The modern operations for cataract : being the Lettsomian Lectures for 1884 / by Robert Brudenell Carter.

THE

MODERN OPERATIONS

FOR

CATARACT;

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LETTSOMIAN LECTURES FOR 1884.

BY

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PREFACE.

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THE MODERN OPERATIONS FOR CATARACT.

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WHEN I first became acquainted with the honour which had been conferred upon me by the Council of the Medical Society of London, by my election to the office of Lettsomian Lecturer, my thoughts naturally ranged over the whole field of ophthalmic surgery, in search of some topic which might furnish me with sufficient material for discourse. I have been able to discover nothing of greater promise than the operative treatment of the cataract of advancing life, an affection which still levies its annual tribute of victims, and which the advances of therapeutical science have done nothing either to prevent or to cure. In the character of the malady itself there is something which appeals with irresistible force to our most kindly sympathies. At a period of life when the physical powers are beginning to decay, when the approach of old age is making itself felt by the gradual curtailment of all pleasant activities, and when the

resources afforded by vision are therefore relatively increased in value and importance, these resources are themselves threatened by a degeneration of such gradual progress that its oncoming cannot be overlooked by the sufferer; to whom it brings home the anticipation of loss of sight, in a manner so forcible as to become almost as distressing as the reality. At a period not far distant in actual time, even although, when measured by the growth of modern improvement, it may now almost be called remote, it was held as a canon of surgery that no operation for the removal of cataract should be performed while the state of the patient admitted of being made worse by failure; and the long misery of suspense, which this practice entailed upon numbers of people, received but a poor compensation from the completeness of the relief which, in cases of favourable issue, was eventually afforded. The operation for cataract was occasionally brilliantly successful, and was frequently followed by great improvement of sight; but yet, in a deplorable proportion of cases, it led only to complete and irremediable failure. For reasons which I will presently assign, I do not think that any of the statistics of cataract operation prior to the introduction of the ophthalmoscope can be regarded as quite trustworthy, or can be used with entire satisfaction as the basis of a comparison between former times and the present; but it was a common estimate, when I commenced the practice of ophthalmic surgery, in 1859, that about 15 per cent. of all extraction cases ended in total loss of sight, and that in about 25 per cent. more the results were imperfect, leaving only about 60 per cent. of the whole which were fully satisfactory. There can be no doubt that the average results of the present

day are greatly better than this ; and also that we have gained in a direction almost equally important to our patients, by being able, with safety and propriety, to operate at a much earlier period than was formerly customary, and thus not only to deal with younger and stronger people, but also to relieve these people from anxiety about the issue before the defect of sight amounts to actual incapacity. It will be my endeavour, on this and subsequent evenings, to trace out the steps by which these improvements have been attained, and the extent to which they have been carried ; and I trust to be able to establish the position that ophthalmic surgeons have not only profited by the better means of exploration and diagnosis of which they have in recent years become possessed, but also that they have laboured with zeal and success to keep pace with the advances which have been made in general surgery, and to render their treatment of long familiar conditions more successful than heretofore. The assertion that ophthalmology has been revolutionised as a branch of science is one the truth of which will be universally admitted ; but the assertion that it has also been revolutionised as a branch of surgery is one which some among my hearers may regard as still requiring the support of evidence. If such there be, I will do my endeavour to satisfy them.

I have just said that none of what may be called the earlier statistics of cataract extraction appear to me to be satisfactory ; and I am afraid that I must extend the remark to some of more recent date. Prior to the use of the ophthalmoscope, the diagnosis was extremely difficult and uncertain ; and I have no doubt that many of the instances of reputed failure were not cases of cataract at all. If we turn to any moderately old treatise

upon the subject, we shall find elaborate rules for distinguishing cataract from glaucoma, the real or supposed differences between them, but more frequently the latter, being placed in parallel columns for the purpose of ready comparison ; and it is impossible but that errors must have been of frequent occurrence. Even now, I sometimes see cases in which, but for the help afforded by the ophthalmoscope, I might possibly feel some doubt ; and, as a matter of fact, I was once asked by a London physician, well known to many of us, to perform extraction for a lady whose lenses were as transparent as his own, and in whom the appearances by which he had been misled were produced by the character of the light-reflection from the fundus of the eye. When we come to more modern times, this source of error no longer exists, for the cloudiness or transparency of the lens can be determined with the ophthalmoscope almost by a glance ; but we have been brought face to face with conditions of a totally different order. We have been in the presence of unquestionably improved methods, and in the presence also of a vast number of small modifications in points of detail, each suggested by some operator, often of very limited experience, who claims to have improved the operation of extraction by its means, who wishes what he is perhaps pleased to describe as "his" method to be called after his name, and who is almost bound to justify his claim to have effected an improvement by publishing better statistics than those of his contemporaries or of his predecessors. In England there has been little or nothing of all this ; but in some countries a good deal, and the foreign constructors of statistics have well-nigh come to occupy the position of the manufacturer who adopted, in the furnace of his

steam-engine, all the patented contrivances for diminishing the expenditure of fuel. He adopted the improvement which saved fifty per cent., and the improvement which saved forty per cent., and the others which saved thirty, twenty, and ten, respectively ; until at last he not only ran his engine for nothing, but actually derived a handsome income from the payments made to him by coal dealers as a recompense for keeping it going. In like manner, a due regard for accuracy would certainly compel some of the originators of improved methods to confer normal vision upon three eyes for every two upon which they were called to operate. As a matter of fact, however, they hardly go so far as this ; and some of the gentlemen whose exploits are chronicled in other lands are so modest that they profess to fall short of a perfect result in at least one per cent. of their cases. Their scrupulous veracity reminds me of the American sportsman, who related how he had killed 999 wild ducks by a single discharge of a swivel gun ; and who, when asked why he "did not say a thousand at once?" replied that he "would not peril his immortal soul for the sake of one duck!" I feel strongly that the time has come for an endeavour to explode some of the pestilent nonsense which has been talked and written on this subject. The operation of extraction has, no doubt, been greatly improved in directions which have added much to the general proportion of success. The fact remains that the patients on whom it is performed are, upon an average, seventy years old or more; and that the opacity of the lens is itself a degenerative change which indicates failure of nutrition. It will be associated, in a considerable number of instances, with failure of nutrition in other directions also, with arterial degeneration, with cardiac

weakness, or with renal inadequacy ; and these conditions must militate against the completion of the processes of repair which are essential to the success of any operation, be it what it may. We may be fairly content to have attained to methods of procedure which reduce the demand upon the reparative powers to the lowest point ; and we cannot expect to operate without having any demand at all, or that this demand shall invariably be responded to in the right manner and at the right time. An operator who aimed at a very large percentage of success would have to select his cases with extreme care ; and to do this would be to refuse relief to numbers of patients who ought to have at least the chance of obtaining it. Even when the selection had been made, he would still be exposed to a class of occurrences which can only be described as accidents, to accidents from vomiting, to accidents from intra-ocular hæmorrhage, to accidents from spasm of the recti muscles ; and some of these things would now and then turn the scale against him. It is far better, in my judgment, because far more truthful and more manly, to admit that in the extraction of cataract, as in every other human undertaking, "time and chance happeneth to all." The prospects of success are sufficient to afford great encouragement to patients ; the prospects of failure are certainly such as to require to be taken into account.

Among recent statistics which strike me as being reasonable and trustworthy, although in some respects very incomplete, I may mention those furnished by the annual reports of the New York Ophthalmic Institute. Taking the last two years, these reports show a total of 144 operations, by Von Graefe's method, for the extraction of senile cataract. The results are stated to have

been "good" in 128 cases, or 88·9 per cent.; "moderate" in 12 cases, or 8·4 per cent.; and "failure" in 4 cases, or 2·77 per cent. The value of the figures is much diminished by the absence of any statement of the precise quality of the vision which is described as "good" or "moderate" respectively; so that cases may have been included in the former category which would by some surgeons have been relegated to the latter, and cases which were hardly distinguishable from failures may have been described as moderately successful. It is safe to assume, however, that, out of 144 eyes, 140 were left in an improved condition by the operation; and that in only four was the sight irretrievably lost.

The analogy may at first sight appear to be a somewhat strained one, but the improvements which have been effected in the extraction of cataract often remind me of those which have been effected in the operation of ovariotomy. In the latter there is, of course, a question of mortality which does not complicate the former; but, otherwise, the resemblance between the two histories is very close indeed. In both of them the efforts of the surgeon are directed to the removal of a substance from within a closed cavity, which is liable, when wounded, to become the seat of severe inflammation; and in both an increased measure of success has been attained by the careful observation and study of all circumstances which tend towards an unfavourable issue, and by bringing these circumstances under control. In both a main feature of the improvement has been the diminished size of the external wound, together with the adoption of precautions for rendering the absolute exit of that which is taken away a process less irritating or injurious to the textures through which the removal is effected. The

antiseptic methods which, according to some operators, have exerted a favourable influence upon ovariotomy are not available, or only in a very limited degree, in cataract cases; but the general conditions by which healing is promoted require to be equally borne in mind in the management of both. The details of ovariotomy are familiar to all who hear me; and I think an outline sketch of the differences between ancient and modern cataract extraction will fully bear out what I have ventured to assert with regard to the resemblance which exists between the two kinds of surgical improvement.

For about one hundred and ten years prior to 1860, the method of cataract extraction had remained substantially unchanged. It was the operation of Daviel, modified only by the introduction of Beer's triangular knife to supersede that which Daviel had originally employed; and it displaced the still earlier operation of depression or couching, in which the dislocated lens was apt to act as a foreign body, and to set up destructive inflammation after a longer or shorter period of time. In Daviel's operation, which of late years has been commonly distinguished as "flap" extraction, the knife was introduced through the cornea, on its horizontal meridian, about one millimetre in front of the corneo-scleral junction, and was carried across the anterior chamber, with the cutting edge either directly upwards or directly downwards, and with the plane of the blade parallel to that of the iris, to a corresponding point on the opposite side of the cornea, at which it was brought out again by a counter-puncture, and was then pushed straight on so as to divide the whole of the tissues between the wound of entrance and the wound of exit. When this was correctly done, the result was a semi-circular section of

the cornea, concentric with, and about a millimetre within, its actual periphery, so that the greater part of its upper or lower half was detached in the form of a flap; and the triangular shape of the blade, which always filled its own wound as it advanced, permitted the aqueous humour to be retained until the section was almost completed. The next step was to divide the capsule of the lens by a curved needle introduced through the wound, and the next was to press out the lens, which had first to stretch and pass through the natural pupil, and then to emerge from the eye through the corneal section. When all this had been accomplished, the lids were closed, and, as a rule, were not opened for any purpose of examination until after the lapse of from five to seven days.

Even after the introduction of anæsthetics, they were but seldom employed in flap extraction, chiefly because the large size of the external wound rendered vomiting an extremely dangerous occurrence; and one consequence of the want of them was that accidents were frequently produced by the unsteadiness of the patient. The eyeball was originally not fixed or held, but only supported against the knife by the fingers of the free hand of the surgeon; and hence the precise line of incision was in a great degree dependent upon the conduct of the patient. If he struggled or rolled the eye upwards, the points of puncture and of counter-puncture and the line of section were liable to be misplaced, the former being either too high or too low, too near the centre of the cornea or too near the sclerotic, and the latter either too far forward or too far back, thus either encroaching too much upon the cornea or entering upon vascular tissue beyond its margin. From the same cause there was frequent failure

to retain the aqueous humour for a sufficiently long period; and, when it escaped prematurely, the iris was apt to fall over the edge of the knife, and to be wounded more or less severely. The pressure by which the cataract was extruded often caused the extrusion of more or less of the vitreous body; and many other accidents, too many indeed to enumerate, were prone to occur.

