operation is deferred the older will be the patient, and the greater the depressing effect exerted on his morale by impending and advancing blindness.

Patients are often encouraged by their home advisers to wait until both eyes are fully affected, in order that both may be operated on at the same time. While the simpler cataract operations may undoubtedly, under ordinary circumstances, be performed in the young on each eye at one time, without incurring unwarrantable risk, the extraction of senile cataract on both eyes simultaneously is unjustifiable, save in the most exceptional cases. And this for the following reasons: If one eye only be operated on, the symptoms which follow, and the way and manner in which the eye rallies from or, in extreme cases, sinks under the violence inflicted on it, guide us materially in what we are to do for the other eye, and teach us to adopt such precautions, or so to modify our method, as to give the patient a better chance of sight, and to save him from the dangers to which our ignorance of his idiosyncrasies exposed him the first time. Again, a patient or his attendants, being little used to such delicate operations, may be imprudent, transgress our positive directions, and consequently lose the eye. If both eyes have been operated on, his only chance is gone. If, however, one only has been touched, he will learn wisdom with experience, and insure success by being more careful the second time.

It is true that the refusal of the surgeon to operate on both eyes at the same time often practically results in but a single operation being performed. After the confinement of a fortnight in a darkened room the average patient may well shrink from a repetition of his experience, or fear its effect on the general health. Many people have not the time to give to the second operation, or the means of meeting its attendant expense. These are, however, minor considerations, and are not to be weighed in the balance with those which have been brought forward to show the superior safety of operating on but one eye at a time, in all cases of senile cataract.

The Result of the Operation for Cataract.—In the most favorable cases the obstruction may be entirely removed from the axis of vision and full sight acquired, its acuteness being quite equal to the normal standard. Under such circumstances all the eye has lost is the power of accommodation, which must be met by the use of glasses of different strengths for different purposes, or by shifting the interval between the glass habitually worn and the eye.

But not always is the result thus successful. Portions of the lens may remain behind in the intracapsular space, clots of blood may be imperfectly absorbed, or inflammation may cause a proliferation of opaque substance on the face of the capsule: the whole sometimes becoming more or less adherent to the edge of the pupil. This forms what is known as secondary cataract, and demands in its turn an appropriate operation, or the loss of the eye may be entire, the inflammation following the original operative interference being so violent as to cause entire opacity of the cornea, or even wasting away of the eye itself. An irritable stump, thus left, may give rise to sympathetic ophthalmia of the remaining eye, a condition of things which may also be brought about by the antecedent inflammation. This result is fortunately extremely rare, and may not once occur in the experience of a lifetime.

Antiseptic Measures.—Before entering on the description of the various operations for cataract, the question of antiseptic measures is naturally to be considered.

Our attempts at sterilization apply to the patient, the operator, and the instruments, the latter being by far the most fertile sources of infection. The surgeon and his assistants should wear special outer garments. Those made of linen, freshly washed and ironed, answer a useful purpose. The hands are to be thoroughly washed in warm water and with soap, scrubbed with a nail brush and afterward dipped in a four-per-cent. carbolic solution, or else in one of corrosive sublimate (1 to 2,000). As far as the patient is concerned the vicinity of the eye and the edges of the lids are to be carefully washed with soap and water, after which a sterilized pad, soaked in the same solution of corrosive, large enough to cover the eye and its immediate neighborhood, may be applied and left in place until the moment for operating arrives. After using the anæsthetic the conjunctival sac may be washed out with sterilized water, or a weak solution of corrosive (1 to 5,000). It seems a matter of comparative indifference which of these methods is employed, as so momentary an application will have but little effect on any bacteria that may be present. Particular attention is to be paid to the state of the lachrymal sac, and its freedom from infectious secretion is positively to be ascertained.

It is in regard to the sterilization of the instruments and the manner of bringing this about that the greatest diversity of practice has perhaps obtained and the most different methods have been adopted. The delicate instruments used in ophthalmic surgery must naturally be handled with greater care than many of those employed on other parts of the body. Immersion in solutions of corrosive sublimate corrodes metal and ruins the edge of the knife. A four-per-cent. solution of carbolic acid has been proved insufficient to destroy the suppurative germs. To bring about this result with certainty, probably no agent is more efficacious than heat, in either the dry or the moist form. Yet each of these has its disadvantages. Steaming or boiling, the latter in simple water or in alkaline solution, is apt to be followed by rusting. Baking at a temperature of 150° C., continued for an hour or more, is absolutely certain. But all instruments subjected to this must be made with metal handles in place of ivory or bone, and it is doubtful whether the fine knives used for the corneal section would, after such baking, retain a perfect edge. Many operators, influenced by the above considerations, content themselves with immersing their instruments, previously thoroughly cleansed, in a bath of absolute alcohol before the operation, and withdrawing them one by one as they are wanted for use.

