Elliot's operation. This, however, appears to be a danger common to all sclerostomies, and of all such operations Elliot's operation, in my opinion, is by far the best.

I may mention that all the notes, tonometric and other, in this case were made by me personally, but I am much indebted to my house surgeon, Dr. Brahma Gupta, for his care of the cases and for looking up the records for me.

THE TREATMENT OF INTRA-OCULAR FOREIGN BODIES AT A BASE HOSPITAL IN FRANCE

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IN April, 1917, a ring magnet was installed at a Base Hospital in France, at the instigation of Colonel Lister, A.M.S., and we have felt that the outcome of our experience with it may be of some interest.

We have no detailed statistics with regard to our cases, for when they are most frequent we have little time for making full records, and are unable to keep the patients under observation for any long period. In fact, in times of pressure we are frequently compelled to transfer them to England within a few days of the extraction of a foreign body.

We have kept two principles before us throughout.

First, we have put up to the magnet every case in which there was the slightest possibility of the presence of an intra-ocular foreign body, and as a consequence the number of our negative cases has been considerably greater than if we had been less punctilious. This procedure has been fully justified, for not only have we sometimes been rewarded in recent injuries, but also on six or eight occasions we have removed fragments from eyes which had been wounded a year or more previously. These were, we think, always cases which had suffered from other wounds and had not passed through an ophthalmic centre.

The other principle which we have observed, has been to patch up every eye that seemed to hold out the slightest prospect of being of value. Our feeling has been that we were usually unable to keep these patients here long enough to decide whether the eye should be sacrificed, and under these circumstances it was clearly unjustifiable to remove an eye which might ultimately be of some use, seeing that its progress could be watched by competent

surgeons at home. We have no doubt that many eyes on which we have spent time and labour here, have afterwards called for removal. The result of adhering to this principle has been that we have sent home a larger number of bad-looking, patched up eyes than if we had been able to keep the men here for a longer period, for in this latter case, more of the patients would have arrived home with a socket instead of a wounded globe.

X-rays.—We do not, as a routine, have a skiagram taken when a foreign body is suspected, for, as already stated, all such cases are put up to the magnet without delay. Localization is unnecessary, because the magnet in any case is first applied to the front of the cornea, with the exceptions afterwards mentioned. If the body is magnetic, it comes forward, if it is not, it stays behind; and the question of excision of the eye does not depend on the presence of the foreign body (though, of course, this is a factor in coming to a decision), but on the reaction of the eye to the injury, and upon the course of the case. X-rays will certainly have a bearing on the prognosis, but even here the presence of a foreign body does not condemn the eye completely; we have seen cases in which men have come out again to France with useful, and even good, vision many months after the original injury, in which a small metallic foreign body has been detected in the vitreous.

Technique.—The necessity for the use of atropin in every case need hardly be insisted upon.

Illumination.—For this purpose we have found the light from a 25-candle power carbon filament lamp, focussed on the eye by means of a lens held just within the ring, to be the most satisfactory. Metal filament lamps are very quickly destroyed by being brought into close proximity with the magnet.

We are satisfied that in the large majority of cases the better route for removal is the anterior one; the question of the posterior route is discussed later.

Magnet.—The patient is placed on the table, the eye cocainized, and the speculum inserted. The ring is then brought down, so that the damaged eye is as near its centre as possible. If this precaution is not observed, and the eye is allowed to approach the side, a considerable lateral pull towards the ring is developed, which tends to displace the foreign body within the globe towards that side.

The smallest rod is now brought slowly up towards the centre of the cornea until it actually touches it. Any movement of the iris or manifestation of pain is watched for, and in some cases movement of the foreign body itself, or of blood or exudate in the vitreous chamber, may be seen.

If this prove negative the larger rods are used, until the largest of all, the bent horn, is applied.

If the result is still negative with the horn applied to the centre

of the cornea, we now apply it in turn to the four quadrants of the sclerotic, as far back as possible, and afterwards to the centre of the cornea again.