Of these several accidents there was scarcely one which was not calculated to impair, while many were calculated to destroy, the character of the result. If the patient were unsteady, one of the first consequences was likely to be a misplaced counter-puncture. When this was made too low, so that more than half of the cornea was severed from its attachment, the exit of the lens was facilitated, but at the same time the risks of loss of vitreous, and the risks of sloughing of the cornea, were increased. When the counter-puncture was made too high, or too far forward, the corneal section would probably be too small for the free exit of the lens. The operator was armed against this contingency by an apparatus of "secondary knives," "right and left-handed scissors," &c., &c., for the enlargement of the section; but the results of being compelled to have recourse to these weapons were often disastrous. When correctly performed, the operation was bloodless; but, if the iris were wounded by falling over the edge of the knife, or if the corneal section were carried too far back, so as to trench upon the corneo-scleral junction and to divide vessels, in either case the anterior chamber became filled with blood, which obscured the pupil, and rendered the subsequent steps difficult and uncertain. If the upper part of the corneal section descended too low, in consequence of the edge of the knife being directed forwards,

not only was the wound likely to be too small for the exit of the lens, and thus, by calling for increased pressure, to promote the loss of vitreous, but it was also liable, in cases which otherwise terminated favourably, to occasion distortion of the corneal curvature by the contraction incidental to healing, and thus very seriously to diminish the resulting acuteness of vision. Loss of vitreous was always a grave disaster. Whenever it occurred, it lifted the iris between the lips of the wound, and was followed by iritis and closure of the pupil. In a certain proportion of such cases, more or less vision could be ultimately restored by a subsequent operation for artificial pupil; but, in the majority, a period of much suffering was the prelude to complete extinction of sight.

When all these shoals and quicksands had been avoided, when the corneal section had been correctly made, when the capsule of the lens had been divided without injury to the iris, and when the lens had been pressed out without either loss of vitreous or protrusion of the iris into the section, the risks of failure were by no means set aside. The eye was closed, the lids being generally fastened together by a strip of plaster, and it was not opened again for some days. About forty-eight hours after the operation, it was not uncommon for the lids to be a little swollen, and for a small amount of muco-purulent discharge, which rapidly assumed a purulent character, to make its appearance at their edges These symptoms were, almost without exception, the precursors of suppuration of the eyeball, terminating, of course, in total destruction of the organ, which, after many days of acute suffering, shrivelled into a sightless button in the bottom of the orbit. Very little was

known about the origin of the changes which led to so disastrous a termination ; for the rule of practice was to abstain from any examination of the eye until either fair success or total failure was sufficiently declared. It was believed that to separate the lids during the first two days would add to the risks of suppuration ; and surgeons were content to learn that all was well from the absence of eyelid swelling ; while, if such swelling occurred, they were fearful of aggravating the mischief, or of destroying any prospect of partial recovery, by an inspection of the inflamed tissues. The feeling was that it was better for the patient, and an addition to his chances, whether these were good or bad, that his eyelids should rest undisturbed ; and, as the surgical traditions of this country place the welfare of the patient before every other consideration, undisturbed they were suffered to remain.

It is perhaps possible, however, for even a sound principle to be carried too far ; and this one, in the case under consideration, was carried to the extent of depriving surgeons of all opportunity of observing the initial stages of mischief of a very grave character. Von Graefe was the first operator who departed from the accepted routine ; for, being wishful to know why some eyes underwent suppuration, while others escaped, he adopted the practice of opening every eye daily, after extraction had been performed, so as to observe the first signs of suppuration and the precise locality in which they occurred. He succeeded in establishing two distinct varieties of the process, if so they may be called ; or, at all events, two distinct classes of cases. In one, the initial phenomenon was iritis, commencing at the portion of iris opposite the section, at the part,

in short, where the iris was most exposed to suffer bruising or compression during the exit of the lens. In cases of the other class, the initial phenomenon was necrosis of the cornea, produced by its extensive severance from the sources of its nutrition. There were, therefore, two possibilities to combat, the plastic inflammation, which, in the recently wounded eye, always led on to suppuration; and the direct necrosis which produced the same effect. As soon as Von Graefe's results were made known, and before he himself made any attempt to turn them to profitable account, Dr. Mooren, then of Crefeld, suggested that the risks of iritis from contusion might be diminished by the performance of iridectomy as a preliminary operation, to be followed by extraction after an interval of time; and he proceeded to put his suggestion into practice. His results were so excellent, that the pamphlet in which he published them was received, in Germany, with very general incredulity; insomuch that the author, referring to this incredulity in a second edition, made it a reason for publishing the name and address of every patient upon whom he had operated by his method, so that all who pleased might go and verify his statements. I may perhaps remark, in passing, that both the incredulity, and the means adopted to combat it, seem to me to indicate that the standard of scientific veracity is less high in certain foreign countries than among ourselves, and in some measure to justify the doubts which I have expressed concerning the trustworthiness of statistics with which the profession and the public have from time to time been favoured. However this may be, it soon became manifest, not only that Mooren had succeeded in diminishing the liability to iritis after extraction, but

that his method, by permitting the escape of the lens through a smaller external wound, had also served, in an indirect manner, to diminish the risks of corneal suppuration. The cases on which he laid most stress were some successful operations upon very feeble and emaciated old women, in whom sloughing of the corneæ would almost certainly have occurred, if they had been subjected to flap-extraction in the ordinary way.

Mooren's pamphlet reached me towards the latter end of 1862; and, in December of that year, I adopted his method, this being, I believe, the first time that it was used in England. The patient was an old man from whose right eye I had previously extracted cataract in the old-fashioned manner, and with complete success; so that I felt myself at liberty to use his left eye for what was then almost an experiment. There was a very general feeling, among those with whom I discussed the operation, that the quality of the visual result would be lowered by the iridectomy, as a consequence of the altered shape of the pupil; but I had the gratification of finding that this was not the case. The left eye made an excellent recovery; and the sight obtained from it was equal to that of the right eye, which had its iris unbroken, and its pupil central and circular. A single case could do nothing, of course, to prove the advantages of the new method of operating; but it did prove that the method was practicable, and that the result might be of the best kind. The interval between the iridectomy and the extraction, in my first case, was fourteen days; but it was ultimately found better, by the general experience of operators, to prolong this interval to about six weeks.

A sufficiently extensive trial of Dr. Mooren's method

may be said to have established three propositions:—1st. That the artificial coloboma iridis produced by the iridectomy afforded a safe way of exit for the lens, and that, by relieving the iris from injurious pressure, it to a great extent set aside the danger of iritis as a consequence of the final operation. 2ndly. That when the exit of the lens through the pupil was thus made easy, its ultimate exit from the eye could be effected through a smaller external wound than it had formerly been customary to employ, thus diminishing the dangers of corneal death as a consequence of the extensive severance of that membrane from the sources of its nutrition. 3rdly. That while the two principal sources of total and irretrievable failure were thus either set aside or greatly diminished, the visual results were nearly or quite as good as any which had been obtained, even in the most successful cases, from the employment of the old or prior form of the operation.

Mooren was speedily followed by other innovators, the most remarkable being Dr. Schuft, who afterwards assumed the name of Waldau, and who proposed to remove cataract by scooping it out of the eye with a little spoon, through a comparatively small wound at the corneal margin. Schuft published some statistics which induced other surgeons to follow his example; and the chief thing worthy of note about his method was that it was extensively tried at the Royal London Ophthalmic Hospital, and that both Sir William Bowman and the late Mr. Critchett thought sufficiently well of it, at one time, to make endeavours to improve the form of the scoop. Schuft's scoop was a small oval spoon, with a margin all round perpendicular to its base. Sir William Bowman did away with the margin,

excepting at the tip of the spoon, and there had it carried forward into a sort of point, as if to glide under or behind the lens more easily. Mr. Critchett also limited the margin to the front part of the spoon, but had it brought backwards towards the handle, in a fashion roughly resembling the toe of a slipper, or the barb of a fish-hook, as if to give it a better hold upon the further margin of the lens when in course of withdrawal. These modifications were not very important, but they were sufficient to show that English surgeons were from the first dissatisfied with the form of Waldau's instrument, although at one time prepared to admit the soundness of the principle on which it was based. Experience soon showed, however, that the method of "outscooping" was beset by many dangers ; and, after a comparatively short trial, it was abandoned even by most of those who had at first been its advocates. Coincidently with the general distrust of its value or safety came the announcement that Von Graefe was engaged upon the development of a new form of operation, from which great results were being obtained ; and, after a short period, a description of this, under the name of "modified linear extraction," was given to the world. Von Graefe's plan essentially consisted in making an iridectomy the first step of the operation, instead of, as Mooren had done, a preliminary and distinct proceeding, and in placing his section in such a manner that the line of wound was entirely outside the cornea, and in a plane which would pass through the centre of the sphere of which the cornea forms part. In his first attempts, he removed the lens by means of a small curved hook ; but experience taught him to refrain, as much as might be possible, from the introduction of any form of traction instrument within

the eye, and he ultimately brought out the lens by pressure alone, exercised below the cornea or upon its lower part, and assisted by a simultaneous gliding pressure upon the posterior lip of the wound with the back of a thin scoop, this gliding pressure being described by him as the "schlitten-manœuvre." Its object was not only to open the wound by holding back its posterior lip, but also to tilt the edge of the lens forwards, and so to assist it to clear all impediments to its free exit. As time went on, we heard less and less of the "schlitten-manœuvre," and more reliance came to be placed upon judiciously exercised direct pressure, made upon the lower part of the cornea by the back of a whalebone or tortoiseshell spoon, which was made to follow the issuing lens upwards as it passed through the section.

Von Graefe's section was made by puncture, counter-puncture, and division of the intervening bridge of tissue, by means of the slender straight knife now so widely known by his name. The centre of the section was just outside of the corneal margin, while its extremities were separated from this margin by an appreciable interval; and one advantage claimed for this situation was that the wound had no tendency to gape, but that its edges fell spontaneously into contact, and were placed in tissue possessing sufficient vascularity to promote rapid and easy healing. On the other hand, it was before long rendered manifest by experience that the situation, whatever might be its advantages, had also its peculiar dangers. If the section were at all unduly prolonged, or if either the puncture or the counter-puncture were placed at all too far back, the extremities came distinctly into the ciliary region, to which, indeed, they were always perilously near; and it

is well known that wounds of the ciliary region have been fertile sources of sympathetic ophthalmia. Cases of this kind following upon extraction were before long reported; and I well remember, on seeking a consultation with Sir William Bowman concerning the first of these which occurred in my own practice, and on remarking to him that I had not seen one previously, his reply to the effect that he wished he could say the same. After awhile it came to be distinctly recognised, by those who had frequent opportunities of operating, that while a truly corneal section always involved more or less danger to the eye from sloughing or necrosis of that membrane, so a section entirely posterior to the cornea involved its own peculiar risks of plastic inflammation, with a possibility of extension to the sound eye. This contingency was, I need hardly say, even more serious than the other; and surgeons generally began to return towards the corneal section. It is surprising, within the narrow limits of the available space, how many differences in the precise position of the incision have been described, if not actually accomplished in practice; for it is one thing to lay down a line upon a diagram, and quite another to adhere strictly to it in the actual conditions of the operating couch. The late Mr. Critchett, with the happy practicality which was so conspicuous among his great merits, was at one time accustomed, whenever he was able to operate upon both eyes at once, to make a corneal section in one of them, and a section slightly posterior to the cornea in the other. He held, doubtless with much correctness, that the circumstances which determined the occurrence of unfavourable results were possibly as much constitutional as local in their character, and that any individual

patient was not likely to suffer, at the same time, from necrosis and from plastic inflammation. By making in one eye a section which had its chief risks on the side of necrosis, and, in the other, a section which had its chief risks on the side of plastic inflammation, he thought himself able to make almost certain of a good result in one or in the other; and, in carrying out this practice, it is manifest that he would generally be rewarded by a good result in both. As a corollary to this reasoning it follows that, as a rule, when an operation upon one eye has been unsuccessful, we should endeavour, in operating upon the second eye, to profit by the experience gained from the first, and to modify the procedure accordingly.

