. 23.)

In both the eyes which had been treated by sclerotomy a large cystoid cicatrix had resulted. They were excised on account of pain, the tension of one at the time of excision being noted as full, and that of the other as — 2.

A microscopical examination and comparison of the parts operated on in each of these eyes ought to throw some light on the causes of success and failure in the operative procedures in glaucoma.

I will first summarise the facts concerning those eyes in which an iridectomy was performed.

It is always difficult to fix the duration of chronic glaucoma, the symptoms beginning so insidiously that patients' statements with regard to them cannot be relied on. In six of the cases (Nos. 6, 7, 8, 11, 18, and 21) the glaucoma was absolute at the time of the iridectomy. Cases 13 and 19 seem both to have commenced with a definite acute attack, the former was operated on a month after it and the latter four days. In Case 15 the increase of tension came on while the patient was using atropine for a corneal ulcer, and the operation was performed a month later. The interval between the date of the iridectomy and excision varied considerably. In Case 20 the eye was removed the next day. In Case 7, two days after the iridectomy. In Case 19, ten years after, the tension having remained normal during that time; and in Case 17, fifteen years elapsed between the iridectomy and the excision, during all which time the tension had apparently continued more than normal.

In the descriptions which are given of the microscopical appearances of these eyes, except when specified to the contrary, sections have been taken as nearly as possible from the centre of the coloboma, and in most of the eyes several sections from different levels have been examined, in order, as far as possible, to ascertain the condition of the cicatrix throughout its entire length.

The operation of iridectomy may be divided into two stages; (i.) the incision; (ii.) the excision of the iris. Of late years there has been a tendency to regard the first as the most important; some even holding that the remedial effects of an iridectomy depend solely on the formation of a cicatrix in the sclerotic at the periphery of the anterior

chamber, the cicatricial tissue acting as a sort of filter which allows the exit of the intraocular fluids through its substance, and that the removal of a piece of iris is of very secondary importance. Hence the origin of sclerotomy.

In examining pathologically eyes that have been iridectomised for glaucoma, it can be seen how each of these stages has been carried out. The position and character of the cicatrix in each eye can be determined and compared. The amount of iris which has been removed and the condition of the filtration area in the cornea ascertained.

In order to be able to determine the exact relative position of a cicatrix to the sclero-corneal margin, I have in several recently excised eyes with healthy corneæ made a scratch with a needle through the epithelium at what appeared to be the exact junction of the clear cornea with the opaque sclerotic. I then hardened the eyes and cut sections of them, and found that my scratch corresponded to the usually well-defined termination of Bowman's membrane. The distance of this landmark to a point on the surface of the globe on a level with Schlemm's canal is 1·6 mm., and to a point level with the commencement of the ligamentum pectinatum, *i.e.*, where Descemet's membrane begins to split up, 1 mm.

On account of the obliquity of the line of junction of the cornea and sclerotic it follows that an incision which passed external to the termination of Bowman's membrane and internal to the commencement of the ligamentum pectinatum, would be partly corneal and partly scleral. One which passed internal to the termination of Bowman's membrane would be purely corneal, and one passing through the ligamentum pectinatum almost entirely in the sclerotic.

The iridectomy cicatrices in the eyes which I have examined are nearly all oblique, the gap left in Descemet's membrane on the posterior surface of the cornea being more internal than the commencement of the cicatrix on

the surface of the globe. The amount of obliquity varies considerably, and speaking generally it is more in those cases in which a keratome was used (Nos. 11, 13, 15, 18, and 22) than in those in which the incision was made with a Gräfe's knife.

In only two of the 20 eyes had the incision been made sufficiently peripheral to penetrate the ligamentum pectinatum (Nos. 11 and 20). One of these is the case in which the lens escaped and the ciliary body prolapsed the day following the operation (Fig. 12). In none had the canal of Schlemm been reached.

In one eye the cicatrix was entirely corneal (No. 7). In the remainder, including Cases 19 and 23, where the glaucoma was cured, it was partly corneal and partly scleral.

With regard to the character of the cicatrices, Cases 1, 9, and 18 show good bands of cicatricial tissue well at the periphery of the chamber, the gap left in Descemet's membrane being free for at any rate some portion of its extent from any entanglement of iris (Fig. 10). In these eyes the tension returned and persisted. In Cases 13 and 23 the gap in the sclero-corneal tissue had been prevented from closing by the prolapse of a knuckle of iris into it (Fig. 14). The conjunctiva and episcleral tissue had healed over it thus leaving a transparent cicatrix with a tendency to become cystoid. (I refer again to this subject later in dealing with the cases in which a sclerotomy had been done.) In Case 13 there had been a slight temporary return of tension after the iridectomy, it being normal at the time of excision. In Case 23 the tension remained normal for a year.

Coming now to the second stage, the excision of the iris, I find that in all except four of the cases (Nos. 12, 13, 15, and 21) a portion of the root of the iris had been left, which in all, except Case 19, was adherent to the cornea, blocking the filtration area in the region of the coloboma. In several of the cases also the cut end of the iris had

become healed in the cicatrix, making it additionally secure in its faulty position (Figs. 3 and 5). In Case 19 the root of the iris was not adherent to the cornea, and the angle of the chamber was widely open (Fig. 11). That it is possible to remove the iris quite up to its root is shown by Cases 12, 13, 15, and 21 (Figs. 9 and 13). In the first three of these the glaucoma was acute or of short duration. Presumably the periphery of the iris had not become adherent to, only in apposition with, the posterior surface of the cornea, hence when the iridectomy was done the iris tore away at its root, *i.e.*, at its junction with the ciliary body. In the more chronic cases, where it had become absolutely adherent, it tore, not at its root but at the point where the adhesion ceased.

In six of the cases (Nos. 5, 8, 12, 15, 21, and 22) the lens was slightly altered in its position, there being adhesion between the anterior capsule and the cornea (Figs. 5 and 13). Three of these (Nos. 12, 15, and 21) were cases in which the iris had been removed quite up to its periphery, and in which the tension had returned. The tilting forwards of the lens was probably sufficient to prevent drainage through the filtration area thus opened up. The adhesion in five of the cases was between the upper margin of the lens and the iridectomy cicatrix, in two of which there was a gap in the capsule and some degeneration of the lens fibres opposite the cicatrix (Nos. 21 and 22). In Case 15, where glaucoma followed the use of atropine for a corneal ulcer, the anterior chamber was slow in re-forming, and the lens capsule became adherent to the cornea at the seat of the ulcer.

In two cases (Nos. 13 and 21) there was a gap in Descemet's membrane about the centre of the cornea, and an adhesion passed from the lower part of the iris, near its pupillary border, to it (Fig. 6). In both these cases a keratome was used, and, no doubt, the wound in Descemet's membrane had been made by its point,

which, in order to avoid the lens, had been turned towards it, the iris subsequently becoming adherent. Collections of small round cells scattered throughout the uveal tract, the so-called *uveitis maligna*, were found in seven cases (Nos. 5, 6, 9, 13, 17, 21, and 22).

Case 14 presented a very remarkable condition. There was a large localised collection of blood in the tissue of the iris, on one side of the coloboma, which might be described as a hæmatoma of the iris. Blood had also found its way from the cut surface of the iris, which was entangled in the wound, in between the tissue of the cornea and Descemet's membrane, stripping the latter up for a considerable distance, and forming a large clot between them (Figs. 7 and 8).

In six cases (Nos. 3, 6, 7, 10, 14, and 20) there were hæmorrhages in the retina. Cases which had been lost directly from hæmorrhage following the operation have not been included in this paper.

The two eyes upon which sclerotomy was performed, both developed a cystoid condition of the cicatrix. I

FIG. 1.—Cystoid cicatrix lined by atrophied iris in an eye lost from glaucoma following extraction of cataract.

have examined microscopically several cystoid cicatrices, and I find they are always lined by more or less atrophied

iris tissue. If the cut end of a piece of iris becomes entangled in a wound, the wound closes, the iris being incorporated in the cicatrix. If, however, a fold of iris tissue becomes involved, the anterior surface of the iris unites to the cut edges of the sclero-corneal tissue, the conjunctiva heals over it, and thus a gap becomes left, lined by iris tissue, in the walls of the eyeball. Now, it is known that the iris tissue is impermeable by the intra-ocular fluids; for when the pupil becomes closed by total posterior synechiæ, they accumulate behind it and bow it forwards instead of passing through it. It follows, therefore, that though an eyeball may have a gap in its walls, there can be no escape of its fluids into the sub-conjunctival tissue as long as that gap is lined by impermeable iris tissue. But should there be any tendency to accumulation of fluids in such an eye, the gap, being a weak spot, would yield and expand, the iris tissue lining it would become atrophied and stretched, and breaks would occur in the continuity of its uveal pigment layer, which is probably the chief obstacle to the passage of fluids through it. There would then be the condition of things which I find in Cases 2, 4, 14, and 23, and shown in Figs. 1, 4, 7, and 14. That is a thin bulging or cystoid cicatrix, lined by very atrophied iris tissue, through which any excess of intraocular fluids could pass into the sub-conjunctival tissue. It is not uncommonly observed, and was pointed out by Gräfe, that these cystoid cicatrices periodically discharge themselves sub-conjunctivally, the explanation being that when the accumulation of fluid has reached a certain stage, a rent occurs in the iris tissue which allows of its escape.