The idea is, that by this means the magnet may be approximated closer to a foreign body in the posterior parts of the globe, and so one, which from its minute size or low magnetic affinity has failed to be brought forward by the magnet applied to the front of the cornea, may be got forward by this means in two stages.

In negative cases we usually apply the magnet again a day or two later, as we have found several times that a foreign body has come forward at a second trial.

The elicitation of pain is an important indication, especially in those cases where no movement is observed. It is clear that if the magnet causes pain every time that it is applied, a magnetic foreign body is present. It is sometimes not easy to satisfy oneself, in dealing with nervous patients, whether pain is really caused. If, however, the rod is applied, sometimes with the current switched on, and sometimes with it off, the patient being unaware of what is being done, one can invariably satisfy oneself as to whether the pain complained of is genuine.

At first we used the large horn fixed in the holder supplied with the instrument, and brought the patient's eye up to it; this we found cumbersome and unsatisfactory. We now use it free in the hands, in the same way as the other rods are used; the strain on one's wrist is great, but it is quite easily controlled. The removal of the plate of attachment for the horn increases the accessibility of the interior of the ring.

In any case, but more especially when using the horn in this way, care must be taken to have the current switched on before introducing the rod within the ring. If the rod is first introduced close to the eye and the current is then switched on, the rod is suddenly jerked downwards, and may well do serious damage.

If by any of these means the foreign body presents behind the iris, it is easier to discard the horn and use one of the smaller terminals for the purpose of bringing it into the anterior chamber; it should be applied to the opposite side of the cornea, so that the foreign body is made to slide along the back of the iris till it reaches the pupillary margin and so enters the anterior chamber. By this means one can usually obviate entanglement in the iris.

The foreign body is next brought into a position on the front of the iris at 3 or 9 o'clock, and the giant magnet is removed.

The operation is now completed by means of a small hand magnet of Snell's pattern with a contact button. The use of a keratome inside the ring is not easy, whilst the small magnet is powerful enough for this part of the operation.

The lashes of the upper lid are first cut away and the surrounding

skin is swabbed over with tincture of iodine. A keratome incision is made above, care being taken to keep the point well forward on withdrawal in order to avoid escape of aqueous.

The small magnet is then applied outside the cornea over the foreign body, which is next guided towards the wound, through which it can usually be withdrawn without insertion of the terminal of the magnet.

In some cases a translucent fibrinous exudate will be found in the anterior chamber, which will often come away with iris forceps. This is an indication of a mild infection; such cases seldom do well.

Removal through the sclera.—There are two chief classes of case in which we have found this route desirable:

First, those in which a recent wound of entry of some size exists here. Secondly, in cases where for some reason or another it has not been found possible to draw a magnetic intra-ocular foreign body forward, although its presence has been demonstrated.

1. When this route has been determined upon, the magnet must be brought up to the site of the wound straight away, and not to the cornea. If the fragment proves to be magnetic, we dry the area of wound and treat it pretty freely with pure carbolic acid. The damaged edges of the conjunctiva are next cut away with scissors. A conjunctival flap is now planned so that it will easily cover the area of the wound, and so that the line of sutures is well away from the perforation.

Having exposed the scleral wound by this means, the small magnet is brought up to the wound, the terminal being introduced within it if necessary, and the foreign body so removed. The conjunctival flap is sewn over and atropin instilled. Pressure on the globe must of course be avoided, and a general anaesthetic is always advisable.

2. We have had a few cases where the presence of a magnetic foreign body has been ascertained by means of the elicitation of pain by applying the magnet, but in which we have been unable to bring it forward into the anterior chamber. This may be due to its being of minute size and rather far from the cornea; to its entanglement in the retina or choroid; to its being only feebly magnetic: to the wounded swollen lens obstructing its passage forward; or to its large size.

We have found that in such cases the position of the fragment may be quite accurately localized by finding the exact spot on the sclera at which the magnet causes most pain. This can generally be stated precisely by the patient, and makes X-rays for the purpose superfluous.

This method of localization will be found surprisingly accurate; it is certainly a more accurate method than is supplied by X-rays, for the spot is noted directly upon the globe, and indeed in two of

our cases the foreign body has been so small that the X-ray report was negative.