Another method which must not be overlooked was that of Pagenstecher, who advocated the extraction of the lens in its unbroken capsule. His plan was to make a rather large section, with a broad lance-knife, at the lower and outer margin of the cornea, and an iridectomy of equal magnitude, and then, in some cases, the lens may be extruded, still within its capsule, by gentle pressure from the side of the corneal margin most remote from the incision. This only happens, manifestly, when the tenacity of the lens-capsule is greater than the strength of its attachment to the hyaloid membrane behind it; for, if the latter be the stronger, one of two results must follow. Either the hyaloid becomes ruptured at the zonule, and vitreous humour escapes before the lens, or the capsule itself yields to the pressure, and the lens escapes through the rent in the ordinary way. The latter event does not place the eye in any peril; and it permits the accomplishment of a successful ordinary extraction, the visual results

of which are perhaps rendered somewhat less good than they might be by the large size and the downward position of the coloboma iridis. When the vitreous escapes, the consequences are more serious. Not unfrequently the capsule yields also, and then the best attainable result is to leave behind in the eye more or less of the cortical substance, entangled by the more viscid vitreous body. Frequently, however, the lens shows no tendency towards emergence, but is rather inclined to recede within the eye as more and more vitreous passes away through the section. When this occurs, the surgeon has no alternative but to lift out the lens with a spoon, which the originator of the operation contrived for the purpose. Even then, the amount of vitreous lost is often considerable; and the use of a spoon or other traction instrument within the eye is a proceeding which should be avoided whenever possible. When Pagenstecher's operation succeeds well—which is chiefly in very aged people with dense and mature cataracts—its results are as good as can be desired; and the pupil, being perfectly free from every trace of opacity, displays a brilliancy of blackness which is not often witnessed as an effect of other methods. When the scoop is introduced, however, some of the cases in which success is at first obtained become afterwards obscured by a peculiar turbidity of the vitreous, which has been attributed to a chronic hyalitis; and it may be said, speaking generally, that the average of success has not been sufficient to satisfy the desires of surgeons. When employed only in selected cases—namely, in very old people whose cataracts are mature—the operation often succeeds extremely well; but even in them it has a drawback, in the shape of the very deep anæsthesia

which is required in order to preserve entire passivity of the eye, since any contraction of its muscles might suffice to rupture the hyaloid, and to expel vitreous through the large iridectomy and external section. The reason of the greater applicability of the method to the aged seems to be that in them, while degenerative processes have loosened the attachment between the lens capsule and the hyaloid, they have at the same time produced some thickening or condensation of the capsule itself, by which it is rendered at once more easily detachable from its connections, and more resistent under pressure.

The methods introduced by Jacobson, and by one or two others of less distinction, seem hardly to call for notice in the limited time at my disposal; but it is perhaps advisable to refer briefly to a group of operators who have distinguished themselves by the advocacy and practice of methods which seem to me to set all the principles of surgery at defiance. The first of this group was Dr. Kuchler, of Darmstadt, who extracted cataract by making an incision straight across the cornea, on its horizontal meridian, and by pressing out the lens through the natural pupil. He then returned to old ways by bandaging up the eye in many folds of plaster of Paris bandage, which were not to be removed for a week. I say of this operation, that it sets all the principles of surgery at defiance, and for these reasons:—In the first place, the ultimate visual result must be dependent on the integrity of the cornea, and the unaltered character of its curves; and an operation which produces a horizontal corneal wound must necessarily be followed by an opaque line, more or less broad, along the track of the section, and by a modification of curvature, inci-

dental to the contraction which attends or follows the completion of healing. In the next place, there are few sources of greater danger to the eye than adhesions of the iris, whether to the cornea or to the lens; and in this operation, the completion of the section permits the iris to fall forwards into contact with the posterior surface of the divided cornea, and thus, almost inevitably, to become adherent to it during the process of healing. As a matter of fact, both these occurrences were frequent in Dr. Kuchler's hands, so that, besides a large proportion of patients whose eyes perished, sooner or later, from the effects of the adhesions of the iris and of recurrent iritis produced by them, he had also a large proportion in whom the corneæ were converted, by a cicatricial contraction, into distorting media, through which no good vision could ever be obtained. Notwithstanding this, and notwithstanding the tolerably obvious necessity of such issues, the operation was one which could be performed with extreme facility, and this circumstance, no doubt, led some surgeons to adopt or to modify it. Mr. Liebreich, for example, introduced to the profession in the St. Thomas's Hospital Reports, and I believe actually performed, what he called a "new" method of cataract extraction, which was, in fact, nothing more than a slight modification of Kuchler's proceeding. The section was made across the lower part of the cornea, instead of across the horizontal meridian, and a notch was cut out of the lower margin of the pupil, to give easier exit to the lens, but these were practically the sole differences. The corneal distortion certain to be produced was more in the lower half of the membrane, and less directly opposite the pupil. It was, therefore, likely to be somewhat less disturbing to distant vision;

but more disturbing even than Kuchler's cicatrix in the act of reading, when the gaze is usually directed downwards. Inasmuch, moreover, as the majority of operations would be performed upon aged people, in whom the general activity of the body is somewhat curtailed, and to whom the power of reading is relatively increased in value, I am disposed to think that the chief difference between Liebreich's and Kuchler's methods is not in favour of the former. As regards liability to iritis and to the formation of adhesions, I should judge them to be much upon a level; but the fact that neither of them ever became established in practice renders it unnecessary to refer more at large to their demerits.

The general results of the work of the last twenty years may, I think, be summed up by saying that the performance of iridectomy permits the escape of the lens through a smaller section, and also, by preventing bruising of the iris, diminishes the risk of inflammation of that membrane, an occurrence which, when it followed immediately after the operation, was always destructive to the eye. The smaller corneal or corneo-sclerotic section diminishes the risk of sloughing of the cornea; and in this way, by the diminution of the two chief dangers of the old operation, a notable increase in the percentage of success has been obtained. For several years after the general principle of these results was well established, surgeons were still more or less bound by the old rule of not operating until the cataract was "mature"—that is to say, until the opacity has extended to the whole of its cortical substance. In time, however, it came to be recognised that this long delay, which had been undoubtedly called for by the results of the contrary practice, as applied to flap extraction, might

to some extent be departed from ; and now, to the great benefit of many persons, it is customary to operate at an earlier period than would formerly have been prudent or right. Of the steps by which this progress has been attained, and of the degree to which it has been carried, it will be my duty to speak in the next lecture.

LECTURE II.

The "maturity" of cataract—How ascertained—Advantages of waiting for it—Compensating disadvantages—Varying conditions in which the lens may be found—State of the nucleus—of the cortex—Conditions which justify early operation—Methods of procedure.

THE division of my general subject to which I propose to direct attention this evening is that of the so-called "maturity" or "immaturity" of cataracts; and the progress which has been made in the surgical treatment of those which must be included under the latter denomination.

The word "maturity," as applied to cataract, must be understood to mean that the degeneration of the lens tissue has extended to the most superficial layers, those immediately adjacent to the investing capsule; and, in like manner, the word "immaturity" conveys that these superficial layers are not yet involved in the degenerative process, and that they retain some of their original characters, notably their transparency, their viscidity, and their adhesion to the capsule, either unimpaired or with only slight impairment.

When cataract is sufficiently advanced for any question about maturity to arise, the lens presents itself under one of two aspects. In the first of these it is blueish-white in colour, the whiteness not being uniform, but broken by lines, and the whole surface having an appearance between that of spermaceti, and that of an inferior opal, one which does not yield coloured reflections. In the second aspect, which is of comparatively rare occurrence, the surface is of uniform tint, and resembles that of bee's-wax, or brownish-yellow horn.

In very exceptional cases of the latter class the colour is still deeper, ranging from dark brown to something which by a figure of speech may not unfairly be described as "black."

When any of the above mentioned appearances are met with, it becomes important to ascertain whether the opaque surface is in actual contact with the capsule of the lens, or is separated from it by a layer of still transparent tissue; and this question admits of being determined in a simple manner. With a moderately dilated pupil, we direct a pencil of light upon the eye, causing it to fall obliquely from the temporal side. If the opaque portion of the lens be in contact with the iris, except for the intervention of the anterior capsule, the margin of the pupil will cast no shadow upon the opacity. If, on the other hand, the iris be separated from the opaque portion by a layer of transparent tissue, the margin of the pupil will cast a crescentic shadow, the breadth of which will be proportionate to the extent of the separation.

Another test is afforded, especially in the white varieties of cataract, by the fact that the margin of the pupil is encircled, in all eyes, by a fine black line, which is generally lost to sight against the blackness of the aperture. When the aperture is no longer black, the fine black line becomes conspicuous, and especially so in persons with light irides and with any of the lighter coloured varieties of lenticular opacity. In such it is not difficult to see, by the exercise of ordinary care, whether the black line is in close apposition with the opacity, or is separated from it by an appreciable interval.

When the operation of "flap-extraction" was the only one practised, the advantages of waiting for the complete

maturity of cataracts were impressed upon surgeons by the unfavourable results of earlier interference; although it may be doubted whether the reasons of these unfavourable results were quite understood until after the custom of an early examination of the eyes operated upon was fully established. The reasons were, that in mature cataract the superficial layers of the lens were rendered visible by their opacity, and that they left the eye easily on account of the loss of their natural viscidity and of their natural adhesion to the capsule. Hence when the pupil appeared clear and black at the close of an operation, it was clear in reality; and, until this condition was attained, the residual cortical matters might be extruded by slight friction and pressure, so gentle as not to involve any great risk of rupture of the hyaloid membrane and consequent escape of the vitreous body. On the other hand, when a lens was extracted in an "immature" condition, the superficial transparent portion not only clung to the interior of the capsule, and could not be removed without much difficulty, but its presence in the eye was concealed by the very fact of its transparency, and might even remain unsuspected by the surgeon. In such cases, although the pupil would seem clear and black at the close of the operation, it would not be clear in reality, and, if the eye had been examined twenty-four hours later, when the residual lens matter had been acted upon by the aqueous humour, the pupil would have been found occupied by a quantity of disintegrated cortical tissue, swollen and rendered opaque by maceration. This material was apt to undergo proliferation and increase; and, at the same time, to excite acute iritis, which, when it occurred immediately after the large external wound of flap-extraction, was

generally, or perhaps always, destructive to the eye. In other words, the only successful cases of the extraction of immature cataract by the flap-operation were those in which iritis did not occur, or in which it occurred in a degree sufficiently slight to be recovered from. The total thus constituted was not considerable, and the advisability of deferring operation until a cataract was fully "ripe" became an accepted principle of ophthalmic surgery. It was only by obedience to this principle that even the moderate measure of success, to which I referred in my first lecture, could with any certainty be commanded by the surgeon.

While such were the advantages of waiting for the maturity of cataract, the disadvantages of doing so, or rather the disadvantages to the patient of being compelled to do so, were of the most striking and obvious kind. The delay was always extremely irksome, and was often of far more serious consequence. In the case of comparatively poor people, cataracts often became sufficiently far advanced to interfere with the usefulness of vision, and to necessitate the abandonment of work, long before they were fit for removal. In other words, their presence often struck at the root of the means of living of an elderly person, who, but for them, might have continued to follow an occupation which afforded a comfortable maintenance. Deprived of this, brought into reduced circumstances, and left a prey to the most cruel anxiety, it could be no matter of surprise if the general health sometimes became so much impaired that its impairment would militate against the ultimate success of any surgical procedure; while, at the same time, the boon of restored sight, if such restoration were ultimately effected, was rendered of comparatively little

value. An industrial connection had been broken, the vacancy occasioned by compulsory withdrawal from occupation had been filled up, and the restored sight did but enable the sufferer to see his or her pathway to the grave. Among people in better circumstances, also, the long tedium of waiting during the period of failing vision was apt to be exceedingly depressing; and, notwithstanding the command of every comfort, it often interfered with sleep and with nutrition, and perceptibly lowered the powers of life. There would be, of course, the widest differences in these respects, differences depending upon temperament, or upon the intellectual or moral character of the individual; but there are few persons so endowed with fortitude and with hopefulness that slowly increasing blindness will leave their health or their spirits unaltered, or their powers of vital resistance unimpaired. In every class, therefore, it becomes an object of legitimate endeavour to abbreviate the period of waiting; and to restore the sight as soon as any operation can be undertaken with a proper degree of safety; while, in a certain proportion of cases, it even becomes justifiable to incur some amount of additional risk, at all events with one eye, in the hope of obtaining a speedy good result. For example, I was consulted, a few years ago, by a lady who held a superintending position in a large mercantile house—a position which required the exercise of much visual discrimination, and in which she was liberally paid. Her lenses became slightly turbid, just in a sufficient degree to interfere with her efficiency; but the turbidity was of such a character that, in all probability, ten years might have elapsed before the cataracts could be called mature. Her employers valued her services very highly, and were

willing to wait any definite or reasonable time; but they could not have waited for the maturation of the cataracts, and hence the question arose whether anything could be done for her without delay. I thought it justifiable, by methods which I shall presently describe, to incur the risk of operating on one eye only; and, when this one had been completely restored, I operated upon the second in its turn, and with a like result. The patient has retained her position, and is able to fulfil all its requirements. I remember the time when no such operations could have been undertaken, by any methods then practised, with a reasonable expectation of success; and, as there is no such thing in life as an isolated case, the grievous loss of income and of occupation from which this lady was rescued must have befallen many who were similarly circumstanced in former years. It would be easy to cite many examples of a similar kind; but the position sought to be established is almost self-evident, and it would be little better than a waste of time to dwell upon it.