Mr. Bader, in the form of sclerotomy which he advocates, seeks to produce a condition such as the above. He says,* "that to secure success it is desirable to obtain, and to maintain, a staphyloma of the conjunctiva, with or without

* Transactions of the International Medical Congress, 1881, vol. iii, p. 98.

prolapse of the iris." De Wecker and most other operators endeavour to avoid a prolapse of any kind.

In order to investigate the immediate results of a sclerotomy, I have performed this operation on several recently excised human eyes, fixed in a Priestley Smith's frame. Under these conditions the operation can be performed with considerable precision. After hardening eyes thus treated, I have cut and examined sections of them. I find that when an incision is made 2 mm. distant from the sclero-corneal margin, if the knife be made to cut nearly perpendicularly outwards, the central part of the ligamentum pectinatum is divided.

In two eyes which were enucleated for absolute glaucoma, upon which I performed a sclerotomy 2 mm. distant from the sclero-corneal margin, I found that my knife had penetrated the iris in two places. Thus, in passing it in, it had pierced conjunctiva, sclerotic, ligamentum pectinatum, and adherent root of iris, and

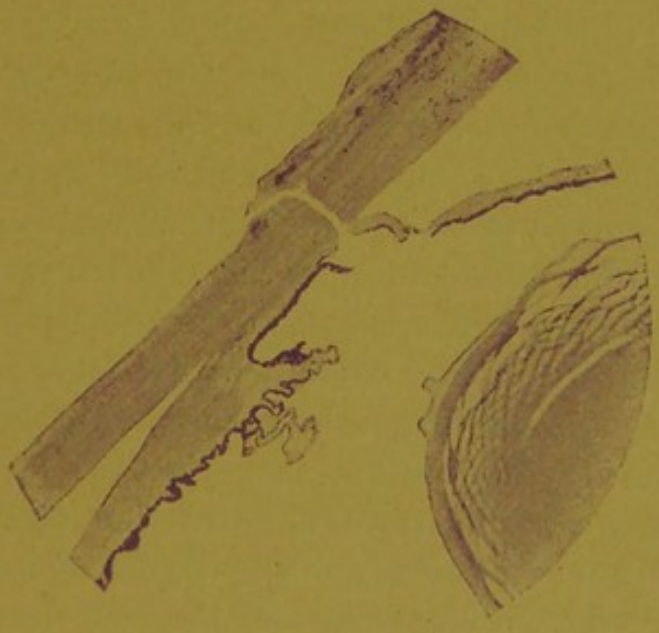

FIG. 2.—Section showing the immediate results of a sclerotomy incision, the root of the iris being cut across in two places.

had so entered the posterior chamber. Then, in coming forwards into the anterior chamber, it passed through the

iris again, this time from behind forwards (Fig. 2). The iris had been penetrated in the same way in making the counter puncture, and in cutting upwards there was no wound of the lens.

If the root of the iris has become adherent to the cornea over the region of the ligamentum pectinatum, as so often is the case in chronic glaucoma, then, if an incision passes across the ligamentum pectinatum, the iris must necessarily be wounded; and if the root, as is not unusual, is atrophied as well as adherent, it would be almost impossible to wound it without penetrating it. That, in iridectomy, incisions situated internal to the commencement of the ligamentum pectinatum, and made with either a Gräfe's knife or a keratome, the root of the iris may be penetrated, is shown by Cases 21 and 22, in both of which there was a wound in the lens capsule, opposite the incision in the sclero-corneal tissue.

If, in making a sclerotomy incision, the knife passes into the posterior chamber opposite the ligamentum pectinatum, there is less likelihood of its wounding the lens than if it enter it less peripherally, for the anterior of the ciliary process are immediately behind the iris in this region, and serve to protect the lens. Moreover, the edge of the lens does not extend as far outwards as the commencement of the ligamentum pectinatum. This relation of the ciliary process to the iris, in this situation, is the reason that an incision for an iridectomy cannot, with safety, be made so peripheral as to pass through the spaces of Fontana, for when the iris is removed the ciliary processes will readily prolapse into a wound situated thus far out. If they prolapse the fibres of the suspensory ligament inserted into them become drawn forwards, and the lens displaced, and may even escape, as occurred in Case 20.

In another eye, recently excised for absolute glaucoma, I injected water into the anterior chamber through a corneal incision, directing the nozzle of my syringe towards the angle of the anterior chamber, so as to try

and force back, by the stream of water, the iris into its normal position. On subsequently examining sections of this eye, I found that I had opened up the angle of the chamber in a considerable portion of its extent. It remained closed, however, at the upper part, towards which I could not so readily direct my syringe, on account of the position of the incision. No dislocation of the lens, or apparent rupture of the fibres of the suspensory ligament, had been occasioned.

The two eyes upon which optico-ciliary neurotomy had been performed, had both, two years after the operation, to be enucleated, on account of the return of pain. The tension had continued + in both during that time. Case 16 had an ulcer of the cornea when removed. In both eyes the atrophy of uveal tract and retina was very extreme. The structures in front of the equator were less atrophied than those behind it. The lenses in both eyes had remained clear.

From a consideration of these cases I am of opinion that an operation for glaucoma may relieve tension in somewhat different ways.

Starting with the now almost universally accepted assumption that the tension in primary glaucoma, in whatever way it may arise, is kept up by the apposition of the root of the iris to the posterior surface of the cornea, which prevents the exit of the aqueous humour from the anterior chamber into the spaces of Fontana, I infer that an iridectomy may remedy this condition in the following ways:—

(1.) When the apposition is recent, very slight means are sometimes sufficient, the escape of the aqueous and a drag on the iris being enough. It was so, I think, in Case 19, for in it the angle of the anterior chamber was open on both sides of the sections, though a piece of the root of the iris had been left at the iridectomy (Fig. 11).

(2.) In some of the recent and acute cases I have

shown that the iris tears away from its extreme root, thus leaving a large portion of the filtration area free for drainage, even should the remainder of the iris retain its faulty position (Fig. 9).

(3.) In other cases a permanent gap is maintained in the walls of the globe by the prolapse of a fold of iris into the wound. This iris tissue, subsequently, either becomes stretched and atrophied, or ruptures periodically, thus allowing the aqueous to pass through it into the sub-conjunctival tissue, and become absorbed by the lymphatics and vessels situated therein. By these means a new channel for the exit of aqueous is formed, the normal ones remaining blocked (Fig. 14). The tension in Case 23 was cured in this way.

A sclerotomy may produce a permanent reduction of tension in the first or third of the above ways; or it may open up a fresh means of access to the filtration area, by forming a permanent gap in the adherent root of the iris, so that excess of fluid could find a direct channel of exit from the posterior chamber, instead of passing through the pupil into the anterior chamber. It would thus be short-circuited. I have shown that a sclerotomy incision may divide an adherent root of the iris (Fig. 2), and that it must necessarily do so when the iris root is atrophied as well as adherent.

There is, I think, no evidence left in support of the view that scar tissue, whether situated at the sclero-corneal margin or elsewhere, allows filtration through it. *A priori*, it is unlikely that the fibrous tissue of a cicatrix should be any more permeable by fluids than the fibrous tissue of the cornea or sclerotic.

Experimentally, Schœler* has shown that in rabbits' eyes, upon which sclerotomies have been performed, filtration is retarded, not promoted; and that when he increased the pressure in these eyes, the cicatrices remained dry.

* Transactions of the International Medical Congress, 1881, vol. iii, p. 100.

Pathologically, I find in eyes iridectomised for glaucoma good bands of cicatricial tissue, well at the periphery of the chamber, free, for some part of their extent, from any entanglement of iris, where the tension returned and persisted (Fig. 10).

An iridectomy or sclerotomy fails to relieve tension when none of the above conditions are attained. An iridectomy may also fail as the result of adhesion of the lens to the sclero-corneal cicatrix, so that it becomes displaced forwards, its upper border blocking the freshly opened up filtration area.

The practical points which may be deduced from these cases are the following:—The advisability of performing iridectomy for chronic glaucoma in the early stages of the disease, before the apposition of the root of the iris to the cornea has resulted in adhesion.

I think it would be justifiable in some cases even to anticipate events and perform what might be termed a preventive iridectomy.

Gräfe* stated that "glaucoma simplex affects almost without exception both eyes successively."

Mr. Priestley Smith† says: "In the large majority of cases primary glaucoma is a bilateral affection."

Mr. Nettleship‡ has recently estimated that in "something like two-thirds the disease is sooner or later symmetrical."

Should, therefore, a patient who had already had one eye affected, present any of the premonitory symptoms in the second eye, the chances of success in an iridectomy performed at once under favourable circumstances would be infinitely greater than if it was delayed until a congestive attack ensued, the depth of the anterior chamber become still further diminished, and a peripheral adhesion of iris formed. There would in some cases no doubt be some

* R. L. O. H. Rep., vol. vii, p. 104.

