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LECTURES ON CATARACT.

LECTURES

ON CATARACT:

ITS CAUSES, VARIETIES, AND TREATMENT.

BEING SIX LECTURES DELIVERED AT THE WESTMINSTER HOSPITAL.

BY

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WITH ILLUSTRATIONS.

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PREFACE.

THESE lectures were originally delivered unwritten to the Students of the Westminster Hospital. They were a few years later written out and re-delivered, but without any idea of publication. They are published at the request of some of the author's old pupils. He claims for them neither merit nor originality. He will, however, not have printed them in vain if they further in the smallest degree the growing interest in ophthalmic subjects which happily distinguishes the modern medical student who is seriously determined to succeed in his profession.

These lectures are not exhaustive, but place the subject, it is hoped, in a not unattractive form. The more important

points only with regard to the causes, varieties and pathology of cataract have been given, the main object of the lectures having been to discuss the chief methods and modifications which have been introduced for its operative treatment.

The author finds that he has omitted to mention the well-established clinical fact —the association of lamellar cataract with an imperfect development of the enamel of the teeth.

An account of the anatomy and development of the lens forms a fitting introduction to these lectures.

3 Cavendish Place,
Cavendish Square, W.

CONTENTS.

LECTURE V.

LECTURE VI.

APPENDIX.

LIST OF ILLUSTRATIONS.

ANATOMICAL INTRODUCTION.

"The crystalline lens is a transparent solid body, of a doubly convex shape, with the circumference rounded off. It is completely inclosed by a transparent elastic membrane known as the *capsule*. The anterior surface is in contact with the iris towards the pupil, receding from it slightly at the circumference; the posterior is embedded in the vitreous humour. Around the circumference is the *zonule*. Its convexity is not alike on the two surfaces, being greater behind; moreover, the curvature is less at the centre than towards the margin, where, in its natural position, it measures about one-third of an inch across, and one-fifth from before backwards. In a fresh lens, divested of its capsule, the outer portion is soft and easily detached; the succeeding layers are of a firmer consistence; and in the centre the substance becomes much harder, constituting the so-called *nucleus*. On the anterior and posterior surfaces are faint white lines directed from the poles towards the circumference; those in the adult are somewhat variable and numerous on the surfaces, but in the fœtal lens throughout, and towards the centre of the lens in the adult, they are three in number, diverging from each other like rays at equal

angles of 120°. The lines at opposite poles have an alternating position (not being over one another); thus of those seen on the posterior surface of the fœtal lens, one is directed vertically upwards, and the other two downwards and to either side, whereas those on the anterior surface are directed, one directly downwards and the other two upwards and to the sides. These lines are the edges of planes, or septa, within the lens, diverging from the axis and receiving the ends of the lens-fibres, which here abut against one another. As Tweedy has pointed out, they may be seen, by the aid of the ophthalmoscope, even during life. The rays seldom meet at a point, but usually along a somewhat irregular line or area.

"*Structure.*—When the lens has been hardened and the capsule removed, a succession of concentric laminæ may be detached from it like the coats from an onion. They are not continuous, but separate into parts opposite the radiating lines above described. The laminæ are composed of long, riband-shaped, microscopic fibres, $\frac{1}{5000}$ of an inch broad, which adhere together by their edges, the latter being often finely serrated, and pass in a curved direction from the intersecting planes of the anterior half of the lens to those of the posterior half, or *vice versâ*: in this course no fibre passes from one pole to the other, but those fibres which begin near the pole or centre of one surface terminate near the marginal part of a plane on the opposite surface, and conversely; the intervening fibres passing to their corresponding places between.

"The lens-fibres, as the history of their development shows, are to be looked upon as much-elongated cells. In the young state each has a clear, oval nucleus, but in the fully-formed lens the nuclei have disappeared from

the fibres which form the more internal parts of the lens, and only remain in the most superficial layers. Here they are found, not quite in the middle of each fibre, but slightly nearer the anterior end, their situation nearly corresponding in adjacent fibres, and they form by their juxtaposition the so-called 'nucleus zone' around the lens. The superficial fibres further differ from the more deeply seated ones in being softer, and in possessing a plain, unserrated margin. The extremities of all the fibres are softer and more readily acted on by reagents than the middle parts, and the axial or more internal part of a fibre more so than the external, but the transition is gradual from one to the other, and there is no definite membrane inclosing each fibre. The lens-fibres, when cut across, are seen to be six-sided prisms. By reason of this shape, and the serrations of their edges, they fit very exactly the one to the other with but little inter-fibrillar cementing substance between. This is met with in larger quantity in the intersecting planes between the ends of the fibres.

"Thin and Ewart have shown that, with certain methods of treatment, the superficial lens-fibres show indications of being composed of a number of regular segments separated by sharply marked lines of inter-segmental substance.

"*Epithelium of the Capsule.*—At the back of the lens, the fibres are directly in contact with the inner surface of the capsule, but in front they are separated from the latter by a single layer of flattened, polygonal, nucleated cells, which covers the whole anterior surface underneath the capsule. Towards the edge or equator of the lens, the appearance and character of these cells undergo a change: they first gradually take on a columnar form,

and then, becoming more and more elongated, present every transition to the nucleated lens-fibres of the superficial layers, into which they are directly continuous. This transition is more easily traced in the lens of some animals than in man.

"The capsule of the lens is a transparent, structureless membrane, somewhat brittle and elastic in character, and, when ruptured, the edges roll outwards. The forepart of the capsule, from about one-sixteenth of an inch from the circumference, where the anterior part of the suspensory ligament joins it, is much thicker than the back: at the posterior pole of the lens the capsule is very thin indeed. In the adult, it, like the lens itself, is entirely non-vascular, but in the fœtus there is a network of vessels in the capsule, supplied by the terminal branch of the central artery of the retina, which passes from the optic papilla through the canal of Stilling in the vitreous humour to reach the back of the capsule, when it divides into radiating branches. After forming a fine network, these turn round the margin of the lens and extend forwards to become continuous with the vessels in the pupilary membrane and iris.

"After death a small quantity of fluid (liquor Morgagni) frequently collects between the back of the lens and the capsule: it appears to be derived from the lens-fibres. There is no epithelium in this situation as in front.

"*Changes in the Lens with Age.*—In the fœtus, the lens is nearly spherical: it has a slightly reddish colour, is not perfectly transparent, and is softer and more readily broken down than at an advanced age.

"In the adult, the anterior surface of the lens is distinctly less convex than the posterior; and the

substance of the lens is firmer, colourless, and transparent.

"In old age, it is more flattened on both surfaces; it assumes a yellowish or amber tinge, and is apt to lose its transparency as it gradually increases in toughness and specific gravity." (*Quain's Anat.* 9th edit. vol. ii. p. 425.)

A paper recently (Jan. 1883) read before the Ophthalmological Society by Mr. Priestly Smith, showed from the examination of 142 lenses removed in their capsules, shortly after death, from the eyes of eighty-three adult subjects, that the average weight of the lens continually increased at the rate 1·5 milligrammes each year, and that the volume of the lens also continually increased in the same proportion. The continuous growth of the lens sufficed to explain the acquired hypermetropia of old age without assuming that the lens changed its form, and explained also the shallow anterior chamber of the senile eye. Cataractous lenses were found to be smaller than transparent lenses of the same age. As this difference was present even when the opacities were very slight, it seemed likely that a period of diminished rate of growth preceded the formation of the opacities of senile cataract. The opacities were in most cases limited to the equatorial zone, where the capsule and cortical layers of the lens were subjected to the traction of the suspensory ligament. This supported the conclusions recently published by Becker concerning the formation of opacity by separation of the fibre layers at the equator.

LECTURES ON CATARACT.

LECTURE I.