In order to determine the class of cases in which early operations may be undertaken, it is necessary to reflect on the various physical conditions which the lens may present. As life advances, and old age steals on, the lens undergoes a process of hardening, which is most pronounced in the central portions, those most remote from the sources of nutrition; and at the same time it gradually assumes a yellowish or a brownish tint. These changes seem to be of universal occurrence, and the central hardening serves to establish a difference, which did not previously exist, between the "nucleus" and the "cortex;" but neither the hardening, nor the discolouration which attends it, would of themselves

interfere seriously with vision. The nuclear hardening, however, seems in some cases to produce a physical separation between the central "nucleus" and the layer of "cortex" which immediately surrounds it; this separation not at first being general, but affecting certain portions only, and leading to the molecular disturbance of the cortical elements, which are thus deprived of their natural continuity with the structures beneath. The elements which are so affected become opaque, and tend to pass into a state of fatty degeneration, which ends in complete liquefaction. The ultimate fibrils of which the lens tissue is composed are themselves built up into wedge-shaped sectors, having their bases towards the equator and their apices towards the poles; while the fibres which form the apices of the sectors in front, and which there extend to the anterior pole of the lens, are those which, on the posterior aspect, barely overlap the equator. It follows from this distribution that, when a layer of lens tissue becomes opaque, the opacity does not advance uniformly, but in sectors; and the result is that, when cataractous change invades the eye of an aged person, we see the uniformity of the pupil broken by wedge-shaped striæ of opacity, having their bases concealed beneath the iris, while their apices approach the centre. The chief differences which occur in the development of senile cataract depend upon the proportions which the nucleus and the cortex bear to one another, or, in other words, upon the depth within the lens at which the detachment of the softer cortex from the harder nucleus commences. If this separation occur at only a small depth below the capsular surface, so that the cortical layer is thin, the nucleus will necessarily be of larger bulk than in the cases in which the separation

occurs more deeply, leaving a comparatively thick layer of superficial material to undergo the peculiar cortical degeneration, and a nucleus of small magnitude inclosed within. The thinner the cortical layer, the more slowly, as a rule, do the changes which produce opacity make progress, and the finer and smaller are the striæ in which the opacity is first apparent. The converse also holds good; insomuch that, when the cortex is thick and abundant, the opaque lines of cataractous invasion are broader and more conspicuous, and they tend to increase, to coalesce, and to invade the whole surface of the lens, with much greater rapidity. In the determination of the sometimes difficult question, at what stage of the development of cataract the fact of its existence should be made known to the patient, it is always necessary to bear in mind that, when the striæ are fine and small, and therefore developed only in a thin and superficial layer of lens substance, their increase and maturation must not be expected to occur nearly so soon as when they are broad, and developed in a thicker layer. In cases of the former class, we often see the state of the lens, especially in very aged persons, remain without little manifest change for long periods; while, in those of the latter, the increase of the opacity is not only conspicuous to external observation, but forces itself upon the attention of the patient by the rapid deterioration of sight which it occasions.

Whether the hard nucleus be large or small, and consequently whether the enveloping layer of cortex be thick or thin, the opacity commences in that portion of the latter which is adjacent to the nucleus, and only afterwards invades the more superficial portion, or that which is adjacent to the lens capsule. The opacity

increases by an increase in the length and breadth of the striæ, by a corresponding increase in their thickness, by which they approach the capsule, and by their coalescence as they meet. Until the opacity has reached the capsule, the lens displays something of its original striation ; but, when or soon after this stage has been attained, the opaque cortex commences to break up and liquefy, to become the seat of calcareous or of fatty deposits, and to lose all trace of structure; while the nucleus, in such cases, no longer receiving the support which the previous coherence of the cortex afforded it, sinks to the bottom of the capsule, and may be seen, by adequate illumination, to change its place with changes in the position of the eye. In a degeneration which is gradual in its course no exact definitions of the successive stages can be framed ; but there is a certain amount of convenience in describing a cataract as "incipient" before it interferes seriously with vision ; as "progressive" when it has fairly invaded the area of the undilated pupil ; as "mature" when the opacity has reached the capsule ; and as "over-mature" when the natural striation of the cortex is beginning to disappear. The distinction between "hard" and "soft" cataracts, as applied to those of aged people, is less satisfactory as a matter of phraseology, because every cataract is both hard and soft, or is composed of a hard nucleus with a softer investment. The words express, however, although in a clumsy sort of way, whether the nucleus be large or small, and this is a matter of the greatest practical importance. A nucleus of large size adds much to the difficulties of the surgeon, and in a corresponding degree diminishes the prospects of a favourable issue.

The physical conditions, then, with which we have

to deal in cataract, may be summarised somewhat as follows :—There must always be a hard nucleus, of variable size, and this must always be enveloped in a layer of cortical substance, the thickness of which varies inversely as the size of the nucleus. In "progressive" cataract the cortical substance may be opaque, or of an opacity interrupted by still transparent lines, in the laminæ immediately surrounding the nucleus ; while it is transparent in the more superficial laminæ which separate the opaque portions from the capsule. When this is so, the still transparent laminæ retain a viscidity and coherence which those invaded by opacity have lost. At this stage it is not uncommon for the bulk of the lens to be increased, as if by the imbibition of fluid, so that the iris becomes pushed forward towards the cornea, and the depth of the anterior chamber is diminished. In more advanced or "mature" cases, the opacity will have reached the capsule, and the whole of the cortex may be reduced to a pulpy consistence, still showing some trace of sectorial divisions and of fibrillated structure, but with little or no adhesion either to the capsule or to the nucleus. By this time, generally speaking, the lens will have returned to its normal dimensions. At a still later period, all traces of sectorial or fibrillated structure will disappear, and the capsule will contain a milky or turbid fluid, and will perhaps be mottled by dots of calcareous deposit, while the nucleus may be discovered floating loosely within. Where surgical interference has been withheld, and time and opportunity afforded, it has sometimes happened that a good deal of the fluid cortex has ultimately undergone absorption, and that some amount of vision has been restored. The nucleus, in such cases, has either retained its transparency,

or its small size has removed it from the axis of vision.

Our predecessors were taught, by the experience of the days of flap extraction, that while it was advisable to wait until a cataract was mature, no advantage was to be derived from waiting too long. The condition of over-maturity, indeed, was decidedly unfavourable to success; partly, it may be, because it would usually be associated with other senile changes, partly because the completely degenerated cortex, when liberated from the capsule, seemed sometimes to act as a septic irritant, and partly because the calcareous particles which were often present were not easily removed from the eye, and were apt to become mechanical irritants if they were left behind. The condition which was regarded as most favourable was that which has been already described as maturity, in which the opacity was in contact with the anterior capsule, but in which it still displayed indications of a radiating striation. The same description of the most favourable condition must be given even now; but the practical question is whether the difference between this, and something which falls short of it, is sufficiently marked to be, in the majority of cases, worth waiting for? It may be laid down as a general principle that a cataract should not be touched so long as the patient is able, even with some difficulty and by the aid of artificial dilation of the pupil, to follow his or her usual occupation, or so long as the final issue can be awaited with cheerfulness and courage. When these conditions can no longer be fulfilled, when the habitual pursuits have to be abandoned, or when sleep, appetite, and digestion are disturbed, it becomes time to inquire whether something cannot be done to afford

relief. In a considerable number of instances the answer may be in the affirmative.

As far as I am aware, the first step in this direction was taken by von Graefe, as one of the results of his method of modified linear extraction. In a large proportion of cases, senile cataract invades both eyes, but advances more rapidly in one of them than in the other; and von Graefe announced that, after having successfully extracted a mature cataract from one eye, he was accustomed to proceed boldly with the other, and to operate upon it at a much earlier period than would formerly have been thought desirable. His example was soon followed by other surgeons; and, both in respect of the choice of methods, and of the conditions most favourable to success, a large amount of experience was speedily obtained. The general result of this experience may, I think, be fairly expressed by saying that, when the physical or moral conditions already referred to are fulfilled in such a degree as to render operation desirable, the prospects of success will be at their highest in cases of small nucleus and abundant cortex, and will be greatly promoted by a return to the original method of Mooren, that is to say, by performing iridectomy as a preliminary operation, some weeks before the actual extraction of the lens is attempted. Still more, I venture think, will depend upon the careful observance of many small details in the conduct of both operations, and also upon the care and knowledge with which, in the event of complications arising, both the local and the general treatment are conducted. As a preliminary to my endeavour to point out the means by which a favourable issue is frequently to be obtained, it will be convenient to sketch, in brief outline, that method

of extracting the mature cataract, by a single operation, which, founded upon the lines laid down by von Graefe, has in some measure been modified by the work of other surgeons. It is not my intention to describe mere paper or diagrammatic variations, impossible to be carried out with certainty in practice, but only the general results which have been obtained, and the broad principles on which they are founded. In many instances, I think, the slight modification introduced by some single operator is to be regarded as personal to himself, perhaps as advantageous for the requirements of his particular hand, for his particular point of dexterity or of the absence of it, but not as having any special applicability to others. In manipulation, as in observation, there is distinctly what is called at an observatory "the personal equation" of each worker, by which his observations are to be reconciled with those, slightly different from them, made by others; and I am quite sure that much invention of instruments, and much modification of operative detail, is in like manner personal, the mere expression of the skill, and sometimes it may be of the awkwardness, of those with whom such variations originate. It is from this point of view that I approach my subject, and it is on this ground that I shall avoid dwelling upon many details which some have thought important, but which seem to me to be trivial.

When modified linear extraction was first introduced, it was the custom of most surgeons to dilate the pupil prior to the operation, and to do so by the repeated application of atropine. The idea was that the lens would thus be suffered to escape more easily, and much stress was laid upon such a manner of making the first incision that the aqueous humour should be suffered

to trickle away slowly and gradually, by which course the pupillary dilatation was maintained. At this period, one of the most frequent and most troublesome complications was the entanglement and adhesion of the iris at one or both of the angles of the wound, an accident which, at the best, was followed by drawing up of the pupillary aperture to a point above the centre of the cornea, and which, at the worst, led on to destructive inflammation. Of late years, the separation of the active principle of the Calabar bean has given us, in the shape of eserine, a drug of very great value in many ocular maladies; and not the least of its uses depends on its power of producing contraction of the pupil, by which the iris may be drawn out of the angles of the operation wound, and pulled well down into the anterior chamber. When once a piece of iris is cut out, and the continuity of the sphincter of the pupil is destroyed, there is nothing left which opposes any resistance to the exit of the lens; and the benefit which was once supposed to be obtained from atropine was probably in a great degree imaginary. At any rate, the loss of this benefit is very cheaply purchased by the gain of preventing entanglement of the iris; and so, at the present day, the instillation of eserine, as a preliminary to iridectomy, has become almost universal. As in the case of atropine, the tendency of the pupil to return to a state of medium dilatation on the evacuation of the aqueous humour may to a great extent be checked by causing this evacuation to occur very slowly, but this is not a matter of much practical importance. Even if the pupil return to medium dilatation at the time of the operation, the effects of the eserine will speedily reassert themselves, and the iris will be kept well away from the wound

angles before it can possibly become adherent to them. During the progressive stage of cataract, moreover, when the iridectomy is often required as a preliminary operation, and especially in cases of small nucleus, it is, as I have already stated, not uncommon for the lens as a whole to be enlarged by swelling of the cortex as a consequence of the imbibition of fluid during the degenerative process. When this occurs, the iris is pushed forward and the anterior chamber narrowed; and, in these circumstances, the pupillary contraction brings the iris between the lens and the entering knife, so as to furnish a background against which the advance of the latter may be clearly seen, and being thus of great value in protecting the former from being accidentally wounded. On all grounds, therefore, whether in performing cataract extraction as a single operation, or in performing iridectomy as a preliminary step, the use of eserine to produce contraction of the pupil is important. My own practice is to apply to the conjunctiva, about half an hour before the operation, a single drop of a solution containing four grains of eserine sulphate to an ounce of distilled water. Some surgeons use a weaker solution, more frequently applied. Both methods, in all probability, answer equally well; and the only one about which I feel doubtful is the instillation of an eserine solution after the operation is completed. I should fear that its entrance into the anterior chamber might be followed by injurious consequences.