† Glaucoma, 1879, p. 5.

‡ R. L. O. H. Rep., vol. xii, p. 79.

immediate diminution in the acuity of vision due to corneal astigmatism, a defect easily remedied by glasses.

Mr. Nettleship* speaking of iridectomy for chronic glaucoma says: "The state of the pupil seems to me to furnish the best prognostic guide; in almost all of the successful cases it acted well to eserine." It can easily be understood why this should be. In an eye with adhesion of the root of the iris to the cornea the pupil would less readily contract than in one where no such adhesion was present. Atrophy of the iris tissue in glaucoma, and ectropion of the uveal pigment at the pupillary margin are usually associated. The atrophy of the iris is due to the constriction of its blood-vessels from pressure of its root against the posterior surface of the cornea. When this pressure has been of long standing adhesion takes place. Hence I think it may be taken that an eye having a pupil with a marked black ring to it, which will not contract well to eserine, has considerable adhesion of the root of the iris to the cornea, and is an unfavourable one upon which to perform an iridectomy for the purpose of relieving tension. A sclerotomy performed with the intention of making a permanent gap in the adherent root of the iris would be more likely to succeed. It sometimes happens that one portion of the periphery of the iris becomes adherent to the cornea sooner than another. This is rendered evident clinically by the pupil becoming eccentric, it being drawn towards the side on which the adhesion is, also by the anterior chamber being shallower on the side of the adhesion, and by there being more marked ectropion of the uveal pigment there. It follows, therefore, that there would be more likelihood of the iris tearing away at its root, if the iridectomy was performed where there was most iris present, where the anterior chamber was deepest, and where there was least ectropion of the uveal pigment, than if done in the opposite direction.

Dr. Brailey† arrived at a similar conclusion. He says:

* R. L. O. H. Rep., vol. xii, p. 97. † R. L. O. H. Rep., vol. ix, p. 224.

"If I may venture to derive from pathology a few suggestions for operative treatment, I shall draw attention to the fact that even where the peripheral marginal corneal adhesion of the iris exists only at one part of its circle, an iridectomy here, which must necessarily leave the periphery of the iris unfreed from the cornea, will not relieve the tension; and therefore I should choose the part where the iris is unadherent."

CASE 1 (*Register No.* 1081).—*Subacute Glaucoma, Iridectomy; return of tension. Excision eight months later. Adherent root of iris left.*

James M., an epileptic, aged 57, was admitted to the Moorfields Hospital, on September 28th, 1882. He stated that ten weeks previously the sight of his right eye failed suddenly. It had not been painful until the last ten days. On examination he was found to have subacute glaucoma. T. + 2.V. = p. l. only. His left eye was unaffected.

He was treated with eserine until October 2nd, when the tension being unrelieved, an iridectomy was performed. On October 26th, the T. was noted to be full. On June 1st, 1883, when he was re-admitted to the hospital, he had no p. l. and T. was + 1. The eye was then excised.

Pathological Examination.—Sclerotic bulged slightly at the equator between the recti muscles. Cornea clear, with a cicatrix at its upper margin. Coloboma upwards; lens clear; vitreous healthy; choroid and retina *in situ;* the optic disc cupped.

Microscopical Appearances.—The iridectomy cicatrix is broad; it is situated anteriorly ·8 mm. external to the point of termination of Bowman's membrane, and posteriorly ·2 mm. distant from a corresponding position on the posterior surface of the cornea. The iris has only been removed as far as the cicatrix, the peripheral portion of it being left, which is much atrophied and firmly adherent to the posterior surface of the cornea. There is no adhesion of the cut end of the iris to the cicatrix itself.

The angle of the anterior chamber on the other side of the sections is also closed by peripheral adhesion of iris to cornea. There is marked ectropion of the uveal pigment layer of the iris.

Case 2 (*Register No.* 1112).—*Chronic Glaucoma of ten months' duration. Sclerotomy. Excision one month later. Prolapse of Iris. Cystoid Cicatrix.*

Eliza P., aged 64, was admitted into Moorfields Hospital on April 18th, 1883. She stated that she had had a blow on her left eye from a frying-pan eight years previously, but that she had only noticed failure of sight in it for the last ten months, and pain for the last two weeks.

On examination, the pupil of her left eye was found to be semi-dilated and immobile. The media were hazy. The tension increased, and she could not tell light from darkness with it. Her right eye was not glaucomatous, but had some choroidal changes in it V. $= \frac{6}{36}\ \bar{c} + 2$ D. $= \frac{6}{12}$.

A sclerotomy was performed on the left. Six days later, the iris was noted as bulging into the wound in its whole extent. The T. was normal.

She was re-admitted to the hospital on May 5th, 1883, complaining of occasional darting pain in her left eye and a dull constant pain in the left half of her head. The cicatrix in the sclerotic was bulging, and the iris prolapsed into it. The T. was full. It was then excised.

Pathological Examination.—The whole of the bulging sclerotomy cicatrix at the upper margin of the cornea is lined by iris. The pupil is semi-dilated and irregular; it is displaced upwards. Iris adherent to the cornea at its periphery in its entire circumference. Lens in its normal position. The vitreous is detached posteriorly; retina *in situ*. Optic disc slightly cupped.

Microscopical Appearances.—The bulging cicatrix is situated some distance external to the termination of Bowman's membrane, but internal to the spaces of Fontana and canal of Schlemm. The whole of the upper part of the iris is involved in the cicatrix; it is much atrophied, and intimately adherent to the cicatricial tissue.

CASE 3 (*Register No.* 1236).—*Subacute Glaucoma, Iridectomy, return of tension. Excision two months later. Large portion of root of iris left, lining a somewhat bulging cicatrix.*

Charlotte P., aged 49, came as an out-patient to Moorfields Hospital on May 1st, 1883, with neuro-retinitis and hæmorrhages in her right eye. On July 5th of the same year the tension of the eye was first noticed increased. She was admitted to the hospital on the 26th, with the vision of her right eye reduced to $\frac{5}{200}$ and T.+2. The left eye was unaffected.

An iridectomy was performed on the right; it was followed by slight hæmorrhage into the anterior chamber, which was soon absorbed. The eye, however, continued painful, and she was re-admitted on September 19th, 1883, with conjunctival injection; some bulging of the cicatrix at the sclero-corneal margin; hyphæma; T. + 2 and V. = shadows only. The eye was then enucleated.

The pathological notes made by Mr. Milles on opening the eyeball after its removal, were as follows:—Cornea clear, some bulging of the cicatrix at its upper margin. Some blood in the lower part of the anterior chamber. Coloboma upwards. Lens clear, adherent at upper equator to the ciliary processes, where it is drawn a little forwards. It is tilted slightly backwards below. Vitreous clear, adherent to retina at places and detached at others. A few hæmorrhages in the retina. Optic disc cupped.

Microscopical Examination shows that the iridectomy incision was fairly peripheral, outside the termination of Bowman's membrane. A broad band of cicatricial tissue, in which are new vessels, has formed in the wound. A large piece of the root of the iris has been left, which is in close contact with the posterior surface of the cornea at its periphery, and probably in great part adherent to it. More of the stroma of the iris has been removed than of the uveal pigment, which is adherent to the cicatrix and lines its posterior surface, where it is notched. The angle of the anterior chamber on the opposite site to the coloboma is closed. The ciliary processes

FIG. 3.—Section of eye in Case 3, showing the large piece of adherent root of iris left after the iridectomy.

are much atrophied. The lens at its upper margin has some rucks in its capsule.

CASE 4 (*Register No.* 1266).—*Acute Glaucoma. Sclerotomy. Excision six years later for pain. Cystoid cicatrix lined by iris tissue.*

Jane P., aged 58, was admitted to Moorfields Hospital on October 19th, 1883. She stated that six years previously, after having had a great deal of trouble, her left eye suddenly became very painful. She also had great pain in the side of her head, and was very sick. She went to an ophthalmic surgeon in London, who operated upon her left eye, after which the pain was relieved for about a year. The last six months it had gradually been getting worse.

On examination there was seen to be a large cystoid cicatrix in the sclerotic at the upper margin of the cornea. No iris could be seen at the upper part. The T. was − 2. V. = bare p. l. V. of the right eye was $= \frac{6}{60} \bar{c} + 1\,\text{D}. \frac{6}{6}$.

The left eye was excised.

Pathological Examination.—The cornea is clear; above its

upper margin is a large bulging scar which is very thin in places, showing the iris through it. The whole of it is lined by iris tissue. None of the iris at the upper part can be seen through the cornea. The anterior chamber is shallow, its angle closed by a peripheral adhesion of iris to cornea. The lens is clear; the vitreous fluid; the optic disc cupped.

Microscopical Appearances.—The iris at the upper part where it lines the bulging cicatrix is much atrophied, its uveal pigment layer is almost all that is left. It is intimately adherent to the cicatricial tissue over-lying it.

FIG. 4.—Section showing the cystoid cicatrix lined by atrophied iris tissue in Case 4.

