6. Its biochemistry is modified by oxidation, first to formaldehyde and then to formic acid, both of which are corrosive poisons.

7. Formic acid is the end-product excreted by the kidneys.

8. If formic acid is present in the urine it will promptly reduce Fehling's solution, thus suggesting to the inexperienced a false diagnosis of diabetes.

9. Van Slyke's test will reveal acidosis in the early stages and alkalosis later.

10. Sudden blindness with vomiting and abdominal pain should always arouse suspicion of methylic poisoning; especially if diplopia or ptosis is associated.

11. Papillitis, sector-like atrophy, and sudden sclerosis of the nervehead are equally typical fundus lesions.

12. Symptoms of pituitary injury are most suggestive in pointing to this as the primary and fundamental lesion.

13. Contracted fields and central or paracentral scotomata are usually present.

14. Treatment should include early neutralization by alkalies, elimination by lavage, emetics, diaphoretics and rapid oxidation, together with stimulation of the optic nerve by negative galvanism applied directly to the eye. Thyroid extract and pituitrin may be indicated.

15. The manufacture and sale of wood alcohol should be prohibited or regulated by law.

16. If sales are permitted, safeguards and warnings should be required and the public instructed as to the great danger to vision and life.

17. A special revenue tax with registered "Poison Sales" would regulate and record its distribution and in cases of poisoning reveal the source.

18. This tax should equalize the cost of denatured alcohol and methyl alcohol, and thus remove the temptation to adulteration because of cheapness.

19. All wines, whiskies, toilet articles and patent medicines imported from foreign countries should be tested for wood alcohol before passing through the Customs inspection.

20. The name "Methanol" specifically designates this product and yet avoids the tempting suggestiveness of the word "alcohol."

SOME LATE GLAUCOMA RESULTS

BY

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In the ordinary course of work, during the last two years in Nottingham, I came across eight examples of return of plus tension

some years after successful operations for primary glaucoma—two trephinations, three of my wedge-isolation operations, two small flap sclerotomies and one conjunctival-infolding operation. This experience suggested an enquiry into all the readily available later results of iris-free filtration operations performed five or more years before. Altogether slightly more than a hundred eyes have been examined, mostly operated upon by Mr. Laws or myself.

But a number of them have to be excluded from consideration in the main enquiry, i.e., with regard to the permanency of the relief obtained by these operations. Some of the operations were for secondary glaucoma following interstitial keratitis, iritis, or hypopyon ulcer of the cornea. Others have been rejected on account of incarceration or sub-conjunctival exposure of uveal tissue. Others because the history of the case or other evidence suggested that the reduction of tension might possibly have been a little incomplete from the beginning, or from a very early period. Two simple iridectomies have been included in the list because the scars showed undoubted filtration. On the other hand, one successful wedge-isolation operation with combined iridectomy was rejected because there was no definite conjunctival oedema to show filtration.

Thus, the number of primary glaucomas in which there was good reason to believe that the tension had been fully relieved for some years by iris-free* leaking scars is reduced to 69, in addition to the eight recurrent glaucomas which prompted the enquiry. In five of the 69 eyes plus tension had returned.

Thus, there are (8+5) 13 recurrent glaucomas and 64 still draining sufficiently, for examination. The mean period which had elapsed since operation in the recurrent group was 8 years, the maximum period being 13 years; the mean of the still successful list was nine years, the maximum 17 years. The earliest recurrence with more or less definite onset was more than 3 years after operation, the latest about 11 years. But in many the rise in tension was evidently very gradual, being spread over a number of years.

While not serving for even an approximate estimate of the percentage of late recurrence to the total successful operations, the figures are undoubtedly of value, expressing a real defect of iris-free drainage, and one that is frequently overlooked in present-day work. The figures as a whole, perhaps, compare favourably with what is known of the later results of classical iridectomy, but the defect must tend eventually to limit the application of the more moderate filtration methods to the less progressive glaucomas. Unfortunately the records of these cases are too imperfect to help at all in differentiating between types of glaucoma likely to be relieved

*The term "iris-free" is, of course, here purely a clinical one.

permanently by moderate drainage, and the more progressive forms, likely sooner or later to need additional drainage.

2. A sub-division of each group may be made according to the type of scar. In 5 of the 13 recurring cases the cicatrix was of the truly filtering type. That is, they were wholly visible, linear, of uniform greyish tint, under more or less oedematous conjunctiva. The cicatrices of the remaining 8 eyes were all judged to be in some degree fistulous. Either dark leaking points could be seen, or there was conjunctival opacity sufficient to make the scars invisible. Such a degree of opacity is found only with considerable conjunctival oedema, often with some tendency to central vesiculation. The tension of the eyes is usually a little sub-normal, and pressure on the eyes is generally very quickly effective in forcing fluid out from the anterior chamber, under the conjunctiva. Hence it probably always indicates one or more underlying fistulous openings.