The state of the pupil having been attended to, the next points for consideration are the size, position, and direction of the incision. I should lay down, as cardinal principles, that it should be proportionate to the diameter

of the nucleus, so far as this can be ascertained ; neither so small as to render the exit difficult, nor so large as to call upon the patient for unnecessary repair. It should be fully as large at its inner as at its outer aspect, not "tailed," so to speak, upon the outside of the eye, with a comparatively small opening into the anterior chamber. It should lie in a plane sloping forwards from its extremities to its summit, because this position greatly facilitates the exit of the lens. The first step towards extrusion is to press upon the eyeball at or just below the lower margin of the cornea, and this pressure causes the lens to turn as if upon a horizontal axis, and to present with the upper part of the equator tilted somewhat forwards. If it meets with a wound of corresponding direction, it falls into it with readiness ; while, if the wound be parallel to the plane of the iris, or still more if it at all trend backwards, the equator of the lens will come into contact with the inner surface of the cornea, in front of the wound, and will be arrested at a critical moment of the proceeding. The correct position is for the wound to lie in a plane which would pass through, or perhaps be a little in front of, the imaginary meeting place of the radii of the corneal curvature. A fourth, and not an unimportant condition, is that the wound of the deeper tunics should be covered by a conjunctival flap.

An incision which shall combine the foregoing characteristics can only be made by puncture and counter-puncture ; and it follows that all lance knives must be discarded, save for the consideration that they have their uses in exceptional cases. If we take a common broad, flat, lance knife, and thrust it into the anterior chamber in front of the iris, the extremities of

the incision, on account of the shape of the eyeball, will lie in a plane anterior to the centre, a condition the very opposite of that which is desirable. Weber endeavoured to overcome this difficulty by the use of a lance knife which was concave on its posterior surface, and Dr. Bell Taylor, by the use of a very narrow lance knife, with the edge of which he cut laterally after its introduction into the chamber, placing the whole length of his incision in the sclero-corneal junction. Neither method affords a conjunctival flap, and neither, according to my experience of them, affords a wound which opens readily for the exit of the lens. I would remark in passing, however, that Dr. Bell Taylor's incision appears to me to be the best which has yet been devised for the performance of iridectomy when there is a shallow anterior chamber.

The incision by puncture and counter-puncture requires a very narrow, thin, straight knife, with a fine point and one cutting edge. There are two patterns, that formerly employed by Linnhardt for flap extraction, which was adopted by Von Graefe and is commonly called by his name, and that of Dr. Bell Taylor. Von Graefe's knife has its back and edge parallel to each other, and its point is made by an equal sacrifice of both. As described by himself, the blade should be two millimetres broad, and three and a half centimetres long. Taylor's knife has a straight back, and is of the same length as Von Graefe's, but it may be likened to a very narrow Beer's, except that its point is wholly produced by the slope of the cutting edge. There is not much to choose between these forms, but, on the whole, I think that Taylor's encounters the less resistance of the two, and that its shape affords a better edge for the completion of the section.

The external points of puncture and counter-puncture were placed by Von Graefe on the same horizontal line, two millimetres below a tangent to the vertical meridian of the cornea, and on the tangents to the horizontal meridian. The margin of the true cornea, on its anterior surface, and especially at the upper part, is partially concealed by a covering of conjunctiva, through which the point of the blade would enter and emerge; while the centre of the incision would coincide with the apparent corneal margin, and thus be somewhat anterior to the true one. I do not think the position thus described can be widely departed from with advantage.

It is desirable, from an optical point of view, and also as a matter of appearance, that the iridectomy should be directly upwards, so as to be concealed by the upper lid; and it follows that the section should be bisected by the vertical meridian of the cornea. In order to secure this, whenever an anæsthetic is employed, the surgeon must be careful to notice some landmark, some vein on the surface of the eye, or some spot on the iris, by which to be sure of the position of the vertical meridian. When under an anæsthetic, the eyes are often much rotated, and an incision which appears to be rightly placed when it is made, may be found, after recovery, to be very oblique in its direction.

The patient being placed on his back on a couch, with his feet towards a sufficient window, the surgeon, standing behind his head, first carefully adjusts a speculum in such a manner as to keep the lids sufficiently apart with the minimum of pressure. He then takes the knife in his right hand for the right eye and in his left hand for the left, with the cutting edge upwards, and with the free hand seizes the conjunctiva,

or if this be very fragile, the tendon of the inferior rectus, with fixation forceps, as near to the cornea as possible, and exactly on the vertical meridian. The fixation forceps should terminate in rather blunt extremities, with which, when needed, pressure may be made against the eyeball. The eye being thus secured, and slightly rotated downwards, the surgeon enters the knife at the spot already indicated, endeavouring to turn its edge somewhat, but very slightly, forwards, and carries it downwards through the anterior chamber, close in front of the iris, to a spot a little below and to the nasal side of the centre of the pupil. By this course, the perforation of the anterior chamber is a little lower than the external puncture, and the internal wound is made at least as large as the external one. The point of the knife is then raised until the back of the blade becomes horizontal, and is pushed on to the selected spot for the counter-puncture, great care being necessary not to be deceived as to the position of the blade by refraction through the aqueous humour or cornea. When the point of the knife emerges, the blade should have its back directed downwards and backwards, towards the centre of the corneal curvature, with the edge upwards and forwards in a corresponding degree; and, when the position is correct, the surgeon has only to complete the section. It is usually desirable to rotate the eye slightly outwards with the fixation forceps, so as to avoid wounding the eyelids, or the side of the nose; and then the section is completed, with Von Graefe's knife, by a gentle sawing movement, or with Taylor's, by simply pushing the blade straight onward. If, when the counter-puncture is made, the surgeon finds that the flat of the knife is parallel with the plane of the iris, so that

the incision would not have the requisite forward direction, and that its centre would be placed too far back, it is necessary slightly to rotate the blade before enlarging the wound ; but this proceeding is to be avoided whenever possible, because it tends to bruise the iris near the extremities of the incision, or in parts which will not be removed by the iridectomy. The section being completed very slowly, the aqueous humour leaks out and elevates the conjunctiva, so that this is not touched by the edge of the knife until after it has completely cut through the corneo-scleral junction. The edge is then directed backwards, and made to cut through the loosened conjunctiva two or three millimetres farther back, so as to leave a flap which may be turned down over the cornea by the blade.

The next step is the iridectomy, the object of which is merely to break the continuity of the sphincter and to avoid bruising or stretching of the fibres. The iris forceps should be introduced at the centre of the wound, carried to the edge of the pupil, and opened just widely enough to seize the narrowest possible fold. This should be gently drawn out of the eye, cut off with scissors up to its peripheral margin on each side of the forceps, and then cut, not torn, from its ciliary attachment. The remainder will generally at once return into the anterior chamber.

The division of the capsule of the lens is a proceeding which has much exercised the minds of the inventors, and many ingenious instruments have been contrived for the purpose. I think there is nothing better than a simple steel point, set upon a flexible platinum stem, which can be bent with the fingers to suit the depth of the eyeball and the shape of the orbital margin. The

operator should fix the eye at the original point whilst introducing the cystitome with its point directed laterally, but should make no pressure with the forceps, or should rather lift the eye towards him, until the point has passed beneath the lower margin of the pupil. It should then be turned down into contact with the lens capsule, and the least pressure with the fixation forceps will render the eye more tense, and will project the lens against the point. This should then be drawn gently to the equator, and then along the equator, in a direction parallel to the section, before it is withdrawn. As the capsule is divided, the lens may generally be seen to start forward, as if released, and a portion of the softened cortex will usually at once escape from the eye.

At this stage, it is often desirable to remove the speculum, and to raise the upper lid by a simple elevator, which, if the operator requires both his hands, may be committed to a careful assistant, who, at the same time, may draw the lower lid gently towards the lower orbital margin. The best elevator is, I think, that contrived by Dr. Noyes, of New York, which holds the lid securely, and takes up but little room. With or without fixation —which only becomes necessary when the eyeball is rolled upwards by the action of the superior rectus muscle, and which must then be managed with the greatest care, for fear of rupturing the hyaloid membrane and permitting the escape of vitreous—the operator makes gentle pressure immediately below the cornea, in a direction backwards, with the back of a tortoiseshell or caoutchouc spoon. Under this pressure, the nucleus should begin to turn, and its upper margin should present itself between the lips of the wound. The spoon pressure should be continued in an upward

direction, and the nucleus will gradually emerge, the pressure being relaxed as soon as the widest part of the nucleus has passed through the opening. As soon as the nucleus has passed out of the eye, the lids should be suffered to close. In a few moments they should be reopened, the eye surface cleansed from cortex and coagula by gentle touches with a morsel of soft and carefully disinfected sponge, and the pupil and the wound examined. If the pupil be clear and black, and if the wound contain no iris, the operation is complete. If, on the other hand, the pupil be occupied by cortical substance, this must be extruded by gentle pressure, and by friction upon the cornea through the lower lid, or, if necessary, removed by the gentle introduction of a small spoon or scoop. Incarcerated iris may be replaced by a delicate whalebone spatula, or by gentle friction at the angles of the wound.

It has been assumed, in all the foregoing description, that the surgeon is dealing with a mature cataract, the whole of the cortex of which has lost its cohesion, and so slips easily out of the capsule, and has also lost its transparency, so that it is a conspicuous object within the eye, and cannot be overlooked. In dealing with immature cataract we have the reverse of these conditions, a greater or less thickness of the outer layers of the cortex being still adherent to the capsule, and being rendered practically invisible by transparency. More or less of this material will usually be left within the eye. After a short period of maceration in the aqueous humour, it swells up, becomes opaque and conspicuous, and sometimes appears to increase by cell proliferation. In some cases it is absorbed with little trouble, in others it excites iritis, it may be of a mild type, it may be of

great severity ; and the latter form, although, after modified linear extraction, it seldom leads either to suppuration of the globe or to sloughing of the cornea, yet sometimes extends to the choroid and to the ciliary region, produces wasting of the eye and loss of sight, and may even lead to sympathetic ophthalmia. The question of the propriety of extracting immature cataract will turn upon the probability of these risks being successfully avoided or overcome.

As a first step in this direction, it is essential to separate the iridectomy from the extraction by a time sufficiently long to allow of the perfectly sound healing of the cut edges of the iris. It hardly needs demonstration that the presence of swollen and possibly decomposing cortex within the eye will be much more likely to excite mischief, if it be in contact with a recently wounded iris, than with one which has completely recovered. As a rule, I think the interval between the two operations should not be less than six weeks.

The iridectomy itself should be performed with the smallest possible amount of disturbanee to the eye. The incision, if there be a good anterior chamber, may be made with a very thin, rather narrow, and acute-angled lance knife, the aqueous humour should be suffered to drain away slowly, and a very small strip of iris should be drawn out and excised in the manner already described. If any portions remain in the angles of the wound, they must be carefully replaced by the spatula before the lids are closed. If the anterior chamber be rendered shallow by enlargement of the lens, the incision may be made in the manner already ascribed to Dr. Bell Taylor. For this purpose, the conjunctiva must be seized by fixation forceps close to the corneal margin, and

immediately to the left of the left-hand extremity of the intended wound. At this point, a very narrow bent lance knife must be entered, and, when its point has been carried into the chamber as far as can be done without risk of wounding either lens or iris, the right hand edge must be made to cut its way around the margin of the chamber until a wound of sufficient length has been obtained, through which the iris may be drawn out and excised in the ordinary manner. Before the eye is closed, both the anterior chamber and the conjunctival sac should be freed from blood as completely as possible, and the bandage should be applied with moderate pressure. The patient should be kept in bed, under suitable regimen, cold wet compresses should be applied if there be any heat or pain, and every endeavour should be made to prevent or to subdue iritis. On the second or third day a drop of solution of atropine should be placed within the conjunctiva, and no risks should be run, and no use of the other eye permitted, until all blood has disappeared from the anterior chamber, all surface vascularity has passed away, and a free and moveable pupil is obtained. It is only when these conditions are fulfilled, that the case can be considered a hopeful one for farther treatment; and the iridectomy is not only valuable as facilitating the extraction, but also as a test of the healing power of the patient, and of the behaviour of the eye under injury. If the iridectomy were followed by iritis, it could scarcely ever be proper to proceed with the extraction prior to complete maturation of the cataract.