But experience shows that knives thus immersed suffer appreciably in their cutting properties. It is the custom of the writer to have a small vessel of boiling water brought to the bedside, just before the operation is commenced, and to immerse the blade of the cataract knife and the point of the keratome in it for a few seconds.

Anæsthesia.—General anæsthesia, brought about by ether or chloroform, has now, in the vast majority of cases, given place to the local anæsthesia induced by cocaine. This agent was introduced and its properties were explained by Koller in 1884. Its use has become general. Employed ordinarily in the form of the hydrochlorate, and in a solution varying from two to five per cent. in strength, its contact with the eye brings about anæsthesia of the conjunctiva and cornea, coming on in from one to two minutes and lasting some ten minutes. In an operation for the extraction of cataract it should be applied two or three times. It is well to remember that the sensitiveness of the iris is not materially affected by the cocaine, and to prepare the patient for a certain amount of pain in case an iridectomy forms part of the operation. Besides producing anæsthesia of the surface of the eyeball, cocaine brings about other changes. It contracts the blood-vessels of the iris, and thus gives rise to a temporary mydriasis; it empties also the conjunctival blood-vessels. On account of this double effect the annoying hemorrhage that sometimes so much embarrasses the performance of an extraction is much less likely to occur. There is also noticed a wider opening of the lids and a lessened tendency to wink. Finally, the intra-ocular pressure becomes slightly reduced.

If the surgeon finds it impracticable to prepare a sterilized solution of cocaine on the spot, he may use a 1 to 5,000 solution of sublimate as a menstruum. It is best to prepare the patient for a slight smarting sensation when the first application is made to the eye. This very rapidly disappears.

A one-per-cent. solution of holocain gives a local anæsthesia quite as effective as that produced by cocaine. It causes an even greater degree of insensibility of the iris. It gives rise to no constitutional symptoms, as is sometimes the case with cocaine. It has the advantage of being distinctly bactericidal in its action. But it does not arrest hemorrhage as does cocaine. The solution of holocain should be made in porcelain, never in glass, and keeps indefinitely.

There are other local anæsthetics, none of which seems to deserve comparison with the two above described.

Discission.—In this operation the removal of the cataract is sought to be effected by wounding the anterior capsule, and bringing the aqueous humor in direct contact with the lens; the object being to cause its complete absorption without impairing the transparency of its capsular envelope. The former object will not be attained if the consistence of the cataract be too great or its sclerosis too marked. The latter cannot be secured if the operation be followed by serious inflammation, due to the excessive effect produced by its performance, and which would follow a want of care in proportioning the size of the opening in the capsule to the amount of toleration the eye is capable of exhibiting.

The substance of the lens, brought into direct contact with the aqueous humor, imbibes it just as a sponge soaks up water. Like the sponge it swells, and then slowly crumbles away and dissolves. It is the tendency to swell, and thus exert mechanical pressure on the contiguous parts that constitutes the main danger of the operation; and it is the merit of von Graefe to have first insisted on the necessity of proportioning the opening in the capsule to the amount of lenticular swelling the eye can safely sustain. The rapidity of absorption depends on the age of the individual, being most active with the young. The amount of swelling varies according to the maturity of the cataract and the period at which it is attacked.

The course of normal absorption is as follows: First the edges of the capsular wound retract; then the lens substance begins to swell and protrude into the anterior chamber. Oblique illumination brings it into relief as a grayish plug, blocking the opening left by the needle. In some cases the whole lens gradually swells and presses forward until the anterior chamber is completely blocked; in others the process is more gradual, and each successive protrusion slowly undergoes absorption. It first grows larger, then more transparent, next its surface becomes irregular, is gradually eaten away, and the mass finally disappears. Sometimes small fragments are successively detached, fall down, and are dissolved. One mass succeeds another, protrudes, and goes through the same process until the whole lens has been removed.[1] It is evident that the aqueous humor that accomplishes this task is too insignificant in amount at any one time to do more than a small portion of it, and must hence be steadily undergoing both excretion and renewal. As will be seen later on, Arlt bases on this fact a recommendation to hasten absorption, in cases in which it is progressing with unusual slowness, by occasionally doing paracentesis of the anterior chamber, and thus artificially removing the saturated aqueous.

We have thus traced the course of an operation followed by normal absorption. But all cases do not progress thus favorably. The lens may imbibe the aqueous humor too freely, and swell with a rapidity that causes destructive pressure to be inflicted on the surrounding parts. The pupil may then be seen to contract, the ciliary redness that naturally is present in some degree during so active a process as absorption becomes alarmingly great, and even conjunctival chemosis may ensue. The iris becomes discolored, the eye waters, intolerance of light is felt, local pain becomes severe, radiating in every direction, and finally, unless proper measures of relief are taken, vision may gradually be extinguished by the development of secondary glaucoma, the legitimate consequence of the great increase in pressure. As has been observed by von Graefe, these symptoms are almost exclusively met with in the young, the lens in elderly people rarely imbibing aqueous humor so rapidly or to such a dangerous extent.