The cicatrix is situated well to the outer side of the termination of Bowman's membrane. It is, however, internal to the spaces of Fontana and canal of Schlemm. The upper pupillary border of the iris is within the cystoid portion of the cicatrix. There is no inflammatory infiltration of choroid or iris.

CASE 5 (*Register No.* 1750).—*Subacute Glaucoma. Iridectomy, temporary relief of tension. Sympathetic Ophthalmitis commencing about five months later. Lens capsule adherent to corneal cicatrix.*

George McC., aged 63, was admitted into the Moorfields Hospital on September 12th, 1884, with subacute glaucoma in his right eye of six weeks' duration. The tension was + 2, and his vision was reduced to p. l. only. An iridectomy was performed the same day, a Gräfe's knife being used to make the incision. The tension remained normal for some time after the operation. He was re-admitted on March 24th, 1885, when the right cornea was so steamy that the coloboma was barely visible. The tension of the eye was + 2 and he had no p. l. with it. In his left eye, of which he said the sight had been failing about one month, he had keratitis punctata, iritis, and T. + 2. V. of L. E. $= \frac{6}{9}$.

His right eye was then excised.

Pathological Examination.—There is some thickening of the cornea in the neighbourhood of the cicatrix. The iris has been removed at the upper part, but not quite up to its root, and the portion left is adherent to the back of the cornea. There are adhesions of iris to the anterior lens capsule at the cut edges of the coloboma. The peripheral part of the iris is adherent to the back of the cornea, in the whole circumference, blocking the iris angle.

The lens is slightly displaced; its upper edge has come forward, and is adherent to the cornea at the scar. The ciliary muscle shows some fibrous degeneration. The vitreous is detached from the retina posteriorly except at the O.D. There is deep glaucomatous excavation of the O.N., the cup being filled with inflammatory products.

Microscopical Appearances.—There are some collections of small round cells about the scar in the cornea. Its exact situation with reference to the termination of Bowman's membrane cannot be made out, as this point is not well defined. It is internal to the commencement of the ligamentum pectinatum. The iris has been cut on a level with the corneal scar, it is atrophied, thin, and adherent to the cornea. There

is marked ectropion of the uveal pigment layers of the iris, and considerable inflammatory infiltration of its tissue, the cells being collected in little clumps of varying size.

CASE 6 (*Register No.* 1857).—*Absolute Glaucoma of two years' standing. Iridectomy; return of tension. Excision ten days later. Adherent root of Iris left.*

Louisa H., aged 49, was admitted to Moorfields Hospital on June 22nd, 1885. Her left eye had been blind from glaucoma for two years. Recently it had become very painful. Her right eye had been operated on for glaucoma previously. The day following her admission an iridectomy was performed upwards on her left eye. She returned to the hospital on July 2nd, 1885, with the eyeball still very painful, and the T. + 3. It was then excised.

Pathological Examination.—The cornea is very hazy, it has a cicatrix at its upper margin. The anterior chamber contains the remains of some old blood clot. A small piece of the iris is absent up and out; the cut extremity is slightly entangled in the cicatrix at the sclero-corneal margin. There are no adhesions between the iris and lens capsule. The ciliary processes appear of normal size. The lens is *in situ*. Vitreous apparently quite healthy. The retina is not detached. The optic disc is deeply cupped.

Microscopical Examination.—The line of the iridectomy incision passes very obliquely through the cornea. There is a small amount of round-celled infiltration about it. Anteriorly it comes to the surface ·64 mm. to the outer side of the termination of Bowman's membrane. Posteriorly the gap left in Descemet's membrane is ·2 mm. to the outer side of this point.

A large portion of the root of the iris has been left where the iridectomy has been done. This is intimately blended with the posterior surface of the cornea and to the cicatrix, thus blocking the angle of the anterior chamber. There are some patches of red blood corpuscles in the substance of the retina, and considerable inflammatory cell infiltration into the tissue of the choroid and ciliary body.

CASE 7 (*Register No.* 1843).—*Absolute Glaucoma for a year. Iridectomy; no relief of tension. Excision two days later. Iridectomy incision very corneal. Root of Iris left.*

Nathaniel K., aged 70, was admitted to the Moorfields Hospital on June 16th, 1885. His left eye had been blind for nearly a year. Fifteen weeks previous to admission he had it "probed with a stick"; since then it had been painful. The sight of his other eye was also failing.

The anterior chambers of both eyes were shallow. The lens in the left was opaque, and the T. + 1. In the right the pupil was active, and the T. doubtfully increased. The same day an iridectomy was performed upwards on the patient's left eye, the incision being made with a Gräfe's knife. Two days after the operation he complained of great pain. He had no perception of light with the eye, and the T. was still + 1. It was then excised.

Pathological Examination.—There is a partially healed operation wound at the upper margin of the cornea, extending just into the sclerotic at one extremity. The anterior chamber contains some blood. A portion of the upper part of the iris has been removed; the cut edge is adherent to and slightly entangled in the wound. The lens is opaque throughout, and soft in consistency. The vitreous is clear, the hyaloid being very adherent to the retina.

The retina is *in situ;* it is covered by extensive hæmorrhages. The optic disc is cupped.

Microscopical Examination.—The line of incision in the cornea passes nearly vertically through it at right angles to its surface. In sections passing through the centre of the incision it is seen to be situated ·72 mm. within the point where Bowman's membrane ends. A plug of blood clot fills the upper part of it, and the surface epithelium dips down a little way into it. A portion of the root of the iris has been left at the seat of iridectomy, and this passes forwards into the gap left in Descemet's membrane. It is in close contact with the posterior surface of the cornea, thus blocking the angle of the anterior chamber in this position. Large numbers of red blood corpuscles are disseminated throughout the substance of the retina.

CASE 8 (*Register No.* 2340).—*Absolute Glaucoma. Iridectomy; return of tension. Excision a year later. Ciliary processes and lens capsule adherent to wound.*

Maria A., aged 69, was admitted to Moorfields Hospital on May 18th, 1886. The sight of her left eye had been failing three years, that of her right eye one year. Both anterior chambers were shallow. In the right the pupil was active, V. $= \frac{6}{60}$ and T. + 1. In the left the pupil was semi-dilated and inactive; V. = no p. l. and T. + 2. An iridectomy was performed on the right, and the tension in it has continued normal since the operation, her vision with a spherico-cylindrical glass being equal to $\frac{6}{18}$. On June 12th, 1886, an iridectomy was performed on her left for relief of the pain. A month later there was congestion about the wound, the iris was discoloured, and a small hypopyon formed. The tension continuing increased, and the pain persisting, the eye was excised on June 1st, 1887.

Pathological Examination.—The cornea is semi-opaque. The scar of the iridectomy incision, just beyond the margin of the cornea, slightly prominent. The iris is absent at its upper part, being removed well up to its root. The lens is slightly tilted forwards at its upper part, and in contact with the cornea and anterior part of the ciliary body. The optic disc is deeply cupped and excavated.

Microscopical Appearances.—The iridectomy scar, which is well healed, is situated ·92 mm. external to the termination of Bowman's membrane anteriorly, and ·8 mm. external to a corresponding point posteriorly. The tips of the ciliary processes are adherent to its posterior surface, and they, together with a small piece of the iris that has been left at the iridectomy, completely block the angle of the anterior chamber above. Adherent to the posterior corneal surface over the scar, and passing to the upper margin of the lens and downwards to the anterior lens capsule, is a thin layer of organised inflammatory tissue, and between it and the anterior capsule a small quantity of blood clot. The iris on the opposite side of

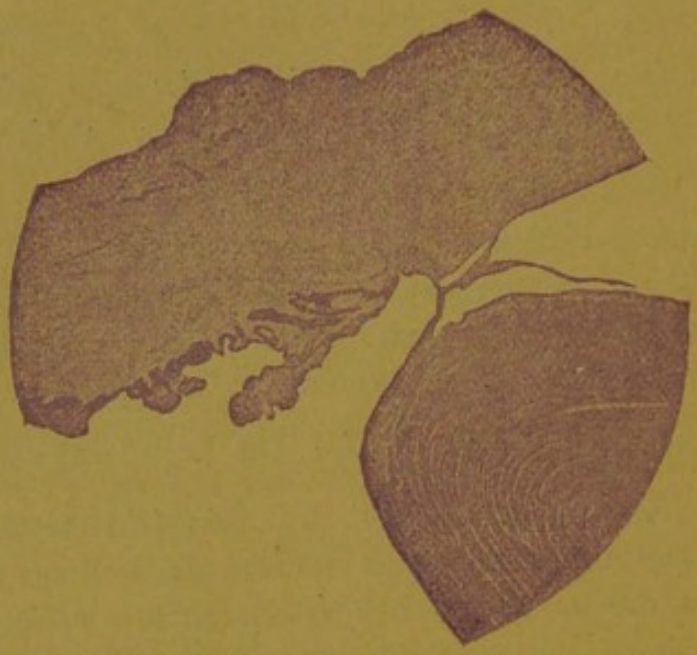

FIG. 5.—Section showing iridectomy cicatrix in Case 8, with root of iris and ciliary processes adherent to it completely blocking the filtration area.

the sections to the coloboma is in contact with the cornea at its periphery; its root is somewhat atrophied. There is marked vacuolation of the corneal epithelium.