An occasional effect of the iridectomy, probably by the change which it produces in the intra-ocular tension, and hence in the state of the fluids within the eye, is to hasten the maturation; and, even in this way alone, it

is sometimes of the greatest service to the patient. I have seen a cataract, which was very incomplete at the time of the iridectomy, become absolutely mature within three weeks thereafter, and slip out of the eye, when the capsule was divided, without leaving a fragment of cortex behind.

When this fortunate result is not attained, but when the completeness of the recovery from the preliminary operation has been satisfactory, we may proceed to extraction as soon as this preliminary operation has, so to speak, been forgotten by the eye. In some cases, I have very gently divided the anterior capsule with a fine needle, so as to admit the aqueous humour to the cortex, and have then deferred extraction for one, two, or even three or more days, carefully watching the eye in the meanwhile, and ready to operate as soon as any symptom of irritation became apparent. In others I have divided the capsule immediately before making the corneo-scleral section, so as to have the lens better supported against the needle, and so as to be ready to apply pressure for extrusion as soon as the section was complete. This plan has been advocated, on general grounds, by Mr. Spencer Watson, and I am disposed to think that it offers some advantages. Unless one of these methods be pursued, the extraction does not differ from that already described, except in the fact that the iridectomy, having been done previously, does not need to be repeated. Another difference is that it is advisable, when the operation is finished, to close the eye in a temporary fashion for ten minutes or so, and then to endeavour to obtain the extrusion of some further portions of cortex, which, by that time, may have been detached from the capsule by the action of

the aqueous humour. Of the after treatment, of the special risks which may arise, and of the methods of encountering them, I hope to say something in the next and concluding lecture.

LECTURE III.

The accidents incidental to early operation—Risks of the preliminary iridectomy—of the ultimate extraction—The advantages and disadvantages of anæsthetics—Complications which may arise after the operation—Treatment—Summary and conclusions.

IT is a maxim of political economy that every learner must spoil a portion of raw material; and this maxim, in its application to the old method of cataract extraction by the flap, was rendered by the saying which Beer is believed to have originated, to the effect that every beginner would destroy a hatful of eyes before he cured one. In any literal sense, this must always have been a gross exaggeration, but still it is not the least valuable result of modern improvements that they tend to place the beginner and the expert more nearly upon a level than was formerly the case. In flap extraction, before fixation by forceps was introduced, and when the eyeball was only steadied and supported against the knife by the tips of the index and middle fingers of the surgeon, resting one above and the other on the nasal side of the cornea, nothing but practice could give the mingled lightness and firmness of touch which were required in order to afford security against two dangers; the first being that the support would be insufficient, and that its insufficiency would permit rotation of the eye before the knife, and consequent displacement of the section from its right position; the second, that the finger pressure would be too decided, and that it might cause the premature expulsion of the lens, followed by more or less of the vitreous body. Fixation by forceps was introduced, I believe, by the late Mr. Poland, and was applied by him to flap extrac-

tion with considerable advantage; but I am not aware that his example was at all extensively followed, and it was not set until shortly before the new methods were devised. Of these, as we all know, forceps fixation forms an essential part; and for this reason, as well as on account of the altered character of the section, it is not too much to say that every young surgeon, who possesses adequate anatomical knowledge, fair mechanical dexterity, and some practical acquaintance with the densities and resistances of the textures especially concerned, should be able to perform even his first cataract operation upon the living eye with a creditable amount of success. The chief advantage of experience consists less in its conferring mere manual dexterity than in its conferring the power of at once perceiving the nature of any difficulties or complications which may arise in the course of an operation, and the best manner of dealing with them; in its conferring, in other words, an immunity from being taken by surprise, and a readiness at any moment, and almost instinctively, to do whatever any deviation from the normal course of things may require. I may add that, in watching young surgeons, few things have struck me more than their frequent unwillingness to avail themselves of the most admirable opportunities for leaving off; so that I have sometimes seen the results of a well-performed operation imperilled, or even lost, by too great solicitude about the last morsel of cortical substance, or about the relations of the iris to the angles of the wound. Both are highly important, but something must occasionally be sacrificed in regard to them in order to avoid expulsion of the vitreous body by reflex contraction of the ocular muscles. The more an

operation is prolonged, the more risk there will be that such reflex contraction may occur.

In speaking of the accidents incidental to early operation, I do not intend to refer to any which are only rendered possible by the absence of adequate surgical dexterity, but to limit myself to those which must sometimes happen to every operator; and among these, as a matter of possible, although of extremely rare, occurrence, we must place injury to the lens in the course of the preliminary iridectomy. Every ophthalmic surgeon of experience has seen cases of traumatic cataract after iridectomy, either in his own practice or in that of others; and in some of these the operator would have no consciousness of having wounded the capsule. It is quite possible that a delicate capsule may sometimes split during iridectomy, without having been touched by either knife or forceps; and there are at least two other ways in which the accident may occur. The speculum will sometimes be jerked out from between the lids by muscular spasm; and, if this should happen while the knife is in the anterior chamber, the surgeon will be fortunate if he succeeds in withdrawing it without the infliction of any undesigned injury. In other cases, even when under apparently profound anæsthesia, the patient will sometimes make an unexpected movement at a critical moment of the operation. I have known a sudden and violent sneeze occur when the knife was in the eye, this sneeze being clearly reflex, and analogous to that which is produced, in some forms of photophobia, by exposure of the cornea to light. However rare such accidents, it is necessary to be prepared for them, and to take thought beforehand of the course of action which they will require.

If the surgeon is conscious of having wounded the lens in the performance of iridectomy, extraction must be proceeded with at once. A serious difficulty may here arise from the circumstance that the wound made for the iridectomy will neither be long enough to afford easy exit to the lens, nor be situated in the most favourable position for the purpose. The iridectomy wound, if made with a narrow knife, will be almost concentric with the corneal margin; if made with a broad knife, its extremities will even advance somewhat upon the corneal tissue. The mechanical difficulties of prolonging it in a suitable direction with the same knife would be great in either case, and would probably be insuperable in the latter. The best method of proceeding is to withdraw the knife, if that has not been done before the accident is discovered, to shift the fixation forceps to the left hand angle of the wound, and then to extend the incision, from the right hand angle, with the side edge of a narrow parallel-sided knife, set at an angle upon its stem, and furnished with a rounded and blunt extremity. Such a knife may be introduced into the anterior chamber, and then made to cut laterally to whatever extent may be desired, while the narrowness of its blade allows the left hand edge to be directed forwards, so as to turn the right hand edge slightly backwards, and thus keep the new portion of the incision in or beyond the corneal margin. It must be remembered that such an incision, after all, will not be in the most favourable position and direction for the exit of the lens; and the difficulties which might hence arise must to some extent be provided against by making it of greater length than would be necessary if it were better planned. If a piece of the iris has not yet been excised, the excision should

be made to the full length of the wound; and, if an iridectomy has been made through the original small opening, a second piece of iris should be removed to the extent of the new one. It is only by this precaution that future entanglement can be guarded against. Notwithstanding the wound of the anterior capsule, the cystitome must be employed to secure that the division is sufficiently extensive, especially in the equatorial region, and then the extrusion of the lens may be attempted by very careful pressure. If it does not advance at once the use of a traction instrument becomes imperative. If the difficulty depend only upon mal-position and reluctant opening of the wound, it will be best to use Pagenstecher's spoon, the tip of which may be insinuated for a short distance behind the nucleus, and made to open the wound by holding back its posterior margin. Slight pressure with the fixation forceps will then frequently be followed by an advance of the lens; but, when the cause of retardation is in the adhesion of the nucleus to the cortex, it is best to lay aside the spoon and to use a fine loop devised by Dr. Bell Taylor, and called by him a "vectis." This loop, which occupies less room than any other traction instrument, and which obtains a very secure hold, should be glided through the posterior cortex to the inferior margin of the lens, and then bedded in the posterior surface of the nucleus by lifting this against the cornea, after which it may be used for extraction, the further margin of the loop being kept well up against the cornea as the bulk of the nucleus passes through the section. The speculum should then be removed, the lids closed, and covered with a supporting pad, while the operator waits two or three minutes for the action of the aqueous humour

upon the residual cortex. After this time the lids may be reopened, any apparent cortex removed by rotatory friction through the lower lid, and by gentle pressure on the cornea, or even brought away by the cautious introduction of a curette. When no more can be done in this direction, either because no more cortex is visible, or because loss of vitreous occurs or seems to be probable, the lids must be closed by the ordinary bandage. In all such cases, a certain amount of iritis must be expected; but, in many of them, it can be kept within bounds by careful and well-directed treatment.

A troublesome complication of an iridectomy, which, perhaps, can hardly be described as an accident, is the occurrence of an unusual amount of hæmorrhage into the anterior chamber. This is especially prone to happen in cases in which an immature cataract is combined with an early stage of glaucoma, or even with the increase of tension which may be produced by an increase in the bulk of the lens. However arising, increased tension produces passive congestion of the intra-ocular structures; and hence the excision of a portion of iris may give rise to a more free and more prolonged bleeding than is usual. In such a case, the blood may generally be evacuated by carefully introducing a spatula or curette within the lips of the wound, but it is apt to re-accumulate, and to fill the available space in the anterior chamber. When this is so, it frequently acts as a foreign body during the period of healing, produces protracted pain and irritation, and sometimes sets up actual iritis. Such occurrences always retard the period at which extraction can safely be undertaken, but they are less serious in their import than an insidious form of iritis which sometimes follows

the iridectomy without manifest cause, and which can only be attributed to some septic influence or to some defect of nutrition. The iritis consequent upon blood irritation will generally yield to treatment; and, as there should be no intra-ocular bleeding at the time of the final operation, there need then be no cause adequate to the reproduction of the effect. The apparently spontaneous form, on the other hand, will probably reappear after extraction; and this probability casts grave doubts upon the propriety of carrying the treatment farther, until the cataract has made such progress that the state of vision does not admit of being altered for the worse In other words, a risk, almost as great as the risks incidental to flap extraction, takes us back to the practice of the time when flap extraction was habitually performed.

In dealing with cases of somewhat heightened tension, whether this be distinctly glaucomatous, or due to enlargement of the lens, it is necessary to diminish both the tension and the intra-ocular congestion which attends it, by the previous instillation of eserine. We must not then be content with a single application, for the mere purpose of obtaining a contracted pupil; but the drug should be applied regularly, say night and morning for four or five days, as a preliminary to the performance of the iridectomy. By this means, we shall frequently succeed in obviating the tendency to hæmorrhage which might otherwise produce embarrassment or even disaster. In all such cases, moreover, the object of the iridectomy will not merely be to destroy the continuity of the sphincter of the pupil, but also to diminish tension in a permanent manner. For this purpose the piece of iris excised must be of considerable magnitude, and it must be taken off quite close to the ciliary border.

When a sufficiently long time has elapsed since the performance of the iridectomy, the propriety of proceeding with the extraction must be considered. We may divide the unfavourable cases into two classes—those in which there is a tendency to sloughing of the cornea, and those in which there is a tendency to plastic iritis. The first-named risk, that of sloughing, is most marked where the cornea is thin and undernourished; a state which may often be inferred from an inelastic condition of the skin of the hands, and from the absorption of subcutaneous fat; and of which we obtain strong evidence when, at the time of the iridectomy, the cornea collapses or falls into wrinkles as soon as it loses the support of the aqueous humour. It was in cases of this class that Mooren obtained his most conspicuous successes by preliminary iridectomy; and they call for the adoption of his method even when the cataract is mature. I have, at present, in St. George's Hospital, a patient who admirably illustrates the value of the proceeding. He is an old and feeble man, whose left eye was destroyed long ago by disease or injury, and who was admitted with mature cataract and extreme conical cornea of the right eye. At the time of the iridectomy, his cornea fell into folds, and seemed to have scarcely an appreciable thickness; but, both then and after the subsequent extraction, the section healed readily and completely. In such cases, it is my usage to shorten the interval between the operations. There is, practically, little or no fear of iritis; and I think the cornea has a better chance of survival, after the second and more extensive incision into the eye, if the vascularity incidental to the healing of the first incision has not yet disappeared, so that the wound falls

into a region of artificially increased blood supply. At the same time, it is of course desirable to limit the extent of the second incision as much as the size of the nucleus will permit, even if we have to assist the escape of the lens by the "schlitten-manœuvre," or by the use of some form of traction instrument. The remaining of a small portion of cortex within the eye is of less importance in these cases than in many others. It seldom causes much irritation, and is often absorbed without trouble, or at most with the effect of leaving capsular films within the eye, which will subsequently require to be torn by the use of a needle or needles. It must be admitted, without hesitation, that the modern forms of extraction, whether on mature or immature cataracts, whether performed as a single operation or divided into two, are followed, more frequently than flap extraction, by secondary films which require a subsequent operation for their removal. I do not regard this as a disadvantage: for the facts might, perhaps, be fairly stated by saying that, in many of the eyes which would have perished under the old method, the new one requires a secondary but trivial operation in order to attain a completely good result.