To avoid iritis caused by direct pressure of the swollen cortical mass on the iris itself, it is most necessary that the pupil be fully dilated before the operation, and kept so during the whole of the absorption. An important contraindication to the performance of simple discission is therefore the failure of the pupil to respond to the action of a mydriatic. Cases in which the pupil cannot be readily and largely dilated are not those in which the performance of a simple discission is at all admissible, and this test should always be employed before deciding on the character of the operation to be selected.

This operation is admissible in all simple lenticular cataracts of early life, up to the twenty-fifth or thirtieth year. It is especially to be employed in the case of infants, both because the size of the opening in the eye is so trivial as to obviate the necessity of attention to the healing process, and because at this age absorption takes place with such rapidity that the pressure of the swollen cortical mass is but little to be dreaded. It is also advisable to do discission in lamellar cataract that occupies so large an area as to render an iridectomy useless, and when the patient has not passed the age of twenty. In the traumatic cataract of early life, where the extent of the original injury has been so limited as to produce an effect but slowly progressive, this operation may be used to hasten ripeness of the cataract, and to promote rapidity of absorption. For nearly a generation it has been justly abandoned in all cases of senile cataract.

Instruments; Preparation of the Patient; Method of Operation.—The instruments needed for the performance of discission are the ordinary spring speculum, fixation forceps, and stop-needle. The latter (Fig. 1151), the perfection of which we owe to the inventive genius of Sir William Bowman, ought to be extremely slender, with a cutting edge of not more than a millimetre in extent. Its shaft should so completely fill the wound made by its point as to prevent the escape of the aqueous humor by its side during the operation. This would cause the lens to fall forward against the cornea, and embarrass the use of the needle. Lower down the instrument is furnished with a shoulder, which renders its penetration into the eye, beyond a certain depth, impossible.

Fig. 1151.—Discission Needle.

The patient may sit in a chair, facing the operator, unless anæsthesia be employed, when the recumbent position is of course preferable. The objections to the use of anæsthetics during the extraction of cataract do not apply to the operation of discission. Although the pain is not excessive, the subjects are young and consequently nervous; and, as will be seen, it is important that sudden spasmodic attempts to close the eye should not be made. Narcosis is therefore generally desirable, and its practice renders an assistant, for the most part, unnecessary. The pupil, as has already been stated, should be fully under the influence of atropine. The lids being separated by the introduction of the speculum, the eye is grasped by the fixation forceps at a point opposite to that selected for the introduction of the needle, generally over the insertion of the internal rectus. The point of the needle is now applied to the cornea midway between its centre and periphery, downward and outward, and made to transfix it in the direction of the posterior pole of the lens, and perpendicular to the corneal surface, so as not to penetrate it obliquely. As soon as the needle has passed in up to its neck the handle is lowered and the point carried forward until it touches the anterior capsule at a point outward from its centre, perhaps midway between that and its periphery. Raising the handle, and now regarding the instrument as a lever, the fulcrum of which is where it passes through the cornea, the operator makes its point descend along the face of the capsule, and inflicts on this membrane a vertical wound, some 2 mm. in extent. Lowering the

handle now, and at the same time slightly withdrawing the needle so that its point is no longer in contact with the capsule, he again pushes it forward, directing this time to a point on the nasal side of the horizontal meridian of the capsule, midway between its centre and periphery, and then making it inflict on its face a horizontal wound, precisely similar to the vertical one already made. The needle is then gently and steadily withdrawn, being held in the same position as when it entered the eye. At the instant of withdrawal it is well for the operator, if unassisted, to release the fixation forceps and raise the speculum slightly from off the eye, with his left hand, so that no pressure may be made upon it. The aqueous humor is thus less likely to escape, and the pupil consequently remains dilated. For a similar reason the removal of the speculum must be conducted with great care, and without touching the eyeball. If anæsthesia remain profound no spasmodic closure of the lids will occur at this juncture, and no aqueous be lost.

Great care must be taken not to bruise or crush the cornea by too forcible manipulation of the needle, and to this end it should be simply allowed to rest lightly on the cornea, at its point of passage through it. The incisions should be as nearly as possible at right angles with each other, and should not be extended as far as the equator of the lens, in order to avoid too rapid swelling, as well as adherences between capsule and iris (Arlt). Should the needle slip out of the eye before the operation is completed it may be reintroduced, unless the aqueous has escaped, in which latter case the operation must be desisted from until the aqueous has again collected.