CASE 9 (*Register No.* 2370).—*Chronic Glaucoma of three years' duration. Iridectomy; return of tension. Excision eight months later. Small adherent root of Iris left.*

Ann G., aged 61, was admitted to the Moorfields Hospital on October 30th, 1886, with chronic glaucoma of both eyes. Her left was quite blind, the sight in it having commenced to fail three years previously. Her right had not been affected so long, but the failure of sight had been more rapid. An iridectomy was performed on both eyes, a Gräfe's knife being used. She was subsequently re-admitted on July 5th, 1887, stating that she had had pain in her eyes ever since the operations, more especially in the left. The T. in the left was + 3; V. = no p. l. In the right the T. was + 1 and V. = Hand Reflex.

The left eye was then enucleated.

Pathological Examination.—The cornea is slightly hazy; the scar of the iridectomy incision at its upper part is just inside the sclero-corneal margin. The anterior chamber is very

shallow. There is a narrow coloboma of the iris upwards; the iris at the angles is not entangled in the cicatrix. The lens is clear and *in situ*. The vitreous is normal; retina not detached.

Microscopical Examination.—The line of cicatrix in the cornea passes vertically through it at right angles to its surface. It is situated ·52 mm. outside the termination of Bowman's membrane. The iris has been removed almost up to its extreme root, but a small portion has been left, which is intimately adherent to the posterior surface of the cornea, and is just sufficient to block the filtration area. In one section the cut end of the iris is adherent to the gap left in Descemet's membrane at the seat of the cicatrix. In the other sections there is no such adhesion. The angle of the anterior chamber on the opposite side to the coloboma has evidently been closed, but the root of the iris has now been partially torn away, probably as the result of manipulation in mounting the specimen.

There are several clumps of small round cells throughout the choroid.

CASE 10 (*Register No.* 2443).—*Acute attack supervening on Chronic Glaucoma of eight months' duration. Iridectomy; return of tension. Excision two months later. Adherent root of Iris left.*

William H., aged 58, was admitted to Moorfields Hospital on August 4th, 1887. Twelve months before, he first noticed some slight irritation about his right eye. In the previous December the sight had begun to fail, and had been steadily getting worse since. A week before admission, he was seized in the night with severe pain in the right eye and temple which had persisted. There was some general injection of his right eye. The cornea was steamy; the anterior chamber shallow; the pupil semi-dilated and inactive. He could only distinguish light from dark with it, and the T. was + 2. In his left eye the disc was slightly cupped. V. was $= \frac{6}{6}$ Tn.

The next day a small iridectomy was performed upwards on his right eye, the incision being made with a Gräfe's knife. The anterior chamber became filled with blood.

On August 9th the T. was noted as + 2. He was re-admitted on October 6th, with the eye very painful; no p. l. and T. + 2. It was then excised.

Pathological Examination.—The cornea is dull. The cicatrix at its upper margin is bulging slightly. The anterior chamber shallow. The coloboma in the iris is narrower at its periphery than at the pupillary margin; it does not extend up to the root of the iris. The lens is clear and *in situ*, it is not pressing on the ciliary processes in any part. The vitreous is normal. The optic disc deeply and widely cupped; in the retina near it are a number of large irregular-shaped hæmorrhages.

Microscopical Appearances.—The line of the iridectomy cicatrix is situated a little to the outer side of the termination of Bowman's membrane, ·32 mm. anteriorly, ·16 mm. posteriorly. It passes nearly vertically downwards at right angles to the surface of the cornea. A large portion of the root of the iris has been left in the situation of the iridectomy. Its cut end is attached to the cicatrix in the cornea. The peripheral part is intimately adherent to the posterior surface of the cornea, thus blocking the angle of the anterior chamber in the region of the coloboma. The root of the iris on the opposite side of the sections is also adherent to the cornea for some distance. There is marked ectropion of the uveal pigment, and marked atrophy of the ciliary processes.

CASE 11 (*Register No.* 2478).—*Chronic Glaucoma of two years' duration. Absolute for three months. Iridectomy; return of tension. Excision eight months later. Iridectomy incision very peripheral, root of Iris left.*

William B., aged 65, was admitted to Moorfields Hospital on March 15th, 1887. The sight of his left eye had been failing two years. He had been unable to tell light from dark with it for the last three months. He had old ciliary blepharitis on both sides. His left lower canaliculus had been slit. There was a well-marked arcus senilis in each cornea, and opacities in both his lenses. In his left eye the pupil was inactive, and the fundus could not be seen. He had no p. l. with it, and T. was

+ 2. In his right eye the pupil was active, and the fundus could be plainly seen. V. was $= \frac{6}{24}$ Hm. 1·5 D. $\frac{6}{6}$ partly; T. n.

On the day following his admission, an iridectomy was performed upwards on his left, a keratome being used. On March 28th, twelve days later, the tension was + 2. It continued increased, and in November of the same year the eye became inflamed and painful, and was excised on the 23rd of that month.

Pathological Examination.—The cornea is hazy, and at the upper part there is a vesicle on its surface. Just beyond the upper margin of the cornea there is some thickening of the conjunctiva corresponding to the seat of the iridectomy incision. The anterior chamber is fairly deep. The iris, at its upper part, is absent. The lens is in its normal position; there is some slight haze about its posterior capsule. The vitreous is of good consistency, and quite clear. The retina is *in situ*, its vessels look small. The optic disc is slightly cupped. The choroid has a small patch of disturbance of pigment in it in the region of the yellow spot.

Microscopical Appearances.—The iridectomy cicatrix is very peripheral, being situated 2 mm. outside the termination of Bowman's membrane anteriorly, and 1·4 mm. from a corresponding spot posteriorly. The inner portion of the ligamentum pectinatum has been penetrated. A small portion of the root of the iris has been left at the seat of the iridectomy, and this is intimately adherent to the posterior surface of the cornea. Its cut extremity, and the tips of the most anterior of the ciliary processes pass just into the gap left in Descemet's membrane, at the posterior surface of the iridectomy incision. The lower angle of the anterior chamber is now open, probably as the result of manipulation in mounting the specimen. No hæmorrhages are seen in the retina.

CASE 12 (*Register No.* 3003).—*Subacute Glaucoma. Iridectomy; return of tension. Excision four weeks later, very peripheral incision. Iris removed quite up to its root. Lens capsule adherent to wound.*

Richard S., aged 75, came as an out-patient to the Moorfields Hospital on October 16th, 1889. He stated that he had

noticed gradual failure of sight in his right eye for six months, and in his left for one month. He had been subject to neuralgia on the left side of his face for fourteen years.

There was slight injection of his right eye, none of his left. The anterior chamber in both was decidedly shallow. The left pupil was more active to light than the right. There were mature cataracts in both eyes. V. of right = p. l.; projection good; T. + $1\frac{1}{2}$. V. of left = fingers at 3 feet; T. full.

On October 23rd an iridectomy was performed upwards on both eyes, a Gräfe's knife being used for the right, and a keratome for the left. A week later the T. of right was noted as − 1, and of the left as low normal. The right was much congested, there was blood in the anterior chamber and in the coloboma.

On November 12th, *i.e.*, nineteen days after the operation, the T. of right was full, it was still injected, but the patient complained of no pain.

On November 19th, the T. of right was + 2. V. = p. l. only. There was haze of cornea, lymph on the iris, and much circumcorneal injection. It was then excised.

Pathological Examination.—The cornea is hazy, a cicatrix at its upper margin passes obliquely through it, and is well healed. The aqueous is turbid, and there are some blood clots in the lower part of the anterior chamber. The anterior capsule of the lens is adherent to the posterior surface of the cornea in the region of the iridectomy cicatrix. The vitreous is thin in consistency, and detached posteriorly from the retina. The retina is *in situ*. The optic disc deeply cupped.

Microscopical Appearances.—In preparing the specimen for cutting microscopical sections, the parts got considerably displaced, owing to the celloidin being allowed to shrink by too long exposure to the air. In this way the attachment of the lens capsule to the iridectomy cicatrix above mentioned became torn through.

The cicatrix, which is very oblique, is situated anteriorly 1·6 mm. external to the termination of Bowman's membrane, and posteriorly ·92 mm. external to a level with the same point.

A wide plug of semi-organised cicatricial tissue fills up the wound; some of it projects through the gap in Descemet's

membrane, and no doubt was adherent to the anterior capsule of the lens.

The iris has been removed right up to its root; a small portion of its anterior layers, however, which had become intimately incorporated with the corneal tissue in the region of the ligamentum pectinatum, has been left.

The angle of the anterior chamber on the opposite side of the sections has evidently been closed, but is now torn open.

The lens shows several tracks of hyaline globules between its laminæ in the cortical parts, no perforation in its capsule can be seen.