GENTLEMEN,—The subject that I have chosen for the first few lectures of this year's summer course on ophthalmic surgery is cataract. Cases of cataract occur sufficiently often to render it almost certain that in the course of the practice of your profession—whatever department of practice you may choose to follow—you will occasionally be called upon for your opinion and advice by patients who are unknowingly perhaps the subject of this affection. It is therefore most necessary that you should possess the information which will not only enable you to recognise cataract when it is present, and place you in a position to offer your patient good advice, but

which will also guard you from a participation in a false diagnosis of cataract when such an affection does not really exist.

Cataract may be defined to be a *loss of transparency of the crystalline lens.* Opacities of the cornea are often popularly but erroneously described as cataract by the ignorant, and it would be much to the detriment of the reputation of any practitioner if he confirmed so mistaken a diagnosis. An appreciation of the above definition will render such a mistake almost impossible. Another error in the diagnosis of cataract is favoured by many books on ophthalmic surgery, in which we find a somewhat common condition of the eye described as "false or spurious cataract," a term which is apt to mislead. This condition really consists of a false membrane occupying the pupil, and more or less filling it up. This false membrane is formed by the remains of lymph which has been effused into the pupil during some prior attack of iritis, and is easily recognised by a lens, by the oblique illumination, and by the instillation of a drop of a solution of atropine, when the pupil will be found to be fixed and

Definition of Cataract.

undilatable, and often more or less irregular in shape. It is important that a correct diagnosis of this condition should be formed, as it often requires to be treated by a timely iridectomy, or a secondary cataract will really ensue. It is better to call this condition by its right name of complete or incomplete occlusion of the pupil, names which I described in my lectures on iritis, rather than by the use of the term "false cataract" to favour the supposition that the interference with vision primarily depends upon an opaque condition of the lens.

Before describing its several varieties, it will be well to say a few words about what we know of the causes of cataract. *Causes of Cataract.* It is surely far more surprising that in the great majority of human beings the lens should retain its transparency, than that it should occasionally undergo changes which render it more or less opaque. It has been said,[1] that cataract is always a secondary affection, depending upon certain pathological changes in one or more of the structures which enter into the formation of the uveal tract.

[1] Mooren.

We know that loss of transparency of the lens is often a result of certain forms of choroiditis and iritis, and of changes in the vitreous humour in the later stages of glaucoma; but in the majority of the cases of cataract there is no evidence to show that inflammatory changes have preceded the lens opacity. Cataract is due largely to hereditary predisposition. It usually depends upon some alteration, perversion, or impairment of nutrition in the lens itself, rather than upon pathological changes around and outside the lens. This supposition is strengthened by the diminished success which undoubtedly attends operative treatment in cases where such external changes are known to exist, and by the remarkable success obtained in cases where these changes are presumed to be absent. Cataract occurs most frequently, too, at periods of life when defects of nutrition are most likely to exist, that is in infancy and early childhood, and in old age. It is frequently associated with diabetes, a disease marked by impairment of nutrition and a diminution of the watery constituents of the blood, and by the presence of large quantities of sugar. Dr. Richardson

has also shown that saccharine and saline matters injected beneath the skin in some of the lower animals cause a loss of transparency in the lens. In the same way the continued administration of *secale cornutum* sometimes produces cataract. Wecker suggests in explanation that a deficient blood supply to the anterior portion of the uveal tract is produced by the continued spasmodic contraction of the ciliary muscle, caused by the drug.

There is no doubt that the watery element is diminished in the lenses of old people and that a slight shrivelling takes place, in fact that the lens undergoes a process of atrophy. In these senile changes minute fissures have long been described as taking place in the capsule of the lens, and forming the initial lesion of a subsequent cataract. Straining of accommodation by continuous work at minute objects is a common cause of cataract. People often continue to strain their eyes in a bad light, and for years after the time has arrived when glasses are required. Some from unwise vanity perhaps dislike to commence their use; others ill-use their eyes by wearing glasses which have been all along

unsuitable. Last, but not least, contusions of the lens, and wounds of the capsule of the lens, must be mentioned as not infrequent causes of cataract; but this subject will be more fully considered under the head of Traumatic Cataract.

Classification of Cataract.

In order that you may thoroughly understand the different varieties of cataract it is necessary to allude to the different modes of classification that have been from time to time adopted. For practical

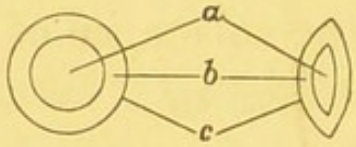

FIG. 1.—Diagram of Lens.

purposes the lens may be considered to be divided into three portions :—

1. The *nucleus* (Fig 1, *a*) or central part.
2. The *cortical portion* (*b*), which is all that part intervening between the nucleus and the capsule.
3. The *capsule* (*c*).

This division at once gives us a classification into nuclear, cortical, and capsular cataracts;

but, unfortunately, although such a division is favourable for description, we find in practice that many cataracts are a combination of the two former, and that so-called capsular cataracts are only apparently opacities of the capsule. For instance, the cataract of old age may commence in, and for a time be confined to, the nucleus of the lens, but it more generally commences in the form of striæ, first in the cortical portion and subsequently in the nucleus.

Another classification depends upon the consistency of the substance of the cataractous lens. This will give us,

1. *Fluid* cataract.
2. *Soft* cataract.
3. *Hard* cataract.

It is practically of immense importance to be able to diagnose the consistency of a cataract, as it will determine the selection of the operation which is necessary for its removal. A fluid or soft cataract will require only a small wound, while a hard nucleus will require a section proportionate to its size. It will be useful then to consider the general

characteristics of these several varieties before entering upon a description of the special and most common forms of cataract which come before us in actual practice.

1. *Fluid* cataract is sometimes congenital, but may occur at any period of life. Its fluidity is owing to a degeneration and disintegration of the material of the lens. Before the age of thirty-five the whole lens may be fluid, but after that age there will generally be a hard nucleus floating in and falling to the bottom of the fluid contents of the capsule and forming what is called a Morgagnian cataract. The process of softening generally commences in the cortical portion near the capsule, but it occasionally begins in the centre of the lens. The position of the softening is recognised by the increased opacity of the part where it has occurred. The cortical portion may be considered fluid, if the opacity extends quite up to the capsule, and is of a white and opaque colour, and presents a surface streaked or dotted over with diffused spots, and if there is an entire absence of translucent streaks. In these cases the lens is often enlarged, pushing

Fluid Cataract.

forward the iris, rendering the anterior chamber shallow, and to a certain extent dilating the pupil.

2. *Soft* cataract is also frequently congenital, or the result of a wound of the capsule (traumatic), and is called soft in contradistinction to the third form, the main feature of which is a hard nucleus. In soft cataract the lens is of the same consistence throughout, and until degeneration has commenced differs little or nothing from the consistence of the healthy lens. The nucleus is soft in cataracts occurring before the age of thirty-five or forty; after that age the nucleus is almost always hard. It therefore happens that all cataracts occurring in early adult life are of the soft variety. Soft cataract may commence at the centre of the lens, or, as is more generally the case, at the periphery, in the form of striæ, that is of longer or shorter streaks extending into the lens substance, or it may commence by a diffused haziness and without the appearance of any striæ. These opacities may be confined to the centre of the lens, or to its cortical portion. The latter

Soft Cataract.

condition is generally met with and presents several varieties. For instance, the whole of the cortical portion may be affected, as in *cortical* cataract; or the inner part of it, namely, that part immediately surrounding the transparent nucleus, may be alone affected, as in the *lamellar* form of congenital cataract; or, lastly, the outer portion immediately within the anterior or posterior capsule, or both, may be the seat of the opacity.