When a single operation proves sufficient the average time necessary for the absorption of the lens is ten weeks. But the process does not always go on uninterruptedly. A small capsular opening may be so blocked by the protruding fragment of lens as to cut off the access of aqueous humor to the parts behind, and absorption of this fragment may be followed by closure of the wound. In such cases the operation must be repeated and larger incisions made. Occasional paracentesis of the anterior chamber greatly promotes absorption, but would be needed only in exceptional cases.

After-Treatment.—A bandage is of doubtful utility. With very young children it encourages weeping, and its moral effect is at any age depressing. A shade, covering both eyes, may be given, and the room be dimly lighted. The pupil must be kept permanently dilated with atropine, a half-per-cent. solution of which should be applied three or four times a day, except in the case of very young children, in whom there is danger that symptoms of intoxication may manifest themselves. The atropine is to be continued as long as the absorption is going on, though after the first it need not be applied so frequently. If symptoms of reaction occur, as indicated by watering, undue ciliary redness, and local pain, strict quiet is to be enjoined and cold compresses are to be applied to the eye. If they continue, one or more leeches may be applied on the temple, care being used to apply the leeches as far as possible from the eye itself. The bowels are to be kept open. If no relief is experienced, and the symptoms grow more pronounced; if tension increase, chemosis appear, and pain become more severe, it will probably be necessary to open the anterior chamber and evacuate the aqueous humor through an opening sufficiently large to allow any detached fragments of lens substance to escape at the same time. In extreme cases it may be necessary to practise linear extraction of the whole lens, with or without iridectomy.

Modified Discision.—In cases in which the pupil fails to respond promptly or thoroughly to atropine, or in which other indications of a tendency to inflammation are present, the operation of discission is rendered much more likely to succeed by the performance of an iridectomy three or four weeks before the use of the needle is undertaken. The excision of iris should be done upward, and the piece removed be of good size, and extend up to the ciliary edge of this membrane. The increased area thus given to the pupil lessens the number of points of contact between the cortical substance and the iris, renders contraction of the pupil much less to be dreaded, and diminishes the danger of secondary glaucoma. This last complication is not infrequently the cause of the blindness that sometimes follows discission, and the likelihood of its occurrence varies directly with the advance in age of the individual. In the performance of this modified discission Wecker[8] advises that the capsule be opened principally within the area of the new pupil, thus limiting the precipitation of fragments of the crystalline into the anterior chamber, and regulating the advance of the absorption. When the upper portion of the lens has thus been removed, its lower part may more advantageously be attacked.

With regard to the operation of discission in general, it may safely be stated that, allowing the cases to be properly selected, and due care used in its performance, it is the safest and surest method at our command. Total loss of the eye is, under these circumstances, excessively rare.

In former times yet another method was practised, having for its object the removal of the cataract from the axis of vision without taking it out of the eye, namely, the operation of *reclination* or depression. A needle specially adapted to the purpose was passed in through the sclerotic, and used to tear the opaque lens away from its attachments, and lay it at the bottom of the eye. False in principle, and often disastrous in result, leading to restoration of vision in but from fifty to sixty per cent. of the cases in which it was used, this operation has justly been abandoned, and is, therefore, no longer to be described among the methods in use at the present day. It is still, however, of interest from a historical point of view, and will be alluded to at length in a subsequent portion of this article. For the present we proceed to the consideration of those operations which rest on the principle of the total removal of the cataract from the eye, and commence with the one involving the smallest solution of continuity, the method of

Suction.—This may be considered the operation of aspiration applied to cataract. Throughout the series of operations that have for their object the extraction of the lens, one of the great dangers to be apprehended is that connected with the healing of the wound necessarily inflicted on the eye. The larger this is, the greater the danger of inflammatory and other complications. Such accidents are least to be dreaded after a discission, they are appreciable with a linear extraction, and, as will be seen, the risk becomes greatest of all in the case of flap extraction. A method which should bodily and entirely remove the cataract through the smallest possible opening avoids at once the dangers attendant on slow absorption and the chance of the imperfect healing of a large wound. The operation of suction fulfils both these conditions. It is accomplished by means of an instrument formed from the glass barrel of an ordinary subcutaneous injection syringe, to one extremity of which is attached a piece of rubber tubing ending in a mouth-piece, while on the other end is a bent hollow needle of large size, open at its extremity. This needle is passed through a small opening in the cornea and anterior capsule, the air in the tube is then exhausted, and the soft cataract substance flows in to take its place.

This, in brief, is extraction by suction. It is a method of great antiquity. Evidence exists of its having been used in the East in the fourth century, and frequent subsequent references are made to it in ophthalmic literature. In 1846 it was revived by Laugier, who made his opening in the sclera, and introduced the point of the suction needle through the posterior capsule. Teale, in 1864, published a drawing of an improved instrument, and recommended a method of operating which is substantially that in use at the present day. Since then most authors refer to the proceeding. Yet it cannot be said to have ever yet found its way into general favor, or to have met with the appreciation which, in a certain class of cases, it really deserves.