Among the 64 glaucomas still satisfactorily relieved, there were 28 examples of true filtration, 32 fistulous scars, and 4 in which the distinction could not be made. Thus the proportion of diffused linear filtration in the non-recurrent list was certainly not lower than in the recurrent group, indicating that the full reduction of tension by the linear filtering cicatrix is at least as lasting as by small fistulae. (It may be taken that on the whole the fistulae in my list were smaller than the average of trephinnings.) This seems to be an observation well worthy of notice, tending strongly to confirm the value of linear filtration in the milder glaucomas, since one dare not nowadays deliberately make iris-free sclero-corneal openings larger than appears necessary, having regard to late infective risks.

3. Careful examination of the present condition of the cicatrices and of the conjunctiva, both of the recurrent and non-recurrent groups, provides no clear evidence of any steadily progressive or recent changes indicative of late consolidation of the scars. On the contrary the evidence, such as it is, is almost entirely the other way, indicating that late insufficiency seems to be generally wholly due to increasing demands on the available drainage by advance in the fundamental glaucomatous changes.

Conjunctival conditions accepted as attributable to drainage of aqueous were definite in all the 13 late recurrences. Conjunctival oedema was noted as "good" in all the uniformly linear scars. In 2 of the partly fistulous cases pressure on the eye increased the oedema, while reducing the hardness of the eye; but generally this was not tested. In one case with opaque oedema ("cushion scar") there was a central partly vesicular area into which the conjunctival blood-vessels failed to penetrate. Yet the tension—evidently a quite recent exacerbation, with slight congestion of the eye—measured 70 McLean, and was very little reduced by finger pressure.

4. An extremely slow rise of tension, much slower than is met with ordinarily in untreated glaucoma, was a notable feature of some cases excluded from my list as being possibly somewhat imperfectly relieved throughout. Such cases are interesting in that they may account for many of the slow failures of vision after operation, which have been attributed to unchecked optic-nerve atrophy, proceeding in spite of supposed complete removal of abnormal tension. The tension in my cases remained for long so slightly raised that it was well within the limit accepted as normal for many eyes, as measured by the tonometer. But that it was actually raised a few degrees above the normal for these particular eyes was shown by a reduction obtained by a day or two's use of eserine, or by comparison with a more normal fellow eye, perhaps also by absence of conjunctival oedema,* and by the subsequent history of the case showing an increasing tension. One must admit that even the slightest persistently plus tension may conceivably destroy sight slowly. And how is one always to know exactly what is the normal measurement for any particular glaucomatous eye? One may go further with Mr. Treacher Collins, and suppose that the cupped disc may constitute a weak point like a staphyloma elsewhere, which may tend to bulge progressively under a tension which was previously normal to the eye, the tension required being now a sub-normal one.

In one patient small flap sclerotomy was performed on both eyes in 1910. In one eye the cicatrix became partly fistulous, but in the other eye no oedema developed at any time, and the greater part of the scar-line soon became difficult or impossible to locate, owing to firm healing. Drainage was obviously deficient, and the Schiötz tension, taken at intervals during the first three years after operation, was always higher than in the fellow eye. But the vision had not deteriorated, though it was without the improvement noted in the fellow eye. During the war, however, it slowly sank from fingers at 5 or 6 feet to perception of hand movements only. The Schiötz tension $1\frac{1}{2}$ years after operation was 23, and even recently had only risen to 30, that of the successfully treated fellow eye remaining about 18 throughout.

In another excluded case the small flap operation was performed on both eyes in 1912. From about a month after operation the patient was not seen again till sent for recently. Though living very near he had allowed his sight to diminish very slowly and gradually from 5/6 and 5/15. Now it is hand-movements in one eye and *nil* in the other eye. The McLean tension, not recorded earlier, is still only 46 and 48. There are typical grey linear scars; oedema good in one eye, but doubtful in the slightly harder eye.

A patient, included in the list of late recurrences, came for recent dimness of vision six years after trephining of both eyes. Plus tension was well marked in one eye. In the other the Schiötz tension was only 23 or 24. But the use of eserine for a few days reduced it to 19, thus demonstrating plus tension, which was otherwise doubtful.