3. *Hard* cataract, so called from the presence of a hard nucleus, is peculiar to people over thirty-five or forty years of age. At this period of life the nucleus of the lens becomes harder and more condensed, and as age advances assumes a pale amber colour. It is necessary to remember this gradual physiological change, as it may exist without the evidence of any diminution of the acuteness of vision, and must not be confounded with actual cataract. It is true that this condensed nucleus may become cataractous, assuming in the process a darker yellow, or even a brownish colour, and losing its translucency. In old age the cataractous change commences in the nucleus, the cortical

Hard Cataract.

portion of the lens remaining transparent and clear. To this form is given the name *nuclear* cataract. But before sixty cataract usually commences in the peripheral portions, the nucleus becoming subsequently affected. In some cases striæ begin to show themselves both peripherally and centrally at the same time, or at all events exist in both positions when first discovered. The striæ differ very much in appearance. The most usual form is that of short streaks extending from the periphery of the lens and pointing towards the centre; between these streaks there may be shorter ones, some appearing perhaps as mere dots. Not infrequently the streaks may run along the posterior or the anterior capsule, eventually meeting at the corresponding poles of the lens.

The description of the visible stellation of the normal and of the cataractous crystalline lens, published a few years since in the Ophthalmic Hospital Reports,[1] by Mr. Tweedy, throws much light on the situation and formation of these striæ. I have already

[1] *Royal London Ophthalmic Hospital Reports*, vol. viii. p. 24 (1874).

mentioned that cataractous changes depend upon some altered, perverted or impaired nutrition. Mr. Tweedy adds that as the lens is entirely extravascular, it must depend on the structures and fluids immediately surrounding it for its nutrition-supply by a process of endosmosis and exosmosis. If either of these processes be interfered with by the imposition of mechanical and physical obstacles, or by an alteration in the surrounding tissues or fluids, the parts of the lens most likely to be primarily affected are those which adjoin the rays of the stella. These rays are the fissures formed, as it were, by the discontinuity of the lens fibres, where the endosmotic processes are most active, and are in fact the parts of greatest vulnerability, and most liable to become affected by disturbed nutritive changes. Mr. Tweedy asserts that these facts are proved by numerous examinations and thus open up an interesting field of inquiry.

It is a matter of some importance to note that cataractous change takes place much more rapidly in the cortex, than in the nucleus, and when the striæ are broad

than when they are fine and narrow. On the other hand, the progress of cataract is often exceedingly slow. There is so much uncertainty in this matter that any opinion as to the probable date of maturity must be carefully guarded. With reference to the recognition of hard cataract, it must be remembered that a nucleus may assume a dark brown or black colour, and in this condition may be overlooked. The tint is owing to the imbibition of some of the hæmatine of the blood. When this condition exists, the eye is often an unhealthy one.

Diagnosis of Cataract.

And this leads me to say something as to the general mode of diagnosing the presence of cataract. This is not always so easy a matter as it appears to be. It will not do to arrive at once at the conclusion that a cataract is present, because the lens appears through the undilated pupil to be gray and opaque. All that this shows is, that certain physiological changes have taken place, in consequence of which the lens has become thickened and consolidated and reflects a greater proportion of the rays of light which fall upon it. The

old mode of diagnosis was by what is called the *catoptric test.* This depends upon the three images of the flame of a lighted taper, which are formed upon the anterior surfaces of the transparent media of the eye. The first is an erect image of the flame on the anterior convex surface of the cornea. The second is also an erect image produced by the anterior convex surface of the lens; and the third is a small inverted image of the flame produced by reflection from the anterior concave surface of the vitreous humour. On moving the candle the first two images will be found to move with the candle, the third to move in the opposite direction. In cataract the third image is lost, and as the opacity increases, the second, namely, that from the anterior surface of the lens, gradually becomes indistinct.

Diagnosis by the Ophthalmoscope.

Since the discovery of the ophthalmoscope the catoptric test has almost entirely fallen into disuse, or rather has become useful only for another purpose—that of demonstrating the changes produced in the lens by the act of accommodation. By means of the ophthalmoscope, if

the pupil be first dilated by atropine, cataract may be recognised in its earliest stages. There are two methods of examination for this purpose. The oblique illumination, by means of a lens of *two* or *three* inches focal length, concentrating the rays of light from a lamp on the patient's lens, when the striæ or lenticular opacities will appear to be gray or whitish gray; and secondly, the transmitted illumination, by means of a concave mirror alone, throwing the light, from a lamp placed

FIG. 2.—Striæ.

behind the level of the patient's head, through the lens, when the opacities will appear dark, and, in the early stages of the cataract, distinct upon the red background of the choroid. Fig. 2 shows the appearance of striæ when examined with the mirror, (*a*) showing peripheral striæ, and (*b*) central striæ. I should advise you never to hazard an opinion upon any but an advanced cataract without having first carefully made this twofold

examination. It is also of importance to continue the ophthalmoscopic examination so as to ascertain the condition of the fundus of the eye during the earlier stages of the cataract, whilst the lens is sufficiently translucent for the purpose. It is only in this way that the co-existence of disease of the choroid, retina, *vitreous*, or optic nerve can be diagnosed; and it is only by carefully ascertaining the degree of mobility of the pupil and determining the amount of vision an eye possesses that a sound opinion can be formed as to the prognosis of the result of a future operation. It would be clearly worse than useless to remove a cataract from an eye which was blind from another cause, and therefore it is essential to determine these various points as far as possible in every case.

Symptoms of Cataract.

The symptoms of cataract in children may vary from marked blindness to only slight imperfection of vision. Hence the affection is often overlooked in the slighter cases and especially in the lamellar variety, where attention may be first drawn to the presence of cataract by the disposition

shown by the child to approach the eyes very near to the objects at which it is looking. In adults the first symptom which would lead you to suspect the presence of incipient cataract is a mistiness of distant vision, gradually extending to nearer objects as the opacity of the lens advances. Distant objects appear surrounded by a sort of halo. If the centre of the lens is affected the patient sees better when the eyes are turned away or shaded from the light. For this reason he will shade the eyes with his hand, carry his head down and prefer a dull day or the early twilight. The pupil then becomes more dilated and admits light to the retina through the more peripheral portions of the lens.

In these cases a weak solution of atropine ($\frac{1}{4}$ gr. to $\bar{3}$i. of water) which dilates the pupil without largely affecting the accommodation, diminishes the dimness of vision, and will be useful for some time during the gradual progress of the cataract. One drop of the solution placed within the lid every morning will generally be sufficient for this purpose. When the opacity is confined to the periphery of the lens, the central part being clear, the

patient will see better through a small pupil, and thus the use of atropine is contra-indicated as it might perhaps increase the dimness instead of diminishing it.

The refraction of the eye is often affected by cataractous changes. Hypermetropia, sometimes to a high degree, occurs in senile cases from the shrinking and flattening of the lens; whilst myopia occurs sometimes in the soft cataracts of young people, and especially, as Donders has pointed out, in the lamellar form of cataract.

Two other signs of cataract in old people must be mentioned. They are due to the shrinking and loss of convexity of the lens above mentioned. They are, first, a diminution of the power of accommodation, always present, although it varies in degree; and secondly, a tremulous movement of the iris consequent upon the diminished support to the iris which the shrunken lens affords. This may be frequently observed, and is best seen when the patient moves the eye from side to side.

LECTURE II.

HAVING now described to you the characteristics of fluid, soft, and hard cataracts, and also the general modes in which these various conditions may be recognised, we are in a position to consider the special forms of cataract according to the following pathological arrangement :— *Forms of Cataract.*

1. Congenital cataract
   - *a.* Lamellar.
   - *b.* Cortical.
   - *c.* Capsular.
   - *d.* Pyramidal.
2. Senile cataract.
3. Secondary cataract.
4. Traumatic cataract.

Under the head of congenital cataract must be included cataracts which are developed in early life, whether they be the result of changes

in the lens which had commenced during the fœtal state or of changes established after birth.

Congenital Cataract.