It is probable that extraction by suction would have

attained greater popularity had the indications for its performance been better understood and the class of cases to which alone it was applicable, more sharply defined. Authors, for example, report instances of subsequent inflammation and failure in lamellar cataract, a form to which this operation is wholly inapplicable. It should never be employed save in cases of known soft or liquid cataract, and in the traumatic form of the disease occurring in persons under the age of thirty. And in the latter class some time should be allowed to intervene between the accident and the operation, several days, or even a week, being, if possible, suffered to elapse, in order that the whole of the lens substance may become thoroughly opaque. The instruments needed are a spring speculum, fixation forceps, bent broad needle, and the suction apparatus (Fig. 1152). To the form of this latter especial attention is directed, as the figure here given differs materially from the instrument described by Mr. Teale, and generally used abroad. Our barrel is shorter, and slightly less in diameter than the English; the neck of the hollow needle, at its lower end, exactly fits the opening made by the broad needle, and the opening is across the extremity (Fig. 1153) instead of being on its front face. The rubber tube that connects with the mouth-piece has a coil of light wire running the entire length of its interior. Each of these modifications offers a corresponding advantage, as will be seen when the operation comes to be described; and the greater favor it has met with in America may with justice be attributed, at least in part, to the superiority of the native instrument.*

Fig. 1152.—Suction Apparatus. (Reduced in size.)

Operation.—This is by no means devoid of pain, and an anæsthetic may be used to advantage. The pupil should of course be fully dilated. The surgeon, sitting behind the patient's head, fixes the eye with forceps, and makes, with a bent broad needle, an oblique incision through the cornea at a point outward from its centre and about three-fifths of the distance between that and the sclero-corneal junction; preferably in the outer-upper quadrant on the right side, in the upper-inner on the left. The point of the needle is carried across the anterior chamber, made to penetrate the anterior capsule, and then withdrawn. If this be carefully done, all the aqueous humor may be retained. The suction instrument is now introduced, its orifice being directed upward, and its point brought in contact with the lens substance. This being done, the air is withdrawn by the mouth, the force applied being perhaps similar to that used in smoking a well-made cigar. The neck of the hollow needle exactly fitting the wound, the instrument may be rotated, advanced and in part withdrawn, without loss of aqueous; and the important advantage is thus gained of not coming in contact with and bruising the iris. After the lens matter has filled the instrument it may be withdrawn, cleansed, and if necessary again inserted, though it will be better if this can be avoided. While the suction is going on the wire in the flexible tube prevents this from doubling on itself, and thus obstructing the draught of air. The shape of the aperture of the needle enables the surgeon to search for separate portions of lens matter, and apply the point directly to them, while they are drawn in with a much greater facility than would be the case with an opening differently situated. The operation completed, the instrument is withdrawn and a bandage applied. It is ordinarily unnecessary to keep the patient in bed more than twenty-four hours, or even to retain a bandage for a longer period. A shade may be worn over both eyes until all redness has disappeared, but the amount of reaction is often astonishingly slight. A fear has been expressed lest vitreous should be drawn into the tube. This seldom happens, especially with the instrument here described, the length having been curtailed and the calibre reduced in order to get less atmospheric pressure and thus avoid the accident.

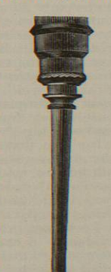

Fig. 1153.—Magnified Picture of Point of Suction Instrument.

As regards the results of the suction operation, the reports of the Massachusetts Charitable Eye and Ear Infirmary for the last eleven years show the performance of one hundred and seven operations by suction. In some of the reports the results of that year are given, in others the number of operations is simply stated; no selection in either case having been made. In the 65 recorded cases the results are as follows: full success, 46; partial, 18; loss, 1. In 5 of these cases vision was perfect, that is ten-tenths.

Fig. 1154.—Straight Lance Knife.

Simple Linear Extraction.—In the operation just described the opaque lens substance was removed through a minute opening, by being made to flow into a vacuum. In that now under consideration the same thing is effected through a larger opening and by pressure. It is used for the same class of cases, viz., liquid, soft, and traumatic cataracts, in those who have not yet passed the age of twenty-five; and is moreover applicable to shrunken or rudimentary cataracts, on which suction would have no effect. And it is to be borne in mind that, while extraction by suction has never yet found universal favor, or been much practised out of England and America, linear extraction has long and generally been regarded as an operation both justifiable and valuable.

Fig. 1155.—Cystitome.