Whenever the risks of the final extraction seem to lie entirely on the side of plastic iritis, it is desirable to extend the interval between the two procedures rather than to shorten it, and to ensure that the eye has, so to speak, forgotten the first before it is called upon to submit to the second. The greatest probability of iritis is present in the cases in which it has followed the preliminary iridectomy, otherwise than as a result of irritation from blood in the anterior chamber. A somewhat plethoric habit, a tendency to the lithic acid diathesis, and

generally any imperfection or inadequacy in the performance of the renal function, are conditions which should be looked upon with grave distrust, and which should be amended, as far as any emendation may be possible, before either the iridectomy or the final extraction can be prudently undertaken. I believe there are many cases in which the prospects of success are enormously increased by two or three weeks of careful medical treatment as a preliminary; such treatment usually comprising a restricted diet, the moderate use of alteratives and purgatives, and attention to the action of the skin.

Whenever the time for the extraction of the lens arrives, there are, of course, certain risks inseparable from the actual conduct of the procedure, although these are, I think, both less numerous and less formidable than those which attend upon extraction performed in immediate sequence to iridectomy. The worst accident which can befall during cataract extraction is hæmorrhage from the rupture of a vessel in the choroid, hæmorrhage which necessarily produces detachment of the retina, and which at once extinguishes all hope of the restoration of sight. When iridectomy has been performed at an earlier period, such hæmorrhage is very unlikely to occur, since the choroidal vessels, even if diseased and weak, will have learnt to accommodate themselves to a diminished amount of support, and will be little likely to give way. I have seldom seen this accident occur in any form of modified linear extraction, never when the iridectomy and the extraction were separated by an interval of time.

The only remaining accidents which need be noted are loss of vitreous, and failure to remove the lens. I

once saw a case in which the surgeon had made an incision insufficient for the exit of a very large and hard nucleus, which became engaged in the wound, but which refused to advance beyond a certain point without the exercise of more pressure than it seemed prudent to employ. The operator, therefore, determined upon the use of a traction instrument, and laid down his pressure spoon to take up a Pagenstecher's scoop. He attempted to insinuate this between the posterior aspect of the nucleus, and the posterior margin of the wound; but with the result that the nucleus returned into the eye and passed out of sight into the vitreous, a considerable quantity of which escaped. The operator made a dive after the lens, but could not find it, and had no choice but to close the eye. A day or two later, the nucleus reappeared in the pupillary region, the wound was re-opened, and the nucleus was removed by a scoop without the slightest difficulty. There was no acute reaction, but the eye became the seat of an insidious form of low inflammation, under which it ultimately underwent total wasting.

A more common cause of loss of vitreous is from spasm of the external ocular muscles, or from the strain incidental to vomiting. About a year ago, I performed an extraction which, up to the moment of completion, was all that I could desire. The cataract was fully mature, and the iridectomy had formed part of the procedure. The pupil was perfectly clear, and I was just taking a last look at the eye prior to the application of the bandage, when the globe was visibly compressed by contraction of the recti, the wound gaped, and a large quantity of vitreous was expelled. In such a case, manifestly, the patient is beginning to recover from the

anæsthetic, and comes into a state in which volition is still suspended, and in which the wound becomes an excitant of reflex spasm. In another case, after the operation had been satisfactorily completed, the bandage applied, and I had left the house, vomiting commenced, apparently from the effects of the anæsthetic, and continued throughout the day with great severity. The patient was under the care of her usual medical attendant, who did not send for me; and, when I went in the evening, I found that the bandage had become displaced, and that the eyeball had been almost emptied by the straining. I have no doubt that he did all that was possible to arrest the vomiting; and, although I should have liked to reapply the bandage in such a manner as to secure effectual external support, it is highly probable that the mischief may have been done almost in the first effort, and that, after this, all such support would have been in vain. These two cases seem to me to furnish admirable illustrations of what may fairly be called "accidents," occurrences which can neither be foreseen nor guarded against, and by which the reasonable expectations, both of the patient and of the surgeon, may be frustrated without fault on the part of either.

A more ordinary form of loss of vitreous is when it occurs during the course of the extraction, either as a result of spasm, or from mere weakness of the hyaloid membrane, which, there can be no doubt, is much more frail, and more prone to yield in some eyes than in others. Great risk of rupture of the hyaloid, even when of normal firmness, is attendant upon a condition of imperfect anæsthesia, in which the natural tendency of the superior rectus muscle to roll the eye upwards, and to remove it out of the way of injury, is not abolished.

In such a condition, the operator is compelled, at every step, to roll the eye downwards by the forceps, in order to obtain access to the region in which his proceedings are conducted; and the result is that the hyaloid is made to bulge towards the wound by the opposing traction of the forceps and of the muscle, and that it is exposed to manifest danger of giving way.

The occurrence of loss of vitreous, however occasioned, calls upon the surgeon for prompt decision with regard to the course which should be pursued. We may take, as three typical conditions, the cases in which the loss occurs after the whole of the nucleus and cortex have been removed, the cases in which the loss occurs prior to the removal of either, and the cases in which the vitreous follows the nucleus, when there is still cortex remaining within the eye.

In cases of the first class, when everything has been removed, and when loss of vitreous follows the last step of a completed operation, there is nothing to do but to apply the usual bandage with as much rapidity as possible, and with something more than the usual degree of firmness. The prognosis, in such a case, will depend almost entirely upon the amount of the loss. If it be but small, the case will usually do as well as if it had not occurred; but, whenever the amount is large, the eye is apt to be attacked by inflammation during or subsequent to the healing process; and, with few exceptions, the sight obtained is at best but very imperfect. The lost vitreous is not replaced by new material of the same kind, but only by a serous fluid, often of incomplete transparency, and liable to undergo fluctuations in quantity, generally on the side of diminution, which lead to recurring subnormal tension, and to many disturb-

ances of the ocular circulation and nutrition consequent thereupon. I have seen several instances in which, after a large loss of vitreous, the immediate visual result was very fair, but in which the vision was not long retained.

When loss of vitreous occurs prior to the extrusion of the lens, the first care of the operator should be to see that anæsthesia is complete. If it should not be so, if there should be any action of the recti muscles, or of the orbicularis, the speculum should be gently removed, and the closed lids covered with a sufficient pad of cotton wool, retained by manual support, until more of the anæsthetic has been administered. As soon as the muscles are brought into repose, the speculum should be re-inserted or the lids kept apart by an assistant, and the surgeon should at once remove the nucleus, and as much of the cortex as possible, by some form of traction instrument, generally either Pagenstecher's spoon or Taylor's vectis. If the muscles continue perfectly quiet, he may even follow portions of cortex, with a smaller spoon or curette; but this should seldom be done at the cost of further loss of vitreous. The curette or spatula may be used to ensure complete replacement of the iris and proper adaptation of the conjunctival flap; and then the great object should be to get the lids closed and supported as quickly as possible.

In conditions intermediate between those last mentioned, when the vitreous follows the nucleus out of the eye, leaving some portion of the cortex behind, the surgeon is called upon to take into consideration three principal factors; namely, the amount of residual cortex, the amount of the actual and threatened loss of vitreous, and the proneness or otherwise of the patient to plastic inflammation. It need hardly be said that, in immature

cases, the precise amount of cortex is difficult to estimate, although the surgeon, before undertaking extraction, should always obtain as exact a knowledge as possible of the thickness of the still transparent cortical layer. Even when this has been done, it must always be difficult to feel sure, at the moment, how much of a practically invisible material remains within the eye. The second element, the amount of actual or probable loss of vitreous, is far more easily ascertained or estimated. In some cases the first loss is a sort of gush or outburst, forcibly expelled by contraction of the recti muscles, while in others it is little more than a leakage, the result of rupture of the hyaloid without muscular spasm. In some cases the vitreous will be liquid, so that it can flow away, in others it will preserve its natural almost gelatinous consistence, and will only leave the eye with difficulty. The decision whether to close the eye, or to persevere in attempts to remove the whole of the cortical substance, must be mainly governed by considerations based upon these respective conditions, the general principle being that cortex must be removed as completely as possible, but that endeavours in this direction must not be prolonged at the expense of a considerable loss of vitreous which might otherwise be retained. The greater the assumed tendency of the patient towards iritis, the more important does the complete removal of the cortex become; but, even when this tendency is strongly marked, I am not aware of any facts which connect the occurrence or the intensity of the inflammation with the quantity of the residual irritant. My experience is rather in the contrary direction; for some eyes are very intolerant of residual cortex, while others are very tolerant of it; and, when we consider that, in

cases of the former kind, the actual quantity appears often to be increased by cell-proliferation, it must be probable that a small amount may do nearly or quite as much mischief as a large one. In patients in whom I consider iritis probable, therefore, I am extremely careful to remove the whole of the cortex when I can ; but even in these, and especially in others, I do not think the prospects of a good issue are to be increased by persevering endeavours to take out as much as possible, when vitreous is escaping, and when some portion of the cortex must manifestly be left behind. I am always more disposed to close the eye, to trust to treatment for the control of inflammation, and to a subsequent operation for the displacement or division of any films which the inflammation may leave behind.

The various manipulations to which I have referred, as being generally or occasionally necessary, are manifestly much more easy of accomplishment when the patient is fully under the influence of an anæsthetic than when this important condition is not fulfilled ; and my hearers will have observed that I have more or less assumed the employment of an anæsthetic throughout. More than once, however, since the time when these agents were introduced, special objections to their being employed in cataract extraction have been advanced ; and one recent writer has been so emphatic in his condemnation of them that, differing from him as I do, I have thought it right to refer to this part of the subject and to say exactly what is on my mind. I have had considerable experience on both sides of the question, for my earlier cataract operations, by flap-extraction, were all done without an anæsthetic ; while of late years I have employed one almost, if not quite, invari-

ably. I believe, in the first place, that the improved methods of operating are mainly due to anæsthetics, and would not have been brought to their present perfection without them. It would certainly not be practicable, in a large proportion of conscious patients, to plan and execute an incision, within very accurately defined limits, at the summit of the cornea; for the simple reason that the instinctive tendency of the superior rectus to roll the eye upwards, and to remove it out of the way of injury, would frequently be too strong to be resisted; while, if this tendency were overcome, against the efforts of the muscle, by forceps traction, there would be frequent laceration of the conjunctiva, and there would be frequent loss of vitreous, at quite an early period of the operation, from rupture of the hyaloid by the struggle between the forceps and the muscle, a struggle which may even now be witnessed, and which is not seldom attended by hurtful consequences, in cases in which the anæsthesia is incomplete. Still less would it have been possible, without the passive eyes afforded by an anæsthetic, to carry out the series of almost experimental operations, of slight variations in the position and magnitude of the section, of which the procedure that I have endeavoured to describe is the final outcome; so that, without anæsthetics, I do not believe that either the broad lines of the operation could have been successfully defined, or that those lines could have been strictly adhered to in practice. Against the great benefits of freedom from pain, from apprehension, from hurry, and from restlessness of the eye, there is, according to my experience, only a single counterbalancing disadvantage, namely, the harm which may possibly arise from obstinate vomiting. I have only

seen one instance, already referred to, in which the effects of such vomiting were destructive; I have seen many in which vomiting of moderate severity has been productive of no ill result whatever.