1. Congenital cataract usually occurs in both eyes. It may be either cortical, or capsular, or both, and its consistency is soft and sometimes fluid. The opacity of the lens is sometimes slight and partial so that it may be overlooked for many years, the opacity not being progressive. On the other hand, the whole lens may be opaque, and the consequent defective vision may be recognised at a very early period. And it is extremely important that any opacity beyond a very small amount should be diagnosed early, in order that any operative treatment which may be necessary should be adopted before any nystagmus comes on. This condition is very common in infants, the subjects of cataract, and consists in a peculiar horizontal oscillation, and occasionally rotatory movement of the eyes, produced by the alternate contraction of the recti and oblique muscles, and when once established, is almost always permanent.

The opacity of the lens may be only partial,

as in some rare forms described by Von Graefe and others. In these cases one lens only may be affected, and the opacity depends upon some intra-ocular disease which will be found, on careful examination, to have materially affected the amount of perception of light and to have contracted the field of vision.

(*a.*) A common form of congenital cataract is lamellar, laminar, or zonular cataract. In this variety the inner portion of the cortex is the seat of the opacity, that portion which immediately surrounds the

Lamellar Cataract.

FIG. 3.—Lamellar Cataract.

nucleus, the nucleus itself and the outer cortical portion of the lens remaining transparent. This form of cataract presents a very characteristic appearance when the pupil has been dilated with atropine (Fig. 3). What used to be formerly described as a small opaque lens, appears to be suspended centrally behind the area of the pupil, and surrounded by a black zone. This zone is shown by the ophthalmo-

scope to be simply the portion of the dilated pupil occupied by the transparent periphery of the lens; the seat of the opacity being shown at the same time to be situated at a distance from the anterior capsule. In some cases, when the nucleus is quite transparent, the margin of this circular and somewhat globular opacity when examined with the oblique illumination appears as a whitish ring. On the other hand this margin, when examined with the mirror of the ophthalmoscope, appears as a dark ring surrounding a reddish-brown reflex, through which the details of the fundus may or may not be visible. These appearances result from a greater thickness of opacity, where the cataractous layer of the lens folds over the margin of the transparent nucleus, than is present in the central part. In other words, they result from the point of reduplication at *a*, Fig. 4, presenting a thicker layer of opaque substance than do the separated opaque layers at *b*, at the centre of the lens. Lamellar cataract is most usually congenital or developed in early infancy, but Von Graefe says that it occasionally occurs in adult life in dislocated

lenses or after iritis. A curious fact has been pointed out by Professor Arlt, that lamellar cataract often occurs in children who have

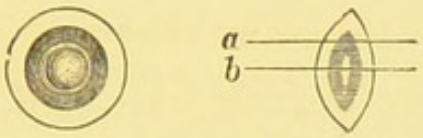

FIG. 4.—Diagram of Lamellar Cataract.
(The shading should have been circular instead of transverse.)

been the subject of convulsions, though he does not offer any sufficient explanation of the connection between them.

In this form of cataract, vision is often materially improved after dilatation of the pupil by a weak solution of atropine, the clear peripheral portion of the lens becoming available. This affords us an indication for treatment by an artificial pupil in some of the cases, rather than by any interference with the lens, the first result of a needle operation being to render the whole of the lens opaque, and thus to destroy all power of accommodation as well as the characteristic appearance described as peculiar to this form of cataract. The best position for an artificial pupil is downwards and inwards (Fig. 38). The mode

of operation will be described after the operations for extraction of cataract.[1]

It is well to bear in mind that in some cases of lamellar cataract, the vision is so slightly implicated, that the existence of cataract may escape detection for many years. In some forms there are small opaque streaks extending from the margin of the opacity into the outer cortex, and these not infrequently are three in number and equidistant, giving the cataract a triangular appearance. At other times, the margin of the opacity may be dotted round with numerous minute white points with or without little streaks intervening between these and the opacity. At other times striæ, radiating from the opacity, may have similar dots arranged along them. The presence of these dots, when small and brilliant, is interesting as showing the almost stationary character of the cataract, and this is of course a matter of great importance in considering the treatment that shall be adopted. A perfectly clear cortex also shows that the cataract is not progressive. On the other hand a cloudy cortex, numerous striæ, especially

[1] See p. 119.

if they are broad, and numerous indistinct spots, all show that the cataract is progressing. It is in the former condition that treatment by artificial pupil is specially indicated. Patients with lamellar cataract often acquire the habit of holding objects, such as a book, close to the eyes. By this means they get larger images, but the habit not infrequently leads to a permanent myopia.

(*b.*) Cortical cataract forms the majority of fluid and soft cataracts already described, and may be congenital or commence at any time after birth. The opacity commences generally in the form of slight streaks at the periphery of the lens, and close to the anterior or the posterior capsule, or both. These become longer, and in time, reach to the centre, fresh dots and striæ are formed, and the surrounding lens, perfectly transparent at first, gradually becomes opaque. This opacity may come on rapidly, and in children it generally does so, a few weeks being sometimes sufficient for the lens to become completely opaque. This affords a strong contrast to cortical cataract occurring in adults, in whom opacity comes on much more tardily, the striæ

Cortical Cataract.

sometimes remaining stationary for years. As a rule, the broader and more numerous the striæ, the more rapidly the cataract advances to maturity. A recollection of this fact will assist our prognosis in almost all cataracts.

(*c.*) The term capsular cataract is applied to cataracts in which the opacity is apparently confined to the capsule of the lens. The term is an incorrect one, as these opacities have been shown to be a deposit on the inner surface of the capsule, occurring in consequence of degeneration following upon a previous cataractous condition of the lens, and not opacities of the capsule itself; for Müller asserts that the lens capsule never itself becomes opaque. The opacities, then, occur within the capsule in the form of white spots or streaks, more frequently in connection with the anterior capsule, very rarely with the posterior capsule, and sometimes with both. The deposit from degeneration is not infrequently found lining the whole capsule. In that case the cataract will present a white and glistening appearance, and the lens will be found to be shrunken in consequence of degeneration and absorption of

Capsular Cataract.

lens substance, and the capsule will be more or less wrinkled. This happens sometimes in cases where the cataract has followed choroiditis. The so called opaque capsule which occurs sometimes after cataract operations is owing to the same form of deposit. In old standing cataracts the deposits are sometimes calcareous.

The form of capsular cataract, however, which is congenital, or occurs in early life, is that of an opacity on the inner surface of the central portion of the anterior capsule. It may depend upon some arrest of development, but Hutchinson has shown that there is almost always a history of purulent conjunctivitis having occurred in infancy, and he has pointed out that sometimes opposite to the opacity of the lens, a minute opacity will be found in the cornea, showing the existence of a former ulcer in that situation. I have seen many cases which have verified this explanation, and in one found a finely-attenuated line of adhesion between the lenticular and corneal opacity.

(*d.*) Pyramidal cataract is the name given to some of these cases of central capsular

cataract, when the opacity projects somewhat from the level of the surface of the lens. In some cases it projects into the anterior chamber to the extent of one or even two lines (Fig. 5). Sometimes the opacity projects inward from the capsule into the lens, at other times projecting in both directions. Many of these opacities, under oblique illumination, present a beautiful appearance, the edges being sharply

Pyramidal Cataract.

