

affusion, hysterical fits and convulsive disease are frequently checked, and persons narcotized by opium or prussic acid are most speedily awakened. Water applied to the surface, whether in a continued and forcible stream, as a *douche*, or in the usual manner by means of the shower bath, frequently produces much benefit in diseases, general and local, acute and chronic. The case I have just related affords an additional example of the beneficial employment of this remedy.

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ART. XXII.—*An Inquiry into the Possibility of transplanting the Cornea, with the view of relieving Blindness (hitherto deemed incurable) caused by several Diseases of that Structure.* By S. L. L. BIGGER, M.B., L.R.C.S.I.

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ON leaving this country four years ago, Dr. Bigger proposed to himself several subjects for investigation, with a determination of bringing to bear upon them all the information he might be able to collect during his stay in the various scientific capitals of Europe. Among these subjects, that which chiefly engaged his attention was the melancholy condition to which persons are reduced, who labour under hopeless and irremediable blindness, from what has been termed incurable staphyloma. In pursuance of this intention, his first object was to inquire what foreign surgeons had accomplished with the view of repairing this defect; and on making a careful inquiry, he found that in France, Italy, or Egypt, (a country noted for the prevalence of destructive ophthalmia,) the idea of reparation was regarded as visionary, and nothing beyond mere palliation had ever been attempted. In Germany alone, the project which had occupied Dr. Bigger had been frequently considered, namely, that of *excising the morbid cornea, and replacing it by a healthy structure, taken from some of the inferior animals.*

The first place in which mention is made of this operation,

is in an inaugural dissertation by Moesner, published at Tübingen in 1823. From the results of his experiments, he was led to the conclusion, that, as the cornea would not unite with the surface from which it was cut, it would not *a fortiori* unite with any other. In 1824 F. Reisinger replaced the cornea, which he had removed from the eye of an animal, by another, and closed the lids by a ligature; adhesion took place; and in twenty days one half of it had become clear. The details of this operation are to be found in the Bavarian Annals for 1824, Tom. I. Stuck 1. The possibility of accomplishing this desirable object was, on the other hand, strongly denied in 1827, by Schön, in the 23rd volume of Rust's Magazin. It appears, however, that he did not institute a single experiment. Drolshagen of Berlin attempted the operation twice, without success, in 1834; the transplanted cornea united only partially, and became more or less shrivelled and opaque; as also happened in the experiments of Himly and Stilling. It failed, too, in the hands of Dieffenbach, a surgeon justly celebrated for his ingenuity and success in various kinds of reparative operations. He was of opinion that the foreign cornea would not adhere, or if it united, that it would become so turbid and opaque as to be wholly unserviceable. His experiments, and those of Himly and Stilling, are to be found in the first volume of Ammon's *Zeitschrift für Ophthalmologie*.

Dissatisfied with such conflicting opinions, Dr. Bigger determined to put the matter to the test of experiment, and accordingly commenced a series of investigations on the subject, to which he was still further encouraged by meeting with an inaugural thesis, published by Wilhelm Thomé, a candidate for the degree of Doctor, in the Friedrich Wilhelm University on the Rhine, in which eight experiments are detailed, all followed by very considerable success.\* Dr. Bigger gave a full trial to the

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\* The first time Dr. Bigger had an opportunity of trying this experiment on one of the inferior animals, occurred in 1835, at a period when he was a prisoner

plan proposed by Thomé, but does not approve of it. The knife employed by Thomé, which is spear-shaped and double-edged, does not answer the purpose for which it is intended, namely, that of cutting off the cornea with a single incision, both edges of the instrument acting simultaneously. It is moreover likely, from its shape, to endanger the iris ; and is even inferior to the knife used by Beer in the operation for the extraction of the cataract.