I have, however, seen accidents, and those of a serious character, caused by attempts to operate when the effect of an anæsthetic had been insufficiently produced, or had to some extent passed away. I have already mentioned extrusion of the vitreous as thus arising; and I think it may be said, generally, that an imperfect anæsthesia is as bad as none at all. There certainly is a stage in which there is no consciousness of pain, but in which the liability to reflex spasm is intact, and is entirely removed from the control of the volition. Such a state occurs when anæsthesia is as yet incomplete, and again when it is beginning to pass away; and it teaches that the administration of an anæsthetic for operations upon the eye is a matter not to be lightly undertaken, but one which requires to be guided by no small amount of skill and of practical knowledge. A condition in which it would be possible to amputate without the knowledge of the patient would often be insufficient for the performance of an eye operation, a proceeding in which the primary object to be attained is not so much immunity from suffering, as immunity from muscular contraction. I may say at once, that I believe there are some persons in whom the state of quiescence desirable for an eye operation is not to be attained without peril and in such cases the administrator should be prepared to warn the operator of the difficulty, and the operator, in his turn, should be prepared to act with great promptitude in the few moments of profound repose which may sometimes be obtained.

The selection of the anæsthetic agent is a matter of considerable importance. But for its liability to occasion death, there is nothing which combines so many advantages as pure chloroform, but this liability is enough to neutralise them all. Chloroform kills, in round numbers, about one in every three thousand of those to whom it is administered ; and there ought to be no deaths in ophthalmic surgery. If experience has made anything certain, I think it is that the fatal accidents from chloroform have occurred in the very cases in which there was no reason to anticipate them. I sometimes use it when I am short-handed, and when the administrator is comparatively unskilled in the use of anæsthetics, because I think it is then as safe as any other, while it is more easy of administration, and more likely to be effectual than any other. Excepting in such conditions, and in the case of young children, in whom the danger to life from its effects seems to be almost infinitesimally small, I think it ought to be banished from surgery. Pure ether is an admirable and very safe anæsthetic, but it requires a boldness and freedom of administration which are only attained by practice, and, if imperfectly given, it is utterly inefficient for the purposes of the ophthalmic surgeon. Moreover, it is apt, especially if tardily and ineffectually administered, to produce a free secretion of bronchial mucus, which occasions troublesome and unrestrained coughing, and sometimes leads to sickness. When nitrous oxide gas is administered as a prelude to ether, the secretion of mucus is less likely to be troublesome, but a great amount of venous congestion is always produced, and the tissues become so gorged that every incision bleeds freely. In the performance of iridectomy, under gas and ether, we not only have an unusual amount

of bleeding from the conjunctiva, or from the vessels of Schlemm's canal, if these should be divided, but we also have a large effusion of dark and unoxidised blood into the anterior chamber from the cut edges of the iris, and this blood, as already incidentally mentioned, is prone to act as a foreign body, and to excite troublesome and possibly very injurious iritis.

Judging from my own opportunities of observation, I am inclined to believe that the best anæsthetic, for general use in ophthalmic surgery, is the mixture which is commonly known as A.C.E., and which contains one part by measure of absolute alcohol, two of chloroform, and three of ether. A mixture of ether and chloroform was long ago suggested by very obvious considerations, but it was not found to succeed well in practice. It was merely a mixture; and, as its ingredients were of different degrees of volatility, they evaporated unequally, and left the administrator in a state of uncertainty with regard to the proportion of each which might be left in his inhaler at any given time. The addition of alcohol provides a solvent for the other two, and they evaporate together. The mixture should be administered freely, from a flannel or felt cone, and the desired effect should be produced as rapidly as possible. To prolong the administration of an anæsthetic, of whatever nature, to give small doses timidly, with frequent admissions of air between them, is, I believe, the most certain method of producing disaster from its imperfect operation. By disaster I do not mean death, but incomplete anæsthesia, prolonged struggling, muscular spasm, and probably eventual sickness. The cases which do best are those in which the effect is rapidly produced, and in which it is as rapidly recovered from. It would

be foreign to my subject, and beyond the limits of my time, to attempt to describe the precautions with which the use of every anæsthetic should be surrounded, but I may add that one advantage of the A.C.E. is the ease with which the mixture can be replaced by pure ether in cases which seem to call for such a substitution. When this substitution is made, moreover, the patient being already narcotised by the A.C.E., the pure ether has little tendency to produce the excessive bronchial secretion which constitutes one of the difficulties of its employment from the first. I need only add, that, more especially in cataract operations, the ophthalmic surgeon who cares for the welfare of his patients, or for his own reputation, will not lightly commit the anæsthetic to strange or unskilled hands, but will insist upon obtaining the aid of an administrator of skill and experience, who knows the special requirements of eye work, and who is capable of relieving the operator from the duty of thinking at all about the anæsthetic or its effects. The administrator should then assume entire responsibility for his share of the proceedings, and the surgeon should await his permission to commence.

I have left myself but short time in which to speak of remaining topics of great importance, such as the complications which may arise after an operation, and the treatment which they may require. Such subjects, however, can only be discussed within short limits in the most general way, because no two cases will present quite the same conditions or peculiarities, and each must be a study in itself.

One of the most troublesome of these complications, and not an uncommon one, is inversion of the lower eyelid by muscular spasm. In old people the skin

covering the lower lid is often lax and distensible, and opposes no resistance to the action of the orbicularis. The surface of the eye is uneasy from the wound, and the orbicularis comes into constant reflex action. The result is that the lower lid becomes completely canted over, its margin tucked down within the retrotarsal fold, so that the eyelashes rest in contact with the globe, where, by the irritation they excite, they provide for the continuance of the displacement. This condition never fails to produce much superficial irritation, which, if neglected, leads on to iritis, so that the position of the lower lid must always be carefully looked to, and any tendency to displacement must be remedied without delay. All that is necessary in this direction may be accomplished by contractile collodion, if only it be effectually applied; but so much depends upon the fulfilment of this condition that the application should never be committed to any but thoroughly trustworthy hands. Much of the collodion sold under the name is not really contractile; and the surgeon should always test it by applying a drop to the back of his own hand, and should not use it for the patient unless, in the act of drying, it pulls the skin into strongly marked wrinkles. When satisfied on this point, the next thing is to draw the lower lid well downwards and away from the eye, and thoroughly to dry its cutaneous surface, to which, otherwise, the collodion will not adhere. The collodion should then be painted on with a camel's hair brush, not too large, which must be carried quite up to the ciliary margin of the lid, along its entire length, so that the collodion film comes into contact with the bases of the lashes, but does not pass upon the free lid margin within them. The application should be liberal in point

of quantity, and should extend well downwards upon the cheek ; but the most important point is that it should go up high enough. If it does not cover the upper portion of the lower lid, this upper portion will become tucked in as before, notwithstanding a patch of collodion below it. The lid should be held down until the drying of the film, which should occur within a minute or so ; and, in the meanwhile, any overflow of tears should be arrested by a morsel of absorbent cotton wool. The film once dry, a little almond oil may be brushed over it, and then it will scarcely be affected by lacrymation. As soon as the surgeon has satisfied himself that the lid is completely commanded, and that no attempt to close the eye can again invert it, the ordinary dressing may be applied, and the collodion film will generally require to be peeled off daily, and renewed with the same precautions as before. I believe it is only to neglect of these precautions, or, in other words, to inefficient application, that its supposed failures have been due. In any case, however, where the close personal supervision of the operator cannot be obtained, it is better to proceed at once to a more radical plan of treatment, which cannot fail, and which consists in the excision of a strip of skin and muscle from the eyelid, parallel with its margin. The piece excised must not be too wide, lest permanent deformity be produced. It should be taken from close to the lid margin, and the wound should be united by a single fine suture. Where lid inversion has already done mischief, the bleeding from the skin excision seems to be sometimes serviceable. The state of inversion is one with which it will not do to temporise ; for I believe it is never recovered from spontaneously, and that it never fails to do harm. Dr. Bell Taylor has

proposed to treat it by the application of a pair of flat bulldog forceps, which pinch up and retain a horizontal fold of skin, but I have no experience of this method, which would certainly, I think, be more painful than excision. It will generally be desirable, whenever lid inversion is at all threatened, although not present in a manner sufficiently declared to call for interference, to leave off a bandage if the state of the eye will at all permit. The heat and pressure which a bandage produces seem to be predisposing causes of the exaggerated action of the orbicularis.

Practically speaking, the only other complication which can follow extraction is the occurrence of internal inflammation ; and as this, in whatever structure it originates, owes its chief importance to the participation of the iris, it may conveniently be called iritis. We may say of it that it is least severe, and least likely to be attended by permanent ill-consequences, when it is excited by hæmorrhage into the anterior chamber, or by inversion of the lid, and that it is most likely to be hurtful when it is excited by the presence of retained cortex, especially if this should have undergone manifest proliferation and increase. In such circumstances, the inflammation is apt to assume a septic character, to extend to the ciliary body and choroid, and to terminate in wasting of the eye.

When iritis occurs in any severity, the treatment must be conducted on the general principles of relieving pain, supporting strength, diminishing vascular action, and relieving tension. In these, which are practically traumatic cases, occurring in old people, mercury, I think, is seldom or never indicated. A leech, or two leeches, applied about an inch from the margin of the

orbit, and repeated according to circumstances, the application of moist compresses, or of fomentations, at a temperature governed by the sensations of the patient, the performance of paracentesis of the anterior chamber, by which, together with the aqueous humour, softened cortical matter may often be removed from the eye, and the prompt division of any organised films, which may form a barrier between the anterior and the posterior chamber, will constitute the chief points which require attention. In any case in which the two chambers become completely separated, there is no time to be lost; for the accumulation of fluid, which occurs behind the barrier, will soon prove permanently destructive to vision. It is useless, generally speaking, to rely upon any small opening, and the only trustworthy method is by the free division of the tissues concerned, which, generally speaking, consist of iris, the posterior lenticular capsule, and more or less lymph which has been effused upon or between them. The plan which I find most effectual is to divide the whole of these structures, generally in a horizontal direction, by a pair of scissors which were devised, for this especial purpose, by Mr. Foveaux, formerly of the firm of Messrs. Weiss and Son. Even when the iritis is not severe, there is generally, after the extraction of immature cataracts, some indication of its presence; and whenever it occurs, in however slight a degree, the pupil is certain to be more or less occluded by films, sometimes of a very delicate character In some of these cases, it will be sufficient to divide the films by Sir William Bowman's elegant method, by the simultaneous use of two needles; but in many, I think the use of the scissors is to be preferred, in a direction downwards, and that it is better to make also a rather

free division of the lower part of the iris. By following this plan, all risk of future traction upon any part of that membrane is finally set aside.

The comparative frequency with which pupillary films require treatment in the modern operations for cataract, and especially after operations for the removal of cataracts which are not fully mature, must not, I think, be regarded entirely as a disadvantage. All operations for the removal or division of films, whether by needles or scissors, divide also the posterior capsule, and afford free communication between the aqueous and the vitreous chambers. The presence of this communication is found, in practice, to afford great security against the occurrence of secondary glaucoma.

I have now, Sir, although in a very fragmentary and imperfect manner, endeavoured to give such a sketch of the chief features of modern cataract operations as the time at my disposal would allow ; and it only remains for me briefly to recapitulate the conclusions which I have ventured to set forth. They are, that the performance of iridectomy as a preliminary operation, and the subsequent employment of a comparatively small section through the tunics of the eye, have combined to render the extraction of cataract a more simple, and hence a more frequently successful operation, than it has been at any previous period of surgical history ; and that the improvements thus effected have enabled surgeons to deal with comparatively immature forms of the affection, and to rescue from impending blindness many of those who, only a few years ago, would have been left unaided until blindness was complete. These great boons to humanity have not been without their drawbacks, and the extraction of cataracts at an early date is still beset

with risks of a peculiar kind, which require, in order that they may be obviated, the possession and the employment of all the resources of the healing art. These risks, however, are such as may properly be incurred in the presence of any adequate inducement; and there are very few people in whom the approach of cataract produces incapacity for the ordinary work or the ordinary amusements of life, in whom it would not be justifiable, with one eye at least, to take steps for their speedy relief. It only remains that I should tender my thanks to you, Sir, and to the Fellows of the Society, for the great indulgence, patience, and kindness, with which my humble efforts have been received.

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