Fig. 5.—Pyramidal Cataract.

defined and the pyramidal shape being well marked. These forms of cataract may occur in one or both eyes, in the latter case the eyes being symmetrically affected. There is no tendency for the opacity to spread through the lens, though sometimes there is a corresponding opacity at the posterior pole of the lens. I mentioned above that an apparent connection between this condition and purulent conjunctivitis has long been observed, and Mr. Hulke holds that it is

produced by the contact of the lens, which is very prominent in early life, with the inflamed and swollen cornea, either through the production of a dot of lymph, or by the interference with "the proper nutritional osmose through the capsule" produced by pressure. Mr. Hutchinson, on the other hand, holds that neither contact nor perforation of the cornea, which was long considered essential, is necessary for the production of deposits; and states that these conditions are exceptional, and that "the mere proximity of the inflammatory action on the surface of the conjunctiva and cornea suffices to disturb the nutrition of the lens capsule and produce deposits." That contact does occasionally occur is proved by the existence sometimes, as mentioned above, of an elongated adhesion between the points of opacity on the lens and cornea; but the extreme rarity of any adhesion and the frequent absence of any opacity in the cornea show that the capsular cataract must result from the nutrition of that portion of the lens having been disturbed by being involved in the focus of the inflammation.

These localised deposits consist of the degenerated products of inflammation immediately beneath the central part of the anterior capsule. There is usually also some deposit of organised lymph upon the front of the capsule, which has been said to be derived from the back of the inflamed iris. The capsule itself is somewhat puckered at the seat of the opacity, and the deposits may often be picked off with a needle.

Opacities of the posterior capsule are much more rare than those of the anterior, and when congenital, usually depend upon some arrest of development and the imperfect retrogression of the hyaloid artery.

2. Senile cataract is, as its name denotes, the cataract of old age, and occurs after the fortieth or fiftieth year. It will not be necessary here to repeat the description of this form as far as it has already been given under the head of Hard Cataract, further than to state that it is marked generally by the presence of a hard nucleus surrounded by a softer cortical portion. It rarely commences at the nucleus, but more generally at the periphery in the form of

Senile Cataract.

striæ. Occasionally it will commence in both positions. The symptoms of the commencement of senile cataract are, first, a mistiness of distant vision, gradually extending to nearer objects as the opacity of the lens advances. Distant objects are described as surrounded by a kind of halo or mist. If the centre of the lens is affected, the patient sees better when the eyes are turned away or shaded from the light or in the dusk, the pupil becoming more dilated and admitting light to the retina through the more peripheral portion of the lens. If, however, as is more generally the case, the opacity is at first confined to the peripheral portions of the lens, the patient will continue to see well, long after the formation of striæ. These facts are of importance, as in the former case useful vision may be obtained for a time by the use of a weak solution of atropine, whilst in the latter the use of atropine will do more harm than good, as the patient sees better through a small pupil. Old persons may of course be the subjects of other forms of cataract. Senile cataract generally attacks both eyes, although it usually happens that one is affected before the other. Its rate of progress

will vary and sometimes the cataract may take years to come to maturity. Opacity progresses much more rapidly in the cortex than in the nucleus, but it is necessary to be very guarded in giving an opinion as to the time at which maturity may be expected. It is necessary to carefully watch the case, for almost the only rule which it is possible to lay down, is that progress is more rapid when broad whitish streaks or spots are present, than when the striæ are small and fine. As an example of the uncertainty which exists, I may mention a case, published by Dr. Chisholm in the *Richmond Medical and Surgical Journal*, of a lady, sixty-five years of age, who, after having had faint striæ in both lenses for fifteen months without perceptible change, appeared as usual one evening, but was found next morning to have both her lenses opaque and her sight gone.

Secondary Cataract.

3. The term secondary cataract is applied to cataracts produced by morbid or inflammatory changes in the eye. Inflammation of any portion of the uveal tract may cause cataractous changes in the lens. In iritis, irido-choroiditis, choroi-

ditis, and morbid changes in the vitreous humour, the lens often becomes implicated in consequence of the disturbance of nutrition, which is produced by the long continuance of inflammatory action, or by depositions upon the anterior capsule. The process takes place somewhat in this way: In iritis, for instance, lymph is rapidly effused, and the iris becomes adherent to the anterior capsule of the lens. During the continuance of the inflammation, red vessels are often seen in the adhesions of the posterior synechiæ, and it frequently follows, that with inflammatory action at the very surface of the lens, cell proliferation will take place, or at least that nutrition will be disturbed within the capsule in the portion of the lens opposite to the point of inflammatory action. There is no reason to suppose that the lens capsule itself becomes the seat of inflammation.

About ten years ago, I recorded in the pages of the *Ophthalmic Hospital Reports*[1] an interesting instance of inflammation of the uveal tract occurring in a father and three sons,

[1] 1872, Vol. vii. pp. 335-342.

amongst whom four eyes became affected with secondary cataract.

Under this head it will be necessary to mention, as further causes of secondary cataract, *glaucoma*, in which disease the lens frequently becomes opaque and assumes a characteristic greenish hue; and *diabetes*, and those diseases in which the watery constituents of the blood are deficient and the salts are in excess. As a rule in glaucoma the lens does not become opaque until some time after the establishment of the disease, and in diabetes the cataract usually develops only after the condition has existed sufficiently long for the occurrence of considerable emaciation. Diabetic cataract generally comes on in middle life, affects both eyes, and is often accompanied with affections of the retina and optic nerve; and therefore it is necessary to be careful to examine the eyes, as to the amount of perception of light and the extent of the field of vision, before recommending an operation, or before giving a prognosis of the disease or of the result of such operation.

4. Traumatic cataract is opacity of the lens produced by some external and mechanical

means. It may be the result of a blow or contusion. I have seen several cases of this, and remember one in which the opacity was complete within ten days of the accident. In other cases the opacity has not become complete until after an interval of from six weeks to five months. Von Graefe attributed the cataract in these cases to some rupture of the capsule at the posterior peripheral part where it is thin; and probably the varying rapidity with which the lens becomes opaque depends upon the size of the rent. It is conceivable, however, that in some of the more slowly progressing cases, the blow alone may have sufficed to disturb the nutrition and cause a gradual development of opacity. Secondly, cataract may be the result of an actual wound of the capsule and lens, and the nature and seriousness of the case will depend very much upon the size and complications of the wound. The lens may be slightly wounded by a needle or fine awl being accidentally forced through the cornea and pupil. Here it may happen that all the inconvenience to the patient, especially if a child, would be slight uneasiness and

Traumatic Cataract.

lachrymation for a day or two during the healing of the slight corneal wound, and then the wound in the lens might heal also, leaving only a small dot of opacity. More generally, however, a little *aqueous* will gain admission to the wound in the lens, and a gradual partial or complete extension of the opacity will be the result. The cataractous change will be gradual, and if the wound in the capsule has closed rapidly, there may be neither increase nor diminution in bulk. There will be no pain, but the opacity will have rendered the eye useless for vision unless an operation be performed. If the capsular wound has not healed, the lens may undergo a gradual solution and absorption, and at last nothing will be left but a shrunken capsule lined with opaque deposit. There is a great tendency in lenses that have been wounded to undergo a fibrous or calcareous degeneration.

There are two drawings of cases of traumatic cataract that I published in the *Ophthalmic Hospital Reports*, sixteen years ago.[1] In one case, the cataract was produced by the patient falling down, whilst running in

[1] 1866, Vol. v. p. 131.

a corn-field, when something ran into the eye, making a wound in the sclerotic, just above the cornea, and carrying into the lens some of the uvea which it had scraped from the back of the iris. In the other, the cataract had been produced by the rapid movement of the point of a needle, which had been accidentally run through the cornea into the eye. The wound in the capsule was straight and perfectly vertical. The capsule on its inner side was intact, and this prevented the swelling up of the lens substance; but on the outer side, the lens substance was swollen and bulged forwards into the anterior chamber. No irritation was produced by the swelling and the whole lens gradually became absorbed.

The wound in the capsule may be caused by some larger instrument, such as a pair of scissors or chisel, and the capsule may be more or less torn; the lips of the lens wound will then gape, the aqueous humour will at once gain admission, and probably when the case is first seen, swollen lens matter will be occupying or escaping from the wound. In these cases the lens rapidly swells up, presses

forward upon the iris and ciliary body, and encroaches upon the anterior chamber, rapidly setting up inflammatory symptoms. These symptoms usually arise more rapidly in the adult than in children, because in the former, the iris and ciliary structures are less tolerant of pressure and irritation, whilst absorption is far less active. The greatest care and watchfulness are required in treating these cases.