The patient is able to say within a millimetre or two at which spot the pain is sharpest.

This spot must be noted with respect to some fixed point of the iris; a conjunctival vessel is no use for the purpose, as this will be turned back with the conjunctival flap.

It is also unsafe to make use of the method of comparing its position with the figures on the face of a watch, as the fixation of a globe by means of the stitch to be described, often causes rotation of the eye round a fore to back axis.

We have recently used this method in six cases. In all of them the foreign body was quite minute, and, as stated in two, the X-ray report was negative.

In five of them the foreign body came out immediately on bringing the magnet to the lips of the wound; in the sixth case the curved terminal had to be inserted within the wound, and the foreign body was removed at the third insertion.

Having now localized the foreign body by this means, the patient is placed under general anaesthesia. The eye is fixed in the most suitable position by means of a separate silk stitch inserted just outside the limbus away from the projected incision, and passed through the surrounding skin of the lids and cheek, and so tied as to fix the eye in the desired position. By this means any possible pressure on the eye, such as may occur when fixation forceps are used, is avoided. A conjunctival flap is then turned back as indicated in Fig. 1, the sclera is incised immediately over

FIG. 1.

The dotted line shows the line of the incision for the conjunctival flap.
The short line shows the scleral incision.

the point indicated by the patient as causing most pain with the magnet. A narrow v. Graefe's knife held vertically to the surface of the sclera is made to puncture the coats, and the puncture enlarged if desired *as the knife is withdrawn*, and never by see-saw movements. By this means and by means of the fixation stitch already mentioned, all pressure on the globe is avoided and no vitreous escapes.

We have usually made the incision in a line radiating from the

centre of the cornea limited as far as possible to the pars plana, but in three cases recently, the incision has been made concentric with the corneal margin, again limited to this area when possible, and we have been very pleased with the results. There was not the slightest loss of vitreous in any of the cases and the eyes did exceedingly well.

The incision having been made, a terminal of the Snell's magnet, which has been hammered out into a screw-driver shape, is brought into the lips of the wound, if necessary inserted between them, and the fragment so removed.

We have made no endeavour to suture the sclera or episcleral tissue for fear of expressing vitreous. The conjunctival flap is sewn over and atropin instilled.

Treatment of the wound of entry.—Treatment of the wound of entry with excision of prolapse of uvea should not be undertaken unless a magnet is at the same time available, for should a magnetic foreign body be present, a second operation and anaesthetic would be required; such cases, therefore, should be transferred as early as possible to a centre where complete treatment can be carried out.

Corneal wounds of any size, with a tendency to bulge, may, with advantage, be covered wholly or partly by a flap of conjunctiva. Previously to doing this the wound must be cleared of uveal tissue and of lens capsule, whilst, if necessary, a certain amount of lens matter may be evacuated.

In evacuating swollen lens matter it is well, in our experience, to do very little. The posterior capsule has nearly always been perforated by the foreign body, and if much lens matter is removed, a dark hole appears as the vitreous comes forward, and any further attempt will lead to loss of vitreous.

The treatment of scleral wounds has already been dealt with.

Comparison of Haab and Ring Magnets.—As to the relative merits of a Haab and Ring Magnet, after an experience of both, our feeling is on the whole decidedly in favour of the Ring. We have had no experience with the suspended Haab. The following appear to us to be the advantages of the Ring.—The patient's head is firm and fixed, and so the difficulty of approximating the eye of a reluctant patient to the Haab terminal is avoided, the magnet is approached to the eye instead of the eye to the magnet.

Exposure of the eye by means of a speculum is more easily obtained. The graduation and direction of the pull are more easily controlled. The patient being on the table is in the suitable position for anaesthesia and any further treatment that is necessary. In stretcher cases, for example, a patient with a fractured femur, or chest wound, the advantage of this position is obvious.

It can be used for the exact localization of foreign bodies in the posterior part of the globe in the way described previously.