This, and several other knives of his own invention, were tried by Dr. Bigger, but ultimately rejected as deficient in some important requisite. At last by adopting a new modification of the operation, Dr. Bigger succeeded in rendering the removal of the cornea a safe operation, and easily practicable by a steady and dexterous hand. Having fixed with a ligature the upper eyelid of the animal from which the cornea is to be taken, he introduces Beer's cataract knife (holding it horizontally, and at first directing it a little backwards, so as to insure its passing through all the layers of the cornea,) with its edge turned upwards, into that part of the cornea situated about a line or more from its most inferior junction with the sclerotic, and about the same distance external to the mesial line of the eye. He then pushes on the knife for the space of one or two lines, inclining the handle, so that the point of the knife may be brought forward, and caused to pierce the cornea again, at a distance as small as possible from the point of entrance. The knife should now be pushed on, when it will make as large a section as may be required, which being turned down, is to be cut off with a

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with a Nomadic tribe of Arabs, about twelve or fourteen days' journey from Grand Cairo. The subject of the operation was a pet gazelle, who had lost one eye from inflammation, and the power of seeing with the other, from a wound of the cornea. The cornea was taken from another animal of the same species, brought in wounded, but not quite dead ; adhesion took place, and ten days after the operation the animal gave unequivocal signs of vision, the upper part of the transplanted cornea remaining perfectly transparent.

pair of scissors. The eyelids are then to be closed, to prevent the escape of the crystalline lens and vitreous humour. The excised cornea should be placed on a slip of cork, and the curved needles, carrying very fine ligatures, (two, three, or four in number,) should be passed through the cornea and the piece of cork. The latter, which has been chiefly used as a support to enable the operator to pass the needles through the tough layers of the cornea, should then be broken off, and the cut surfaces of the cornea should be kept moistened with some of the secretion from the eye. The surgeon then proceeds to perform the same operation on the eye to which the cornea is intended to be transplanted. Having done this, and closed the lids for a few moments, until the spasmodic action of the muscles of the eye diminishes, the operator proceeds to adapt the cornea to its new situation, and for this purpose, inserts the point of his needle carefully between the margin of the now prolapsed iris and the remains of the cornea, and pressing externally with the nail of the other forefinger against the point of the needle, so as to make it pass through the cornea without dragging or injuring the eye, draws out the needle. To accomplish the latter object, Dr. Bigger was often obliged to use a small forceps, and in this case, the thumb and finger nails of the other hand must be pressed closely and firmly against the cornea on either side of the needle, to obviate any injurious disturbance or dragging of the eye. The ligatures should then be carefully tied, and the ends cut off. Dr. Bigger has found two ligatures to answer the purpose quite as well as four. Finally, the operator clears away any lymph or blood which may have collected on the eye, and concludes the operation by smearing the eyelids with a little spermaceti ointment.

In operating upon animals, the chief difficulty arises from the struggles of the animal; even the slightest motion perils the integrity of the iris. This accident frequently occurred in Dr. Bigger's experiment, and he acknowledges, that if the operation were brought to bear on the human subject, the iris would be

in very great danger, in cases where opaque albugo intervened between the edge of the knife and the operator. Besides slight motion on the part of the patient, or any unsteadiness on the part of the surgeon, might cause either injury of the iris, or the slipping out of the knife, so that the cornea could not be separated with a single stroke. In the latter case Dr. Bigger thinks it would be highly injudicious to proceed with the operation.

The mode which Dr. Bigger has employed for securing small animals, such as marmots, rabbits, &c., is to enclose the animal in a box, with a hole just large enough to let the head pass through. A much better way, however, particularly in the case of small animals, is to swathe the animal in long towels, which are to be brought rather tightly around the neck, to prevent the escape of the fore feet. The animal is then to be secured by an assistant holding it against his breast, with the croup and hind legs under his arm, whilst, with both hands, he can fix the head by the ears and chin.

In November, 1835, shortly after his return from Egypt, Dr. Bigger operated on two rabbits by a mutual transplantation. In these operations three ligatures of fine silk were employed. In both the lens escaped, and the iris was injured. There was great inflammation and tumefaction of the conjunctiva, so as to render it difficult to find the ligatures, which were removed forty-eight hours after the operation. At this period the cornea was adherent at the points where the ligatures had been applied, leaving small lacunæ on either side, filled with white coagulated lymph. In these experiments Dr. Bigger secured the eyelids with a ligature, with a view of preventing the animal from scratching or rubbing the eye, but found that this only added to the inflammation by confining the discharge; and he afterwards ascertained that the precaution was wholly unnecessary, as the pain caused by touching the inflamed parts is sufficient to prevent the animal from using any injurious violence.