With wounds of this character various complications may occur. The iris may be wounded at the same time as the lens, and may or may not be entangled in, or prolapse through, the wound of the cornea. The external wound may not be confined to the cornea, but may extend to or through the ciliary region. In the latter case the eye will probably be destroyed, and if allowed to remain may be the means of producing sympathetic ophthalmia in the other eye. It must be remembered, too, that a foreign body may have found its way into and remain in the eye, such as a piece of stone or guncap, or a chip of metal from a tool. In the summer of 1874, I removed a swollen traumatic

cataract from a man who had violently wounded his eye whilst shaking a carpet. The eye appeared at first to recover satisfactorily. It never, however, entirely lost its redness and a certain amount of uneasiness, and could only count fingers. The patient was lost sight of for a time, but I had warned him to come at once, if the eye became inflamed or painful, and a few months afterwards he returned to the hospital on this account. The globe was slightly red, but it was soft and shrunken, all vision having been gradually lost since his former attendance. I at once removed this painful eye, and at the bottom of it, lying in a mass of lymph, all healthy *vitreous* having quite disappeared, was a rusty iron tack, such as is used for nailing down carpets.

The danger to be feared from the pressure of a swollen lens upon the iris and ciliary body, is acute irido-cyclitis, which is often destructive to the eye, and most certainly so if the inflammation be maintained by the presence of a foreign body.

As another form of traumatic cataract I must not omit to mention, that blows on the

eye sometimes cause a partial separation of the lens from its attachments. The lens may thus be displaced, or it may only be loosened, while still retaining its normal position. In both cases, it generally sooner or later becomes opaque. Very frequently this partially dislocated lens, from its mobility, and sometimes from its temporarily increased size, causes considerable irritation, and thus affords an additional reason for its speedy removal.

Lastly, Von Graefe and others have described as of very rare occurrence cases where cataract has been produced by *entozoa*, which had punctured the capsule and taken up a position within the lens.

LECTURE III.

Cataract is an affection which can only be successfully treated by operation. The internal administration of drugs, such as iodide of potassium, has from time to time been vainly extolled, as exercising some influence in restoring the transparency of the lens. Local applications too have been tried, but all that we can admit is, that the daily instillation of a weak solution of atropine will, as has already been shown, improve vision in those cases where the centre of the lens is involved, and where the peripheral portions are transparent; but it does so by dilating the pupil, and thus admitting rays of light, by the side of the opacity, to the central portions of the retina. The same result may be partially and temporarily produced by shading the patient's

eyes from the bright light, the pupils dilating as they do in the dusk of evening. These facts have induced some surgeons to perform iridectomy in such cases, in order that a portion of the transparent margin of the lens may be brought into use. The temporary advantage thus gained may, however, be too dearly bought, as a coloboma downwards and inwards, the position in which it is of most use, will be a marked disadvantage after the subsequent performance of extraction. But with the exception of these rational modes of treatment, which are only possible at one stage of the affection, no treatment, other than by operation, can be of any avail. I ought to mention here, that it was once proposed to restore transparency to the lens in the early stages of cataract by the repeated performance of paracentesis of the anterior chamber. This was tried and continued for many months by some surgeons, and the naturally slow progress of some cataracts led to its being extolled for a time as beneficial. A more careful consideration of the evidence, however, soon showed that it was worse than useless, and the proceeding was abandoned.

The operations now practised for the relief of cataract are of two kinds:—

1. Those for the removal or extraction of the opaque lens, where the whole lens is implicated.

2. The formation of an artificial pupil, where it is possible to utilise some transparent portion of the lens, in some non-progressive cases of partial cataract.

In former days, before the recognition of these two kinds of operation as alone legitimate, it was thought that the removal of the opaque lens from the axis of vision was all that had to be accomplished. With this object in view, the two operations of reclination and depression were practised and received the name of *couching*. Both forms of the operation were performed with a slightly curved needle (Fig. 8), passed into the eye through the sclerotic at the outer and lower margin of the cornea, behind the iris, and either in front of the anterior surface of the lens or into its substance. If the needle were then carried backwards and downwards in a quarter of a circle, and the lens were torn from

Couching.

its upper and lateral attachments, and made to lie with its anterior surface upwards at the bottom of the eye, turned back, as it were, but still attached and hanging by its lower border, then the operation of reclination was said to have been performed. If, on the other hand, the needle transfixed the nucleus of the lens, and both needle and lens were carried directly downwards and towards the floor of the eye-ball, and the lens were torn from all its attachments, and made to lie with its posterior surface upwards at the anterior part of the floor of the eye, then the operation of depression was said to have been performed. These operations were comparatively easy, and the immediate effect, at all events of the former, was so brilliant, that it is no wonder that they gained for a time a considerable reputation. They are, I am sorry to say, still performed by a few English surgeons amongst the natives of Oriental and other countries, and every one who has practised these procedures upon a sufficient number of patients, has a few permanently successful cases to appeal to in their justification. In the vast majority of cases treated by these now generally abandoned

methods, the eyes, will sometimes rapidly, sometimes slowly, be destroyed. In fifty per cent. of the eyes the vision is known to be *lost*, but permanent success is very rare. We now know that in almost every case the displaced lens acts as a foreign body. It presses upon the ciliary structures, or upon the choroid and retina, and gradually but surely sets up inflammatory changes, irido-choroiditis, or cyclitis, or glaucomatous symptoms. Subsequently, the *vitreous* undergoes changes and becomes more fluid, and eventually the eye atrophies and shrinks. In contrast, therefore, to the brilliancy of the immediate result, must be placed the blindness which is the frequent end of these inflammatory changes. I have no hesitation in saying that the operations of reclination and depression are unjustifiable, and ought now to be abandoned entirely for one or other of the improved methods of extraction, by means of which useful vision may be obtained in from eighty to ninety per cent. of the eyes operated upon.

It has already been said, that the method of removal will vary with the consistency of the lens. For the removal of soft cataracts we

may avail ourselves of the natural power of absorption, whilst hard cataracts have to be removed bodily from the interior of the eye.

Solution or Discission.

A soft lens, such as exists in most of the forms of cataract of early life, may be removed by absorption, by the operation which is termed *solution* or *discission*. In all cases of cataract in children, and in many patients up to twenty or even thirty years of age, where, on the instillation of atropine, the whole lens is found to be opaque, this operation is indicated. It is also required sometimes after the operation of extraction, where there is an opaque deposit upon the posterior capsule. It is performed as follows. In infants and the older patients, as the operation is almost painless, chloroform will not be necessary, but in children from two to ten or twelve it is better to render the patient quiescent by an anæsthetic. Infants may have their arms and legs controlled by being rolled up in a folded sheet or jack-towel. If no anæsthetic be used, a fine needle will be the only instrument required. This may be of the form of Bowman's stop

needle (Fig. 6), Saunder's fine straight needle (Fig. 7), or Beer's needle (Fig. 8), slightly curved at the point. The patient should be

FIG. 6.—Bowman's stop needle.

lying down, and the surgeon standing behind the patient's head. The lids may be kept apart and the eyeball steadied by two fingers of the left hand, and the needle should be

FIG. 7.—Fine straight needle.

introduced perpendicularly through the cornea, at a point just opposite the margin of the dilated pupil, the fine point of the needle being directed towards the posterior pole of

FIG. 8.—Needle curved at point.