CASE 13 (*Register No.* 3028).—*Acute Glaucoma. Iridectomy, slight temporary return of tension. Three months later sympathetic ophthalmitis in other eye. A peripheral partially-healed cicatrix with a piece of detached iris incarcerated in it.*

Maria M., aged 60, was admitted to Moorfields Hospital on October 2nd, 1889. A month previously she had had a bad attack of neuralgia and vomiting, and completely lost the sight of her right eye. It was on her admission somewhat injected, the anterior chamber was shallow and the pupil semi-dilated and inactive. The T. + 3, V. = p. l. only.

In her left eye V. was = $\frac{6}{24}$ Hm. 2·5 D. $\frac{6}{9}$ $\bar{c}$ + 6 D. Ji. T. full.

An iridectomy was performed upwards on her right, the incision being made with a keratome.

On November 13th, about six weeks later, it was noted that there was some circumcorneal injection; that the eye was painful, and that the tension was increased.

She was re-admitted to the hospital on January 1st, 1890, with injection and keratitis punctata of her left eye, also posterior synechiæ, and patches of uveal pigment and lymph on the anterior capsule of the lens. There was no keratitis punctata in the right eye. It was injected, and there was a small piece of iris adherent to the upper and outer part of the corneal cicatrix. The T. was n. V. = no p. l. The right eye was then excised.

Pathological Examination.—The epithelium of the cornea is hazy; there is a cicatrix at its upper margin. The angle of the anterior chamber is evidently closed elsewhere than in the coloboma. The lens is in its normal position and healthy. The vitreous, of good consistency, has the remains of an old hæmorrhage in its lower part over the ciliary body. The retina is *in situ*. The optic disc deeply cupped.

Microscopical Appearances.—The scar of the iridectomy is situated 1 mm. outside the termination of Bowman's membrane anteriorly, and about on a level with this point posteriorly. It has not healed throughout its whole thickness, only superficially. A piece of folded iris detached from the ciliary body is incarcerated in it. At the inner lip of the posterior surface of the iridectomy incision is some loose fibrous tissue, to which a fibre of the suspensory ligament is attached. About the centre of the posterior surface of the cornea is a gap in the continuity of Descemet's membrane, from which a slender adhesion passes to the lower part of the iris near its pupillary

FIG. 6.—Section showing an anterior synechia of the lower part of the iris near its pupillary border in Case 13, caused by a wound of Descemet's membrane with point of the keratome.

border. Hardly any of the root of the iris has been left at the seat of the iridectomy adherent to the periphery of the cornea. The angle of the anterior chamber is considerably constricted on the opposite side.

There is a slight amount of inflammatory infiltration in the

ciliary body. The optic nerve is much sclerosed; there is some hypernucleation of it immediately posterior to the lamina cribrosa.

CASE 14 (*Register No.* 3071).—*Acute Intermittent Glaucoma. Iridectomy, return of tension, bulging of cicatrix. Excision a fortnight after the iridectomy. Descemet's membrane stripped off cornea by hæmorrhage from iris between them.*

Jane R., aged 62, was admitted to the Moorfields Hospital on February 4th, 1890, with acute glaucoma in her left eye. She stated that she first had an attack of pain and dimness of sight a year previously. At that time she saw rainbow-coloured rings around lamps. The eye got better, but recently the same symptoms had recurred.

An iridectomy was performed upwards, a Gräfe's knife being used to make the incision. The anterior chamber immediately became filled with blood.

On February 11th, a week after the operation, the tension was found to be still increased. The cicatrix was bulging, the blood in the anterior chamber was less.

On February 18th, the tension still being increased and the eye painful, it was excised.

Pathological Examination.—There is a partly healed and slightly bulging cicatrix at the upper sclero-corneal margin. A recent blood clot appears to nearly fill the anterior chamber. There is a coloboma upwards, but a large portion of the root of the iris has been left. On one side of the coloboma, a

FIG. 7.—Section of eye in Case 14, showing prolapse of a knuckle of iris near its root, the first stage in the formation of a cystoid cicatrix.

knuckle of the iris, near its root, has prolapsed into the cicatrix. The lens is in its normal position and appears

healthy. The retina is *in situ;* there are some hæmorrhages in it. The optic disc is deeply cupped.

Microscopical Appearances.—The line of the iridectomy incision is situated ·6 mm. external to the point where Bowman's membrane ends anteriorly, and ·2 mm. internal to a corresponding point posteriorly. The large portion of the root of the iris which has been left at the seat of the iridectomy completely blocks the angle of the anterior chamber above. It is also closed on the opposite side. There is a large collection of red blood corpuscles sub-conjunctivally in the region of the cicatrix. There has also been a large hæmorrhage into the

FIG. 8.—Section showing large hæmorrhage into substance of iris, and blood clots between Descemet's membrane and tissue of cornea, in Case 14.

tissue of the iris on one side of the coloboma. Blood has passed from the cut iris into the gap left in Descemet's membrane at the iridectomy incision, and from there between the substance of the cornea and Descemet's membrane, stripping this latter off, and forming a large clot between it and the fibrous tissue of the cornea.

There are numerous various sized hæmorrhages in the retina, also in the suprachoroidal lymph space at its lower and anterior part. The blood vessels of the retina have very thickened walls.

CASE 15 (*Register No.* 3119).—*Subacute Glaucoma following the use of atropine for a corneal ulcer. Iridectomy, return of tension. Iris removed quite up to root. Adhesion of lens capsule to cornea at seat of ulcer.*

Mary H., aged 40, came as an out-patient to Moorfields Hospital on November 2nd, 1889, with an ulcer of her right cornea. Atropine drops were prescribed, which she used until November 20th, when she came with considerable injection of the eye, a widely dilated pupil, and T. + 1. Eserine drops were then substituted for the atropine, but the tension was not quite reduced to normal by their use. On January 15th, 1890, an iridectomy was done upwards, a keratome being used to make the incision. The ulcer at that time was only partially healed. After the operation the anterior chamber was slow in re-forming, and when it did re-form it remained shallow. The tension returned, and she was re-admitted on March 7th with V. reduced to hand reflex and T. + 2. A scleral puncture was then tried, but proved unsuccessful in relieving tension. The eyeball being very painful, it was excised on May 3rd.

Pathological Examination.—There is some bulging of the globe equatorially between the insertions of the superior and internal recti muscles. The cornea has a small central opacity in it; the lens is adherent to it at the seat of the opacity, being tilted forwards on its inner side. The pupil is dilated. There is a wide coloboma of the iris upwards, the iris having been removed well up to its periphery. The retina is *in situ*. The optic disc is cupped.

Microscopical Appearances.—The line of the iridectomy incision passes very obliquely through the cornea, being 1·8 mm. external to the termination of Bowman's membrane anteriorly,

FIG. 9.—Section showing that iris has been removed quite up to its extreme periphery in Case 15. Line of incision very oblique.

and only ·2 mm. external to a point on a corresponding level posteriorly.

There is very little cell infiltration about it, the iris has been removed quite up to its extreme periphery, the filtration area being well opened up.

CASE 16 (*Register No.* 3192).—*Absolute Glaucoma. Optico-ciliary neurotomy for the relief of pain. Return of pain and excision two years later.*

Lucy F., age 68, was admitted as an in-patient to the Moorfields Hospital on July 30th, 1888, with absolute glaucoma in her right eye, which had commenced nine weeks previously with acute pain. Her left eye showed no symptoms of glaucoma. V. was $= \frac{6}{6}$.

An optico-ciliary neurotomy was done on her right eye, after which the globe protruded considerably. A fortnight later the eyeball had nearly regained its normal position. The pain was less, but the T. was still + 3.

On July 23rd, 1890, she was re-admitted, pain having again set in, in her right eye. The cornea was hazy and ulcerated, and the T. + 3. It was then excised.

Pathological Examination.—An antero-posterior vertical section was made of the eyeball. The angle of the anterior chamber is firmly closed by an extensive peripheral adhesion of the root of the iris. The lens is clear. The retina *in situ*, and the optic disc deeply cupped.

Microscopical Appearances.—The epithelium on the anterior surface of the cornea is very thick, in one place it is separated from Bowman's membrane by some loose fibrous tissue. The excavation of the corneal tissue at the seat of ulceration is not very deep. There is some round cell infiltration throughout the superficial layers of the cornea, becoming very dense at the seat of ulceration. On the inner surface of the cornea is some granular material and round cells. The iris has its anterior endothelium much thickened, and every here and there raised, forming little blebs. There are also circular spaces lined by endothelial cells in the substance of the iris, evidently dilated lymphatics. The whole stroma of the iris, the ciliary processes,

and ciliary muscle are much atrophied. There are numerous cystic spaces in the retina behind the ora serrata. It and the choroid behind the equator show extreme atrophy.

CASE 17 (*Register No.* 3158).—*Chronic Glaucoma. Iridectomy, return of tension. Excision fifteen years afterwards. Adherent root of iris left, extreme atrophy of ciliary body and iris.*

Frederick P., aged 42, was admitted to the Moorfields Hospital on February 2nd, 1875, with chronic glaucoma in his right eye, said to be of six weeks' duration. He could just see to count fingers with it; his other eye was unaffected. An iridectomy was performed upwards, a Gräfe's knife being used to make the incision. On his discharge, a note was made stating that there was still some increase of tension, and that the cicatrix had a tendency to bulge.