The instruments used in its performance are a spring speculum, fixation forceps, straight lance knife, cystitome, and Daviel spoon (Figs. 1154, 1155, 1156). Iris forceps and fine scissors should be in readiness, in case it is found necessary to excise a prolapse. The forceps may also have to be used where a shrunken cataract is to be removed.

Fig. 1156.—Daviel Spoon.

The patient is to be in a recumbent position, and to have the pupil fully dilated. Anæsthesia, either general or local, may advantageously be employed. Having grasped, with the fixation forceps, a fold of conjunctiva to the inside of the cornea, the operator makes an incision with the lance knife in the corneal substance, perpendicular to the surface of this membrane, and at a point on its horizontal meridian either midway between its centre and outer edge or, if nearer the latter, at least 2 mm. removed from it. As soon as the point of the instrument has entered the anterior chamber its direction is changed, and the knife is pushed forward in a plane parallel to that of the iris. A wound of from 6 to 8 mm. having been made, the lance knife is slowly and steadily withdrawn, care

* This instrument is the one in use at the Massachusetts Charitable Eye and Ear Infirmary, and the modifications here detailed are largely due to the late Dr. Robert Willard.

being taken to keep it always in the same plane, and thus avoid the too rapid escape of the aqueous, an event which would be followed by the contraction of the pupil. Owing to the triangular shape of the knife it is evident that the inner wound must be smaller than the outer, and it is well to attempt to equalize the two by directing the point of the lance either a little upward or a little downward, as it is withdrawn. But it should never be rotated, and should exert as little pressure as possible.

If the capsule is opaque, or if we are seeking to extract a shrunken cataract, a small sharp hook, or the iris forceps, may now be introduced through the wound, and the capsule or cataract seized and withdrawn. If, however, we are dealing with an ordinary soft cataract, the next step is the opening of the capsule. The cystitome is passed through the wound by gently pressing it against the outer edge, its cutting edge being held parallel with the face of the cornea. Once in the anterior chamber its flat is made to glide over the front of the cataract until the point at which it is desired to commence the capsular opening is reached. The handle of the instrument is then turned so as to have the edge face the capsule, on which a wound is inflicted by the withdrawal of the cystitome in its new position, care being taken that the handle is again rotated just before the edge of the pupil is reached, so as to avoid wounding the iris. If the cataract be very soft the cortical mass will now begin to escape and rapidly fill the anterior chamber. Many operators content themselves with this single opening, which is quite sufficient when a Graefe's cystitome is used, as a triangular flap is thus torn from the capsule. (This is the instrument given in Fig. 1158.) If a straight cut be made in the capsule it must be supplemented by another running at a slightly different angle; a large capsular opening being essential to the entire removal of the cataract, as well as the prevention of secondary capsular opacity. Many of the cataracts removed by this operation are very thin, and care must be used not to sink the point of the cystitome so deeply in the mass as to wound the posterior capsule.

The opaque lens is next to be removed by pressure. At this stage of the operation it is better to take out the spring speculum, and to raise the upper lid with the thumb of the left hand. The rounded back of the Daviel spoon is now to be applied to the portion of the cornea that remains between the opening and the periphery of this membrane, and the wound so made to gape slightly. Pressure thus judiciously applied, aided by a slight amount of rubbing in the same region, will often cause the expulsion of the lens substance. But if this takes place very slowly, or ceases altogether, counter pressure may be applied through the upper lid, at the opposite side of the cornea, by means of the thumb that is used to hold the lid in place. The pressure and counter pressure thus made must be used alternately, with a gentle rocking motion, until the last portion of the cataract has emerged and the pupil has taken on a uniformly black appearance.

If the nucleus should turn out larger or more consistent than was expected, and hence refuse to pass through the wound, the Daviel spoon may be gently introduced and an attempt made to extract it, either whole or piecemeal. Care must be taken not to rupture the posterior capsule, as the escape of vitreous both complicates and retards convalescence, besides at once interrupting the operation if it occurs in its early stages. The fragments of the cataract are then often driven apart and away from the wound, and cannot in many cases be collected or removed without entailing a dangerous loss of the vitreous humor. If a prolapse of the iris takes place, it may be allowed to remain until the cataract has been removed, when it will often return spontaneously, or can be made to do so by gently rubbing through the closed lids. But if it obstinately retains its position, it must be at once excised. The healing of this into the wound might not only alter the corneal curve, but prove a source of irritation by the traction it would exert, thus giving rise to serious trouble. It might also increase the density of the scar. The more peripheric the wound the greater the danger of prolapse.