the lens. The operation was originally performed by introducing the needle through the sclerotic at a distance of from $1\frac{1}{2}$ to 2 lines from the margin of the cornea. In this way

the operator could with facility thoroughly break up the lens substance, and tear a large piece from the middle of the anterior capsule. This operation is called sclerotico-nyxis. The introduction of the needle through the cornea is now preferred, as better results are obtained by kerato-nyxis with or without a subsequent linear extraction of the softened lens matter

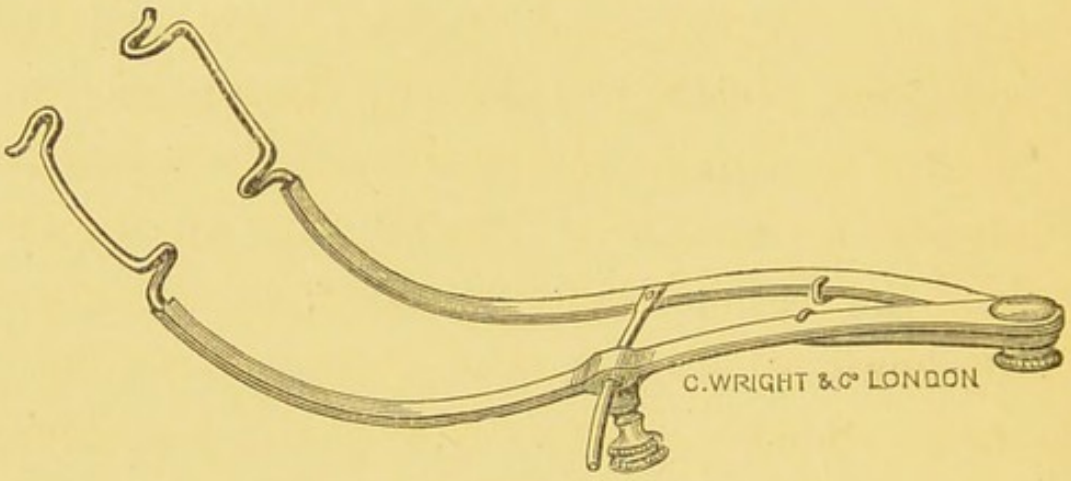

FIG. 9.—Speculum.

than was usual when the broken lens was left to undergo absorption in the vitreous chamber. If an anæsthetic be administered, a speculum may be used to keep the lids apart. (Fig. 9 shows the form in use at the Westminster and Royal Westminster Ophthalmic Hospitals, which is made in two sizes, for children and adults.) The globe may be

held by a pair of forceps. The object of the operation is to wound the anterior capsule of the lens to the required extent without wounding the iris, and without allowing the escape of aqueous humour until the proceeding is complete and the needle is withdrawn. The laceration of the capsule is best performed by making a crucial incision with the point of the needle, or several incisions in young children, converging to a central point, at the same time rotating the needle in the opaque lens substance. By this means some of the aqueous humour makes its way within the capsule of the lens, the substance of which, or that portion of it which has been disturbed, softens, swells up, and becomes absorbed. In older children and young adults, much less laceration must be effected. With every year of life the rapidity of absorption diminishes, and a smaller portion of lens substance must be disturbed at the first operation. It is better to repeat the operation a number of times than to do too much, for if the swelling up of the lens is too rapid, the iris and ciliary body will be pressed upon, and pain and inflammation, and perhaps serous-iritis, irido-choroiditis,

or irido-cyclitis, will be the result. In infants, then, the laceration may be free; in children diminishing with every year of age, until, in patients of twenty to thirty years, the wound of the anterior capsule must be limited to one slight transverse or vertical tear. In each case, the second needle operation may be slightly more free than the first. In young children the operation should be performed early, and before the habit of nystagmus described above is established. If you are not accustomed to operate, the best form of needle to use for this purpose is Bowman's fine stop needle (Fig. 6). The time which this process of solution takes, varies from seven to twelve weeks in young children, to many months in the more adult patients. In the former cases, two or at most three operations will be necessary, whilst in the latter, a greater number of very slight operations will be required, and the redness produced by one operation should be allowed to pass away before another is undertaken.

All the after treatment that is required in these cases, is the immediate and daily instillation of a solution of atropine (two grains to

the ounce of water is sufficient), so as to keep the pupil dilated and out of the way of the swelling of the lens, the application of a bandage for the first twenty-four hours after the operation, and subsequently a large shade covering both eyes. The amount of light in the room should be diminished for the first two or three days by a venetian blind, or one composed of a green material, but afterwards an ordinary blind and a large shade over the patient's eyes will be sufficient, all bright light being of course avoided.

I would here say, once for all, that a shade, to be effective, must cover both eyes; over one eye alone it is almost useless, because the light to the sound eye causes movements of the iris in both. This seems also a favourable opportunity for recording a protest against shutting old or young cataract patients up for a week or ten days in a dark room. Such a practice is most prejudicial to their health, and interferes with, and retards, the healing process in the wound. The vital processes of the body cannot be healthily performed without light, and although it is wise to darken the patient's room for a few days immediately following the

operation, it is never wise to make the room to all intents and purposes completely dark. After the first few days, it will be sufficient to moderate the light, and to shield the eyes and brows of the patient with a large shade of paper, or some light material of a dark colour. You have seen many cases of cataract successfully treated in the general wards of this hospital,[1] with no greater diminution of the light surrounding the patients than can be obtained by partially surrounding the bed for a few days with an ordinary screen.

It will have been seen that cases treated by this form of needle-operation will run a somewhat tedious course, and especially in the older children, and it has therefore been proposed to avoid the series of operations that will sometimes be required, and hasten the removal of the lens by very freely breaking up the lens substance at the first operation, and removing the rapidly softened lens matter a few days later by a curette or by a suction instrument. With this object in view the needle is made to make several parallel incisions in the anterior capsule, and then freely

[1] Westminster Hospital.

to break up the whole lens substance. If this be thoroughly effected softening will rapidly take place, and in a few days, and before irritation is set up, the whole of the lens may be removed. Some surgeons use two needles for the more effectual breaking up of the lens.

This mode of treating soft cataract, when successful, possesses the advantages of brilliancy and economy of time, but unfortunately it is not unattended with risk, and as in most of these cases time is no object to the young patient, I should advise you to prefer safety to brilliancy of proceeding. There are, however, many cases when the more orthodox needle operation is used, in which the lens becomes swollen and commences to set up irritation. This occurs more frequently in the more adult patients, that is, who are over fifteen years of age; and in order to avoid the risk of irritation and consequent inflammation, it was proposed by Von Graefe to perform a large iridectomy upwards a week or two before the needle operation, so as to leave plenty of room for the swelling up of the lens. This certainly does sometimes prevent the occurrence of irritation.

In cases, however, where the lens becomes much swollen and irritation does occur, it becomes necessary to remove the lens by the operation called *linear extraction;* the removal of a softened lens by a suction instrument as above mentioned being only another form of this operation.

Linear Extraction.

Linear extraction is the removal of a soft lens through a small corneal incision, and is specially indicated in cases when the lens has become soft and swollen after the needle operation for solution, and especially in older children and young adults, also in cases of traumatic cataract when the lens is swollen and the eye becoming uneasy, injected, or painful. It is also adopted in the cortical cataracts of people under thirty or thirty-five years of age, when the lens is soft and when there is no hard nucleus. Linear extraction should not be adopted if the lens retains its normal consistence or if a firm nucleus be present.