He returned to the hospital in June, 1890, and said he had been unable to tell light from dark with the eye since the operation. His left eye had remained good. There was then some conjunctival injection of the right, and a clear corneal ulcer. The lens was cataractous. T. full, V. = no p. l. It was then excised.

Pathological Examination.—There is a general mottled superficial haze of the cornea, a facetted surface about its centre, and the scar of an iridectomy incision at its upper margin. The iris is very much atrophied, there being only a narrow rim at the pupillary border which is not adherent to the posterior surface of the cornea. It is absent above. The vitreous is shrunken. The retina *in situ*. The optic disc is deeply cupped and excavated.

Microscopical Appearances.—The line of the iridectomy incision is very oblique, anteriorly it is situated external to the termination of Bowman's membrane. This point, however, is not sufficiently well defined to allow of any accurate measurement of the distance from it. A small portion of the root of the iris, much atrophied, has been left blocking the filtration area in the region of the coloboma. The ciliary muscle, ciliary processes, and iris are all extremely atrophied. The uveal pigment covers the whole of the anterior surface of the iris that

is free. There are some patches of round cell infiltration in the ciliary body and iris.

CASE 18 (*Register No.* 3246).—*Absolute Glaucoma. Iridectomy, return of tension, optico-ciliary neurotomy. Excision six months after iridectomy. Adherent root of iris left.*

Charles M., aged 44, came first as an out-patient to Moorfields Hospital on October 1st, 1887. He then had no perception of light with his right eye. The pupil was semi-dilated and inactive. The cornea hazy. The tension of both it and of the left was noted as doubtfully increased. The vision of his left was $= \frac{6}{36}$, the pupil of it was active and optic disc cupped. On April 14th, 1888, he came complaining of pain in his right eye, it was then much injected, and the T. + 2. The T. of L. + 1. An iridectomy was performed at once on the right, and three days later on the left also, a keratome being used to make the incisions. Three months after these operations the tension of the right was noted to be + 2, and of the left + 1. Pain continuing in the right and the patient refusing to have it excised, on September 19th, 1888, an optic-ciliary neurotomy was performed, a piece of the nerve being removed.

On October 15th, 1890, pain having again returned, the T. being + 3, the eye was enucleated.

Pathological Examination.—There is considerable adhesion of orbital tissues to the globe. There is a well-healed peripheral iridectomy incision at the upper sclero-corneal margin. A small piece of the root of the iris has been left in the region of the coloboma, which adheres to the posterior surface of the cornea. The angle of the anterior chamber on the opposite side to the coloboma is also closed. The lens is *in situ* and apparently healthy. The vitreous somewhat shrunken. The optic disc exceedingly deeply cupped and very white. The choroid is much atrophied, the sclerotic showing through for a wide area around the optic disc. The retina is pigmented in the equatorial region.

Microscopical Appearances.—The iridectomy cicatrix is situated anteriorly 1·5 mm. outside the termination of Bowman's layer, and posteriorly ·96 mm. external to a cor-

responding point. In two of the three mounted sections the gap in Descemet's membrane is quite free from any entanglement of iris; in the third there is a slight adhesion which, however, in no way fills up the gap. The small portion of the root of the iris which has been left at the iridectomy completely

FIG. 10.—Section showing the iridectomy cicatrix in Case 18, very peripheral and free from any entanglement of iris. Filtration area blocked by adherent root of iris.

blocks the angle of the chamber above. The angle on the other side is also restricted. The ciliary muscle and processes are extensively atrophied, as also are the choroid and retina. At the posterior part of the globe, the elastic lamina is all that can be made out of the former, and a strand of fibrous tissue of the latter, with a few uveal pigment cells scattered here and there. At the equator, and anterior to it, more retinal tissue is left, and there are cystic spaces in it.

CASE 19 (*Register No.* 3252).—*Acute Glaucoma. Iridectomy, relief of tension. Excision ten years later for ulcer of cornea with Hypopyon.*

Susan H., aged 57, was admitted to the Moorfields Hospital on June 5th, 1880. She stated that four days previously at 11 p.m. when going to bed she was suddenly taken with severe pain in the forehead, and that in the course of an hour the sight of her right eye had almost gone. That it had continued in that condition up to the present time.

On examination, the right eye was found to be injected, the anterior chamber was shallow, and the cornea hazy. V. was reduced to p. l. only, T. was + 2. The left eye was then unaffected. An iridectomy was at once performed on her right, a Gräfe's knife being used to make the incision. A fortnight later she got an acute attack of glaucoma in the left, and an iridectomy was done on that also. The note with reference to her right eye on her discharge from the hospital three weeks after admission, states :—T. n., dark pigment spot at each end of wound; good coloboma upwards, O.D. healthy with physiological cup.

She subsequently came as an out-patient on May 29th, 1889, when the condition of her right eye was described as follows :—

R. V. $= \frac{6}{60}$ spells J. 20. A diffuse milky opacity of upper half of cornea. A medium coloboma upwards; a. c. very shallow. Iris grey, motionless, and atrophic, so much so that downwards between its pupillary margin and periphery it can be readily seen through, looking as though there was a ring of pigment on lens. The anterior lens capsule shows an opacity at its centre. The fundus is dimly seen, it appears normal, no cupping. T. n.

On October 15th, 1890, she came complaining of pain, which she stated had come on lately in her right eye. There was no congestion and no tenderness. The lens had become quite opaque and the cornea was dull. T. n.

A fortnight later it had become much worse, there was a central ring-abscess or ulcer of the cornea, and diffuse hypopyon. The lids were very œdematous, the eyeball very tender, and T. full. It was then excised.

Pathological Examination.—There is a central facetted yellow ulcer of the cornea; general haze and an iridectomy cicatrix at the upper margin.

A small portion of the root of the iris has been left at the iridectomy. The lens is normal. The vitreous clear; slightly shrunken. The retina *in situ*. The optic disc is slightly cupped, but not excavated.

Microscopical Appearances.—The iridectomy scar passes nearly vertically through the corneal tissue; it is situated ·56 mm. external to the point of termination of Bowman's membrane

anteriorly, and ·2 mm. external to a point on a corresponding level posteriorly. There is some round cell infiltration about the cicatrix which looks recent. The ulceration of the cornea is superficial; there is, however, considerable round cell infiltra-

Fig. 11.—Section showing the angle of the anterior chamber open in Case 19, though a small portion of the root of the iris has been left after the iridectomy.

tion between the laminæ about its base (Fig. 11). The small portion of the root of the iris which has been left at the iridectomy, is not in contact with the cornea, so that the angle of the anterior chamber is widely open. On the opposite side it is also open, but not so widely, and has probably at one time been closed, as there is a bend in the iris near its root.

Case 20 (*Register No.* 3269).—*Glaucoma for two months. Iridectomy. Escape of lens and prolapse of ciliary body on the following day.*

Mary F., aged 67, was admitted to the Moorfields Hospital on November 8th, 1890. She stated that the sight of her right eye had been dim for two months, that it had been painful and that she had seen coloured rings around lights with it for about one month. The T. was found to be + 2, and vision reduced to hand-movement. The T. of her left eye was normal, but the optic disc was slightly cupped.

An iridectomy was performed on the right two days later, under an anæsthetic, a Gräfe's knife being used to make the incision. The following day the lens escaped.

The eyeball was excised on November 15th, five days after the iridectomy.

Pathological Examination.—The globe is flaccid, there being a gaping, very peripheral iridectomy incision at the upper part. The vitreous is presenting through it. The lens is absent. There are some blood clots in the anterior chamber. The retina was probably *in situ* previous to enucleation; it has a small amount of blood clot on its inner surface. The optic disc is cupped.

Microscopical Examination.—The iridectomy incision is nearly vertical; it is situated 1·68 mm. external to the point of termination of Bowman's membrane anteriorly, and 1·36 mm. external to a corresponding spot on the posterior surface posteriorly. It passes through the inner portion of the ligamentum pectinatum, but is internal to the canal of Schlemm.

FIG. 12.—Section showing prolapse of ciliary body into the iridectomy wound in Case 20.

The anterior portion of the ciliary body, and some of the torn fibres of the suspensory ligament, are prolapsing into the wound. The angle of the anterior chamber on the opposite side to the iridectomy is firmly closed; there is some atrophy of the root of the iris.

CASE 21 (*Register No.* 3380).—*Absolute Glaucoma. Iridectomy; temporary relief of tension. Sympathetic Ophthalmitis. Lens wounded and adherent to cornea.*

Elizabeth H., aged 63, came as an out-patient to the Moorfields Hospital on September 8th, 1890, with no perception of light with her left eye, the anterior chamber being shallow, and the T. + 2. In her right V. $= \frac{6}{24}$, the field was contracted, T. n., there was atrophy of the choroid, but no cupping of the disc.