Fragments of the cataract remaining in the pupil imbibe aqueous humor, swell, and may thus give rise to grave inflammatory symptoms; causing iritis, and delaying or preventing the healing of the wound. It may not always be possible to effect a complete removal of these portions, owing to the size of the wound, the consistence of the cataract, or the lodgment of the smaller pieces in remote situations inaccessible to ordinary pressure. As Arlt, whose account of the operation has largely here been followed,[9] justly observes, simple linear extraction is by no means as universally applicable in cases of soft cataract as the first accounts of the operation, given by von Graefe, would lead one to suppose.

After-Treatment.—After having instilled a drop of a solution of atropine, and ascertained that the lips of the wound are in proper coaptation, as well as that no remains of the cataract or coagulated blood are to be found in the conjunctival sac, the eye is closed, and a simple compressive bandage applied over each eye, thus securing absolute repose. An elliptical piece of linen, soaked in the weak sublimate solution, 1 to 5,000, is first laid on each eye. The orbital cavity is then evenly filled with corrosive cotton applied in small tufts, as evenly distributed as possible. These, as well as the bandage itself, should of course have been carefully sterilized. The hand, passed over the summit of the heap, should not distinguish the prominence of the eyeball. This process having been completed, the whole mass should be made to exert gentle pressure on the eye by means of a bandage, which may be either a simple cotton or flannel roller, or, still better, the so-called Liebreich bandage. The simplest form of this well-known appliance is a cotton band, about 30 cm. long and 6 wide, knit in small alternate squares, the threads in adjacent squares running at right angles to each other. Long tapes are attached to each of the four corners. The peculiar construction of this band insures a considerable degree of elasticity, and it is held in place over the eyes by securing the tapes behind the head, the two upper being tied above, the two lower below the crown. It is well to remove the bandage some eight hours after the operation, gently sponge the outer surface of the lids, and apply a fresh dressing. If no pain, swelling, or excessive lachrymation be present, nothing will be gained by opening and examining the eye. At the end of twenty-four hours, during which time the patient has been kept in a recumbent position, it will be well to open the eye and instil a drop of a solution of atropine. The bandage is now to be changed once a day for three or four days, when it may be removed altogether and a shade over both eyes substituted. After the first day the patient may leave his bed. As the redness slowly disappears, more light may be admitted and moderate use of the eyes allowed. It must be remembered that the wound requires several days to consolidate, and that during this time it is no difficult thing to separate its edges.

Local pain, redness, and increasing photophobia are evidences of excessive reaction. The bandage may then be removed and cold compresses substituted, leeches applied to the temple, and even subcutaneous injections of morphine made in the same region if the suffering is considerable. The bowels must be kept open. If none of these measures give relief, the aqueous humor is to be evacuated; better, according to Arlt, through a peripheric puncture, than by reopening the original wound. In spite of all these precautions, iridocyclitis may ensue, and even give rise to sympathetic affection of the remaining eye. Such cases are, happily, very infrequent.

We now come to the consideration of one of the most important operations on the eye—that for the removal of senile cataract. It is proper to consider it immediately after linear extraction, just described, inasmuch as the most approved method now in use is that of peripheric linear extraction; a proceeding somewhat allied to the foregoing, and the general adoption of which has resulted in the virtual abandonment of flap extraction, so universally practised less than a generation ago. Before, however, commencing the discussion of this method, it is desirable to consider one or two plans that have been recently proposed for the artificial ripening of senile cataracts, the formation of which proceeds with unusual slowness. This delay in the growth of cataract has been alluded to in an earlier portion of this article. In many cases, as was there stated, it proves a serious misfortune to the patient. All power of using either eye on near objects may be gone; it may even be difficult for the individual to move about unattended, especially in strange places, and he may thus become a burden to his family. Meanwhile the cortical substance still retains a portion of its transparency. The best years of life are passing away, or those dependent on the patient may be reduced to poverty in consequence of his inability to continue their support. Something ought, under such circumstances, to be done; and the alternative to removing an unripe cataract is the artificial production of maturity.

Two methods alone are regarded at the present day as offering ordinary chances of safety. The first is that proposed by Professor Förster, of Breslau, in 1881, and consists in the performance of an iridectomy upward, together with the rubbing of the cornea, over the face of the lens, with the angle of a strabismus hook. There being no anterior chamber, the pressure is directly applied to the lens through the intervening cornea. "The effect in ripening the cataract," says Förster, "is frequently to interrupt the entire reflex from the fundus within six days. In from six to eight weeks at farthest the cataract entirely matures." At the time of his bringing out this method he had practised it for five years and in about one hundred and fifty cases. He considered it chiefly applicable in cases of senile cataract with hard nucleus, and partially opaque cortical; but advised that it be not employed in posterior polar cataract. He warned against using a pressure, on the one hand, so light as not to hasten the cortical opacity, and on the other so extreme as to rupture the zonula. Recently Dr. Charles Bull, of New York, has given an analysis of thirty cases, in which he employed this method. In addition to the rupture of the zonula, which may be produced by too strong pressure, he alludes to another consequence, "a striated or radiating opacity of the cornea, which seems to be confined to the anterior layers, frequently remains for a long period, and fades out but slowly." He also recommends a rotatory rubbing or massage. Slight iritis has been observed to follow the operation by several observers, including the present writer. In Dr. Bull's series, iritis occurred five times. All his cases were successful, vision ranging between $\frac{2}{10}$ and $\frac{8}{10}$ in all but three, in which it was under $\frac{2}{100}$. The average duration of the confinement, after the first operation, was five days.