Eighteen days after the operation, the implanted cornea appeared whitish and opaque, and large red vessels could be seen

passing from it to the adjacent cornea. The iris was considerably inflamed and irregular, and the aqueous humour was turbid, and in quantity beyond the normal amount. On the twenty-fifth day the inflammation was considerably diminished; the cornea was much contracted, a circumstance which occurred in many other cases; but the opacity had cleared away at many points, particularly at the superior portion of the cornea. On the thirtieth day violent inflammation occurred in one of the rabbits, without any evident cause, and terminated in a copious deposition of puriform lymph in the anterior chamber. At the end of ten days it subsided, and Dr. Bigger found that the eye in this rabbit was not at all injured thereby, but was rather clearer than that of the other, which had gone on improving. In both there were some spots of the cornea perfectly clear; and it was plain, from the motions of the animals, that they could see, although evidently not distinctly. In running to take food presented to them, they seemed to be incapable of accurately calculating the distance of the object, a defect which Dr. Bigger is inclined to attribute to the loss of the lens. The lymphy deposition in the anterior chamber of the eye which had suffered from secondary inflammation, became in a great measure absorbed; and what remained floated about loosely, and did not interfere with vision. On the fiftieth day, the cornea was still farther contracted, but perfectly pellucid in the centre, and surrounded by the appearance of an irregular ring, which marked the situation of the cicatrix. No further improvement taking place, the animals were killed on the sixtieth day.

Dr. Bigger's next experiment consisted in removing the corneæ from six rabbits. Two of them were immediately replaced on the eyes from which they had been taken, the other four were mutually transposed. In two the iris escaped injury, and these were the cases which succeeded best; in those to which their own corneæ had been restored, the iris became adherent; and in one, the pupillary opening became perfectly closed, so as to require an operation for artificial pupil. In

one of these cases the success was very remarkable; vision was much more perfect, and there was less contraction of the implanted cornea. In all, however, the animals continued to enjoy more or less power of vision.

About this period, Dr. Bigger became acquainted with the method pursued by Wilhelm Thomé, and performed with his knife, an operation on a pointer dog which had an opacity of the cornea from injury. The implanted cornea in this case was taken from the eye of a wolf. Two ligatures only could be applied in consequence of the struggles of the animal, and two days afterwards the dog made his escape to the woods. From this period, nothing was heard of him, until at the end of three months, when he returned in a half famished state, but with a very remarkable power of vision in the eye which had been operated on; a triangular cicatrix, about one-fourth of the size of the original piece, was almost all that remained, and very little of this cicatrix intruded upon the axis of vision. It appeared as if the transplanted part in contracting had drawn the clear cornea of the side forward, so that although the operation had only a partial success, it furnished a useful hint with respect to the general success of the undertaking: viz. the advantage derived from removing no more of the diseased cornea than is absolutely necessary, as the sound portion which remains may enact a very useful and important part in the reparative process. In this case, the iris was attached to the inferior angle of the cicatrix. Dr. Bigger has observed this in many of his experiments, and attributes it to the predominance of inflammation in the inferior part of the eye, a fact which he has noticed on numerous occasions.

On his return to Dublin, Dr. Bigger commenced his experiments anew; of these, he has now performed eighteen. The subjects of the first and last, two rabbits, were presented before an evening meeting of the King and Queen's College of Physicians, on the 18th of May last. They were examined with great interest by the members and visitors present, and the

degree of vision which one of them evidently possessed, reflects the highest credit on the ingenuity, patience, and manual dexterity of the scientific operator. The results of these eighteen experiments were: in ten, the iris was injured; in eleven, the crystalline lens escaped; in seventeen, union took place between the implanted corneæ and the adjacent surfaces in forty-eight hours, so as to admit of the withdrawal of the ligatures, which are always a great source of irritation; in four, three ligatures were employed; in fourteen, only two, and with equally favourable results; in twelve, adhesion of the iris to some part of the cicatrix ensued; in one, sloughing of the cornea and destruction of the eye took place, an event which arose from the cornea being kept for half an hour without applying it, with the view of ascertaining how long it would be likely to retain a sufficient degree of vitality to enable it to unite. Dr. Bigger is inclined to think, that, generally speaking, a delay of this space of time would be prejudicial to the success of the operation, and that it may be always avoided by common dexterity on the part of the operator. Of the whole eighteen experimented on, sixteen recovered imperfect vision.