On February 23rd, 1891, her left eye having become inflamed and painful, an iridectomy was performed, the incision being made with a Gräfe's knife. She was discharged ten days later with the pain relieved, the T. n. and the anterior chamber of good depth. On re-admission in April, 1891, she stated that during the previous week she had noticed that the vision of her right eye was "getting smoky," and that black specks floated in front of the eye. She had had no pain in either eye.

On examination there was found to be some deep injection of the ciliary region, and some slight engorgement of the conjunctival vessels in her left eye. The anterior chamber was of good depth, and there did not appear to be any entanglement of iris in the corneal cicatrix. There was a milky nuclear opacity of the lens. T. + 1. V. = no p. l.

There was no injection of her right eye, but numerous posterior synechiæ; pigment on the anterior capsule of the lens, and dots of keratitis punctata over the lower half of the cornea. V. $= \frac{6}{36} \bar{c} - 2{\cdot}5$ D. $\frac{6}{18}$. T. full.

The left eye was then excised.

Pathological Examination.—The iridectomy cicatrix situated at the upper sclero-corneal margin is slightly oblique. Adherent to its posterior surface is the lens, which is tilted so that its upper margin projects forwards. The angle of the anterior chamber is closed below by the root of the iris. The vitreous is much shrunken and detached at its lower part; it has some old blood clots in it. There is a patch of atrophy in the choroid in the equatorial region in the outer half. The O.D. is deeply cupped and excavated.

Microscopical Appearances.—The line of the corneal cicatrix is situated anteriorly ·8 mm. external to the termination of Bowman's membrane, and the gap in Descemet's membrane is ·3 mm. external to a point on the same level posteriorly. In this gap is some organised inflammatory tissue, which attaches the lens to the cornea. There is a break in the continuity of the lens capsule at this point, and some proliferation of its epithelium and collection of hyaline globules between the fibres

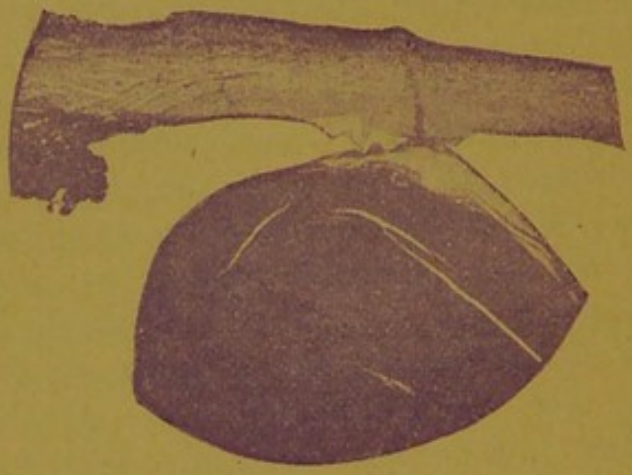

FIG. 13.—Section showing adhesion of lens capsule to iridectomy cicatrix in Case 21.

of the lens. The iris has been removed well up to its root, and in some sections it is quite absent right up to the ciliary body. There is a peripheral adhesion of iris and cornea on the side of the sections opposite to the iridectomy. In a section taken on one side of the coloboma there is an entanglement of the iris in the cicatrix.

There are patches of round cell infiltration in the iris and ciliary body, and the choroid is infiltrated with inflammatory cells in patches right up to the O.D. There is considerable atrophy of the ciliary muscle and processes. The optic nerve shows inflammatory infiltration up to its point of section.

CASE 22 (*Register No.* 3392).—*Intermittent Glaucoma for six months. Iridectomy, wound of lens. Excision seven weeks later.*

Mary Ann B., aged 43, was admitted to the Moorfields Hospital on February 3rd, 1891, when the following notes were taken by Mr. Donald Gunn, the Senior House-Surgeon.

Patient states that her left eye, several times during the last six months, has come over dim after doing a day's washing. This dimness has generally been accompanied by pain on that side of the face and head. Recovery was complete until a month ago, since then she has had much pain, and been very ill. Right eye came bad with fog and pain a week ago.

State on admission.—Spasmodic entropion of both lower lids and general injection. Both corneæ steamy, and anterior chambers very shallow. Pupils dilated, irregular, and fixed. No details of either fundus seen, only a red reflex. V. of R. = Fingers at 18″, T. + 1. V. of L. = Fingers at 12″ T. + 1 to 2.

The following day an iridectomy was performed on each eye, a keratome being used for the incision in both. In the left the iris was seen to be penetrated from behind near its ciliary margin by the keratome. A good sized piece of iris was removed from each eye.

On February 7th, three days after the operation, the lens of the left was noticed to be getting opaque.

She was re-admitted on April 21st, 1891, on account of pain in her left temple and occiput. The condition of the left eye at that time was described as follows:—Coloboma upwards small. Iridectomy scar in cornea pigmented. Iris adherent to a small scar in the centre of the posterior surface. Lens cataractous, T. n. Vision, bare p. l. only. It was then excised.

Pathological Examination.—The iridectomy cicatrix at the upper sclero-corneal margin is but partially healed. It is somewhat depressed backwards, the lens, which is opaque and shrunken, especially at the upper part, being adherent to it. The margin of the coloboma is irregular; an opaque membrane fills it. There is a small adhesion between the lower part of the iris, near its pupillary border, and the posterior surface of the cornea about its centre. Also a peripheral adhesion of the iris. The vitreous is of fairly good consistency. The retina *in situ*, and the optic disc cupped.

Microscopical Appearances.—In sections taken through the centre of the coloboma there are seen to be two cicatrices at the upper sclero-corneal margin. The more internal has now a direction backwards, and slightly outwards; it is only healed superficially, and has a piece of iris incarcerated in it. The more external one is directed backwards and inwards; it is also

only healed throughout a portion of its extent. The outer one is certainly external to the termination of Bowman's membrane, and internal to the commencement of the ligamentum pectinatum, but the precise distance it is from them cannot be determined. The explanation of there being two cicatrices probably is that when the keratome was seen appearing through the iris from behind forwards, it was either partially or entirely withdrawn and inserted in a fresh direction. There is considerable round-celled infiltration in the sub-conjunctival tissue and cornea adjacent to the cicatrices. It is difficult to say to what extent the iris tissue has been removed, as the infiltrated iris tissue cannot be differentiated from the inflammatory exudation. A large piece of what is probably detached iris is entangled in the inner cicatrix. There is a gap in the anterior capsule of the lens opposite the cicatrices, and considerable invasion of the lens substance by leucocytes. The lens fibres have, in places, large collections of hyaline globules amongst them.

There is an inflammatory membrane on the anterior surface of the lower part of the iris which passes to the anterior capsule of the lens. In some sections there is a gap in Descemet's membrane in the centre of the cornea into which an adhesion passes from the iris.

Case 23 (*Register No.* 3458).—*Chronic Glaucoma. Iridectomy. Tension normal for a year. Excision on account of Iritis and pain.*

Mrs. M. came under observation first in November, 1887. She then had chronic glaucoma in both eyes. She stated she had seen halos for many years. In the left the optic disc was pale and slightly cupped. Her field was much contracted. An iridectomy was performed on both eyes, a Gräfe's knife being used for the incisions.

In February, 1888, the vision of her left eye was found to have considerably improved since the operation, it was then with glasses $=\frac{6}{18}$ and J. 4. The cicatrix was cystoid, and the T. n.

On June 23rd, her left eye was noted to be quiet, T. n. Media hazy.

On October 15th, she came stating that she thought she had caught cold in her left eye while out driving. She had been using eserine for six weeks. There was then found to be total posterior synechiæ and no reflex. The T. was normal.

On November 3rd, the T. of her left was full.

It was excised on account of pain on January 21st, 1889.

Pathological Examination.—The eyeball had been in Müller's fluid for several months previous to my receiving it.

On section the anterior chamber is found to be shallow. At the upper margin of the cornea is a cystoid cicatrix. The lens appears to be normal. The vitreous is somewhat thin. The retina *in situ;* the optic disc slightly cupped, not excavated. A portion of the iris is absent above, what is left of the pupillary border is adherent to the lens capsule.

Microscopical Appearances.—The iridectomy incision is situated ·6 mm. external to the termination of Bowman's membrane anteriorly, and passes through Descemet's membrane previous to its splitting up into the fibres of the ligamentum pectinatum.

FIG. 14.—Section showing cystoid cicatrix in Case 23, lined partly by prolapsed ciliary body and partly by atrophied root of iris.

There is a wide gap in the sclero-corneal tissue in the situation of the incision, the conjunctival and episcleral tissue having healed over it. A portion of the root of the iris has been left at the iridectomy, and this, together with the anterior part of the ciliary body, turns round into the gap in the sclero-corneal tissue, and lines it for nearly its whole extent. The

tissue of the iris is here very much atrophied, and in places its uveal pigment layer is absent, probably being broken through as the result of stretching. The angle of the anterior chamber on the opposite side of the sections to the iridectomy is open.

The illustrations in this paper are reproductions of photo-micrographs taken by the author.