The following is apparently a case of steady diminution of vision in spite of fully lowered tension, but it was not a pure case of ordinary primary glaucoma. Two operations had been performed on the one eye for glaucoma. Part of the visual defect was due to central haze of the lens; the field of projection of light was good when the vision was at its worst. The tension while eserine was being used regularly measured 24 Schiötz, but to the finger there seemed no doubt at all regarding full reduction. The

*Recognisable conjunctival oedema may take several months to develop after one of the more moderate successful filtration operations; but its absence years after operation, while not precluding the possibility of some drainage taking place, is, in my experience, scarcely consistent with drainage sufficient for full relief of abnormal tension.

vision sank gradually in the course of seven months from 6/60 to fingers at 1 or 2 feet. Bearing in mind a case mentioned by Elliot, the patient's few teeth were then extracted, as they were in an unsatisfactory state. His vision began at once steadily to improve, and in $3\frac{1}{2}$ months was 6/36, at which it still remains 5 months later. There were considerable pigmented extensions from the atrophic glaucomatous "halo" surrounding the fully cupped disc, one up and in, and a larger one down and out.

Cases such as the one just described are possibly deserving of fuller record than is here given. The old assumption of the very occasional occurrence of an atrophy of optic-nerve fibres, which was due solely to glaucomatous tension, and which yet progressed after complete removal of the abnormal tension, has always appeared very unsatisfying. Why should it occur so seldom? And it would naturally be seen particularly in the most advanced glaucomas, such as those mentioned in the next paragraph. But this is not so.

5. In my list of 64 primary glaucomas still successfully relieved, there were four cases of the very opposite result from the above-discussed progressive loss of vision, viz., the continued unimpaired preservation of a very small remnant of vision, existing at the time of operation in a limited portion of the field.

In two of the four cases the present vision is better than was recorded before operation, though the glaucoma was in both apparently non-congestive; in one case now fingers at three feet outwards seventeen years after iridectomy, in the other case fingers at four feet outwards seven years after a conjunctival infolding operation. Recent notes made regarding the two optic discs are "rather deep cup, but not of whole disc" and "disc white, shallow cupping."

In the remaining two cases the vision both before operation and now was only perception of moving bodies in the outer field; the operations were a small flap sclerotomy and a conjunctival infolding, both about seven years ago.

6. *Wedge-isolation results.* Wholly among the older cases were 19 of my wedge-isolation operations. But 3 of the 19 were among the excluded cases; 1 through absence of conjunctival oedema, and 2 through uveal impaction. In these two cases the wedge had been placed so far from the limbus that it had lain completely detached beneath the conjunctiva, and had hence become absorbed. (Similar disappearance of the wedge in other cases has not involved exposure or incarceration of iris.)

I wish particularly to refer to this group, since surgeons who have practised the method steadily for many years wonder why I gave it up for "less effective" or "reactionary and dangerous" procedures.* My reason was this: Though well pleased with my own results, and thoroughly convinced of the high possibilities of the method, I felt constrained to utilise my limited material in searching for a simpler operation, more suited, for example, to the

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average civil surgeon in India. Slight variations in the technique of this operation may produce large changes in the result, and though this is an advantage in the hands of the trained operator, suiting various grades and types of glaucoma, it is disconcerting to the beginner.

The method has a very obvious advantage over trephining, as will be readily understood from the growing recognition of the importance of spreading sub-conjunctival drainage over a wide area. And, as I have realised lately, it is particularly suited for use at the site of a previous wide iridectomy. The very narrow knife can be freely manipulated in the periphery of the anterior chamber without the slightest risk of injury to the lens. But, particularly, perhaps, where there may be some conjunctival adhesion from former operation, I think the covering conjunctival flap should be more freed above than in my old description.* Early elastic retraction of the flap may then be expected to cause slight bulging from accumulation of aqueous beneath it, thus producing a very desirable slight forward displacement of the sclero-corneal wedge.

Of the 16 (19-3) results included in my lists, 5 were in the recurrent and 11 in the non-recurrent list. The mean period since operation was 11 and 12 years respectively in the two groups. Three of the 5 recurrences were so recent and so intermittent as to have had little or no permanent effect on vision.

The feature which impressed one most in the whole series of these particular iris-free cicatrices was their very satisfactory appearance. There were no dangerous-looking scars. There were perfect examples of filtering lines still outlining the wedges. And in cases in which, a few months after operation, disappearance of ill-placed detached wedges had led to ugly and threatening sclero-corneal gaps, with hypotony, there were now the narrowest of slits under practically normal conjunctiva, only doubtfully distinguishable from true filtration. Possibly the change may have occurred almost entirely during the first two years after operation.

I have known of two late infections after this operation, but they were both mild and transient.

ANNOTATIONS

Motor Headlights

The important question of the best form of headlight for motor vehicles formed the subject of an interesting debate at a recent

* *The Ophthalmoscope*, Vol. V. (1907), p. 298.