The difficulty of performing the experiment in such a way as to afford a chance of preserving the transparency of the implanted cornea, was a source of much disappointment to Dr. Bigger, and for a long period he could not succeed in devising any means for this purpose, until after his eighth experiment at home, when he discovered that much benefit might be derived from the local application of bichloride of mercury. A weak solution of this salt, gradually increased to the extent of three grains to the ounce of distilled water, and dropped into the eye three or four times a day, after the cornea had become adherent, was found by him to exercise an almost specific action in diminishing the opacity of the implanted cornea. He had made several trials with iodine and the nitrate of silver, but found that although they improved the appearance of the cicatrix, they did not appear to act upon the milky state of the



cornea. The only caution necessary to be observed in using the corrosive sublimate is, to begin with a weak solution of it, and not to use it until the implanted cornea is perfectly united to its new connexions.

Dr. Bigger exhibited to the meeting two rabbits, one of which had been treated with the bichloride of mercury, the other had been left to nature ; in the latter case nine months had elapsed since the performance of the operation ; in the former, only ten weeks. These animals, as has been already stated, were the subject of his first and last experiments at home, and were calculated to show the improvement made in the mode of performing the operation. The difference between them was very remarkable. The eye to which the bichloride of mercury had been applied, seemed to possess a distinct and perfect power of vision ; and there was nothing to indicate the existence of a transplanted cornea, but a slight line in the situation of the cicatrix, and some degree of conicality in the cornea. To enable himself and the meeting to judge more accurately of the power of vision in this animal, Dr. Bigger had destroyed the opposite eye. In the other animal vision was very imperfect, not so much from opacity of the cornea, as from the condition of the iris and the deeper-seated tissues of the eye. The cicatrix in this case was large, dense, and of a somewhat triangular form.

With reference to the applicability of the operation to the human species, Dr. Bigger observed, that he thought that in man the chances of success would be greater, at least so far as steadiness during the operation, avoidance of injury, and other obvious circumstances might contribute to that desirable end. With respect to the animal from which the cornea would be taken in the case of the human subject, Dr. Bigger has not yet decided, and invites the attention of comparative anatomists to this point of the investigation. The animal whose cornea he has found to make the nearest approach to that of man is the pig ; it is, however, much thicker and coarser in its texture. In a spirit of just and humane feeling, he deprecates the removal of

the cornea from the human eye, even when permitted for gain by the possessor ; but thinks that a person afflicted with incurable amaurosis might be prevailed on to part with his pellucid cornea, which might be replaced by one taken from some of the inferior animals. He thinks, however, that the operation should not be sanctioned under any circumstances, when the patient enjoys even a tolerable degree of vision with the other eye, at least until our knowledge has been increased by further experiments and observations. He is of opinion that cases of blindness caused by small-pox, ulcers on the cornea, and ophthalmia not affecting the deeper structures of the eye, would be the most favourable for operation. Dr. Bigger concluded his interesting memoir by imploring hospital surgeons to give the matter their attentive consideration, particularly as experiments and analogy had shown the feasibility of the operation.

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ART. XXIII.—*Observations on Excision, particularly on Excision in the Middle of the Hand and Foot, and of the Phalanges of both.* By DR. GERNET, Assistant Surgeon to the General Hospital at Hamburg.

[Translated from the *Zeitschrift für die gesammte Medicin*, by S. L. L. BIGGER, M. B., L. R. C. S. D.]

It is an extraordinary circumstance, that the latter times, which have produced the fairest blossoms on so many branches of surgery, should (particularly in Germany) have bestowed so little attention on the excision of diseased joints.

Many of our most distinguished surgeons have spoken unfavourably of excision, and yet only a few have engaged themselves practically with it, a circumstance necessary to obtain a satisfactory result, and to enable any one to deduce a rational decision from it; as a method of operation.

The wish to publish a short commentary on those cases