On the other hand, the Ring Magnet we have is of less power than the Haab at a neighbouring ophthalmic centre, which is a distinct disadvantage. We have no certain knowledge whether this disadvantage is overcome in the latest type of Ring Magnet. We have several times found after removing an eye which clearly called for it, and which had proved negative to the magnet, that it has contained a foreign body, which on testing afterwards was magnetic to a varying degree. Such foreign bodies were usually either feebly magnetic or were engaged in blood clot or exudate or were far back in the globe.

We have no means of judging whether some of the cases which we have sent home marked negative to magnet may, perhaps, have proved positive to a Haab.

In two or three cases of feebly magnetic foreign bodies we have watched, either by the ophthalmoscope or by oblique illumination, a fragment move slowly towards the magnet when it was applied and fall away as slowly when the current was broken.

Occasionally a needle-shaped foreign body will come forward and impact itself in the cornea so that it remains in this position after the break of the current. In these cases a curious physical phenomenon occurs, which when first seen is rather striking. As the terminal of the magnet is moved across the cornea, the foreign body tilts in the opposite direction, the point remaining impacted in the back of the cornea. This is explained by the fact that the long axis of a magnetizable body tends to turn in the direction of the lines of force when brought into a magnetic field.

It is for this reason also that steel fragments, when removed by the magnet, fortunately come out lengthwise instead of broadside on.

On several occasions we have seen a small foreign body come forward from behind and remain as if adherent to the front of the lens for quite an appreciable time. It has then suddenly come forward to the cornea, as if it had been previously held against the capsule of the lens perhaps by some fine exudate. It was clear that the foreign body was not under the lens capsule, it came forward too easily and quickly, and in one case five days later the lens was perfectly transparent except for the presence of a Vossius ring. If this observation could be confirmed in other similar cases, it might add some weight to the theory that the ring is due to an exudation on the lens capsule.

We have seen one case only of siderosis. This was in a man who had been wounded five months previously. It was the siderosis which especially suggested the need for applying the magnet, and a fragment of iron was removed.

In two cases we have seen the presence of an intra-ocular foreign body associated with a fixed and semidilated pupil which was not

explained in any of the usual ways, a condition which has been pointed out by Tuckett (*British Journal of Ophthalmology*, February, 1918.)

SIDEROSIS BULBI

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In the *BRITISH JOURNAL OF OPHTHALMOLOGY* for February there appeared a communication by Ivor Ll. Tuckett, M.D., on "Siderosis Bulbi," in which the author concludes that iron salts have a selective action on the nerve terminals in the dilatator and constrictor muscles of the iris. This conclusion is based on the fact that in the case reported the pupillary reactions became abolished, and were later restored after removal of the foreign body.

About thirteen years ago I made the observation that the cells of the dilatator, and, to a less extent, those of the constrictor muscle also, become densely packed with iron pigment in cases of siderosis bulbi, more so, in fact, than any other cells in the iris. This observation I have confirmed many times since, and in a discussion before the American Ophthalmological Society in 1906, I made brief mention of the fact that the dilatator muscle has a marked affinity for iron. The accompanying photograph strikingly illustrates this fact. It is of a section stained in haematoxylin and eosin, in which all of the natural pigment has been bleached by a modification of Alfieri's method.* Why such an evident condition has been overlooked by other observers is difficult to understand. From my observations, therefore, it would seem that the impaired motility of the iris in siderosis bulbi is not due to selective action on nerve terminals, but to impairment in function of the muscles of the iris resulting from their affinity for iron. In advanced cases of siderosis, chronic iritis is set up, which no doubt also impairs the motility of the iris.

The ciliary muscle, I find, becomes pigmented only in the immediate vicinity of the ligamentum pectinatum. This may be due to the fact that fluid containing iron does not reach it elsewhere, or to the fact that owing to its different origin it has less affinity for iron than the iris muscles.

The author of the communication referred to seems to be under a misapprehension in regard to the pigmentation of the lens that occurs in siderosis bulbi, he assuming that in his case the siderotic

*VERHOEFF and FISHER.—An improved method of bleaching pigmented tissues.—*Arch. of Ophthalm.*, 1908, p. 561.