The second method of artificially ripening a cataract was alluded to by Förster when he brought forward the operation above described. It had been, he said, observed by Snellen that a simple iridectomy would sometimes hasten the progress of lenticular opacity. This he confirmed from his own experience. In a recent publication Jakobson again calls attention to this fact. "It is well known," he says, "that, up to within a short time, people half blind were obliged for months, and sometimes even for years, to rely on extraneous aid. By the performance of an iridectomy we are now enabled to offer them a prospect of sight within three months."[10] He goes on to say that his experience with Förster's operation has been unfortunate, iritis and inflammatory thickening of the anterior capsule having occurred in his practice. An iridectomy alone, in cases of unripe cataract, has been followed by inflammatory reaction, yielding, however, readily to atropine and fomentations.

Of these two methods the second is undeniably safer, as offering less instrumental interference with the eye. It possesses the advantage of being in itself one of the steps in peripheric linear extraction, and its anterior performance leaves just so much less to be done when the cataract is finally removed. The practical objection to it is the fact that it subjects the patient to two operations on the eye, instead of one; two confinements with both eyes bandaged in a darkened chamber. The effect of all this on the general health and morale of the individual will vary in different cases; and therefore renders it impossible to lay down any fixed rule with regard to the propriety of producing artificial maturity. All that can be said is, that in ordinary cases of slow growth, the performance of the additional operation would seem a lesser evil than weary months of waiting for natural ripening.

A few general remarks with regard to the extraction of senile cataract may fitly precede the descriptions of the various operations devised for this purpose. And first with regard to the induction of anæsthesia. On this point there has been much difference of opinion, its use having been comparatively general in this country, but far less frequent on the continent of Europe. The experience of the present writer has convinced him that the state of anæsthesia throws appreciable obstacles in the way of a successful extraction, and that its regular employment tends to diminish the number of favorable results that would otherwise be obtained. This opinion is based on several grounds. The necessity of fasting before the administration of the ether or chloroform, and the inability to retain nourishment for some time afterward, have a depressing effect, especially on the aged and feeble. The amount of congestion induced in many by the inhalation of ether encourages hemorrhage and embarrasses the performance of the operation. The patient's ability to move his eye at will being lost during anæsthesia, every needed motion has to be given to the eye by traction with the fixation forceps, inflicting a fresh bruise at every application, and sometimes leading to a loss of vitreous. The collapse due to anæsthesia annuls tension and renders the removal of cortical fragments proportionally difficult. After the operation the patient is incapable of giving information with regard to the clearness of his acquired sight, and moreover loses the moral support of having once seen, a support well calculated to cheer the succeeding dark days of convalescence. The surgeon, too, is thus deprived of important knowledge with regard to the result of the efforts he has made to clear the pupil. Finally, the nausea that so often comes on as the effect of the ether passes off, the retching and vomiting, that sometimes endure for hours, can only have an injurious effect on an eye so recently laid open, besides rendering the patient unable to take nourishment and depressing his morale. To ascertain whether these objections were more than theoretical, two series of cases were operated on, a certain number with and an equal number without ether. Each series consisted of one hundred, and the great difference in the percentage of success was wholly in favor of the non-administration of the anæsthetic.

This discussion, however, becomes less important in view of the fact that, save in the most exceptional cases, local anæsthesia amply suffices. It has already been described.

A very important question next arises, as to whether the eye shall be prepared for the removal of the cataract by the dilatation of the pupil, as was formerly the usual custom. This practice was generally continued after the operation of flap extraction had given way to that introduced by von Graefe. The arguments for the instillation of atropine before extraction were, in brief, that there would be more room for the knife in its passage across the anterior chamber; that its point would be less likely to catch in the iris, and a wound or dialysis would consequently more seldom follow; and that the secondary dilatation that ensues on the re-establishment of the anterior chamber would tend to keep the edge of the iris clear of any fragments of cortical substance that might remain behind, and lessen the likelihood of a closed pupil and of a secondary cataract. It began, however, by degrees to be found that, where mydriasis had not been induced, it was easier to replace the iris after extraction, and thus prevent its healing into the corners of the wound. To prevent this accident it was even advised to apply a solution of eserine, after the lens was removed.[11] Acting