There are several ways of performing this operation. An anæsthetic is not essential, but it will be found advisable unless you can trust

the quietude of your patient. The pupil should be previously dilated with atropine. Some surgeons recommend an iridectomy previously or at the time of the operation, so as to avoid the iritis which might be set up by any fragments of lens matter being left

FIG. 10.—Broad needle with cutting edge.

behind. If an anæsthetic be used it will be convenient to separate the lids by a wire speculum. Either a broad needle with a cutting edge, which may be straight (Fig. 10), or bent on the flat (Fig. 11), a cataract knife,

FIG. 11.—Broad needle with cutting edge bent on the flat.

or a narrow spear-shaped iridectomy knife, may be used. The operator should stand behind the patient, and the point of the instrument should be passed into the anterior chamber through the upper part of the cornea a little within its margin, and a section of from

one and a half to two and a half lines should be made. On withdrawing the knife the *aqueous* will escape through the wound, and if there has been a wound of the capsule, as in traumatic cases, some soft lens matter will escape also. If the capsule be still intact, it may be freely opened by the needle, or by the ordinary extraction pricker, or cystotome, which is usually set in the same handle as the curette (Fig. 12). Some of the

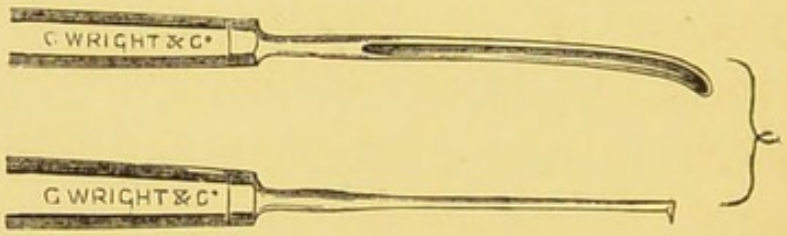

FIG. 12.—Curette and Cystotome.

soft lens matter will at once escape through the wound; the curette may then be introduced through the wound into the area of the pupil, when most of the remainder will readily escape along its groove, forced out by the intraocular pressure. Other instruments have been devised to assist in removing the material of soft cataract, such as the suction tube of Mr. Teale of Leeds, and the modifica-

tion of it which forms the suction syringe of Mr. Bowman. Or one of the various forms of scoop may be used to remove fragments, and the ordinary iris forceps will be useful for the removal of fragments of capsule. As a rule, however, the fewer instruments introduced into the eye the better, and it will be found that many soft cataracts may be completely removed, the only instruments which are introduced being the instrument used to make the linear incision and the grooved end of the curette. It is true that sometimes, as before alluded to, a brilliant operation may be performed and time may be saved, by the dexterous use of a suction instrument, but unless you are in the habit of performing these operations I should advise you not to use them, as they are attended with much risk.

If, during the operation, a portion of iris becomes prolapsed through the wound, it should be gently replaced if possible. If not, or if it has been bruised, it should be cut off. If it is found that the lens is not sufficiently soft, and that none or only a small portion of it will escape, the portion of iris corresponding

to the size of the incision should be removed, and gentle pressure again tried, remembering, however, that not the slightest force is to be used. If the lens matter does not then readily come away, further proceedings should be postponed. The eye should be tied up, and the aqueous humour allowed to continue the process of softening the lens matter which remains. It is in some of these cases that a suction instrument used with judgment may be the means of avoiding this delay. After these proceedings the eye must be carefully watched, so as to treat any inflammation that may arise, and if necessary to remove any lens matter which may swell up and produce irritation. Otherwise, the process of absorption may be allowed to go on, without interference, to complete the removal of the opaque lens.

In the older patients, on the other hand, it is often better to remove the lens with a Critchett's or Bowman's traction instrument (Figs. 19, 20), a proceeding for which the performance of an iridectomy will have given facility.

The after-treatment of linear extraction is

the same as that after needle operations. The eyes must be tied up for a few days, two or three will generally be sufficient, and they must be thoroughly shielded from the light, and a solution of atropine should be used once a day. If any pain or puffiness of the lids comes on, the eye must be looked at, and inflammation checked at the outset by the application of a leech between the nose and the inner canthus. If there is found to be much swollen lens matter the above operation must be repeated.

Extraction of Cataract.

We now come to the consideration of the various methods, of extraction of the lens, which have been recommended for adoption when the presence of a hard nucleus necessitates a larger wound for its removal than is required in the case of the softer cataracts. Numerous methods of operation have been devised, differing from each other in the size or position of the section, or by being accompanied or not by an iridectomy previously or simultaneously performed. I think it will make this portion of the subject more interesting, and perhaps more practically useful, if I arrange the

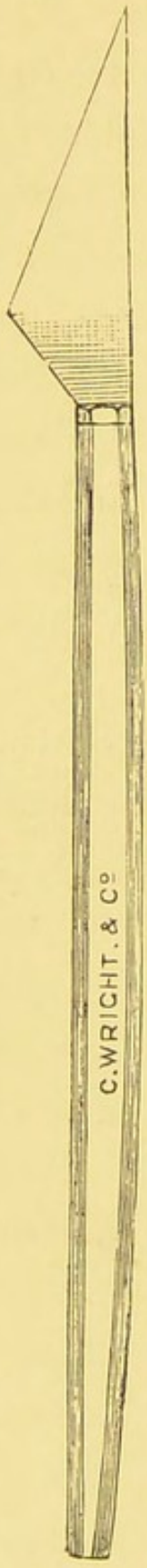

Fig. 13.—Beer's knife.

descriptions of the various methods as far as possible in chronological order. It appears that David, in the year 1748, was the first to extract a cataractous lens. He did it by a semilunar incision through the cornea, but from the rough method of performing it, and the rude instruments at that time obtainable for the purpose, he does not seem to have met with much success, and his operation gave way to the methods of couching already described.

It was not until the present century that Wenzel introduced a method of extraction by a flap. This method was improved by Professor Beer of Vienna, and afterwards by Professor Jæger, the former of whom devised a knife, which still bears his name (Fig. 13); the object of which was, by its wedge shape, to fill up the wound in the cornea as it was being made, and thus to prevent the escape

of the aqueous humour until the section was approaching completeness. This knife has ever since been retained for this form of operation, with, however, slight modifications on the part of individual operators. The late M. Sichel, of Paris, used a blade rather longer but slightly narrower (Fig. 14); a form which came largely into use as more convenient than the broader blade of Beer. There were also other slighter modifications

FIG. 14.—Sichel's knife.

which I need not stop to enumerate. There is no doubt that this operation is the most perfect one that has been devised, if we could only ensure for it a more general success. When it is completely successful there is a round, central, and movable pupil, and an eye almost unchanged in appearance, and with a minimum of damage. Unfortunately, however, such success cannot be ensured. So many dangers accompany and follow the operation that in a large proportion of the

cases the subsequent usefulness of the eye is curtailed and in many cases vision is altogether destroyed. Although this operation is now seldom performed, it is important that you should be thoroughly acquainted with it, as it forms the basis of modern operations, and affords important points of contrast with them.

LECTURE IV.

The operation of flap extraction, *extraction à lambeau*, may be performed either upwards or downwards, the latter being the easier of the two. I have, however, always recommended the upper section. Some operators perform the upper section in the right eye and the lower in the left, as the upper section in the left eye requires the use of the left hand. The pupil should be dilated with atropine before the operation. The patient should be lying down upon a couch of a height convenient to the operator, and placed immediately opposite to a window affording a good light. A sky-light is, as a rule, to be avoided as producing too much reflection from the cornea. The patient's head should rest on a tolerably hard pillow,

Flap Extraction.

and should lie as comfortably as possible. No anæsthetic is to be used. The patient should be instructed to keep the teeth and lips slightly apart in order to avoid any straining of the facial muscles. The instruments required are: 1, a cataract knife (Figs. 13 and 14); 2, a pair of toothed forceps for the purpose of holding the eye (Fig. 15); 3, a cystotome and curette (Fig. 12); 4, a blunt pointed pair of scissors. The forceps for holding the eye were recommended by Mr. France, and afford great facility to the operator in making the upper section. They should be given to an assistant, who should with them take hold of the conjunctiva about a line and a half below the cornea and gently draw the eye down, taking care not to press upon the globe with the point of the forceps. The operator may fix the eye himself by holding the

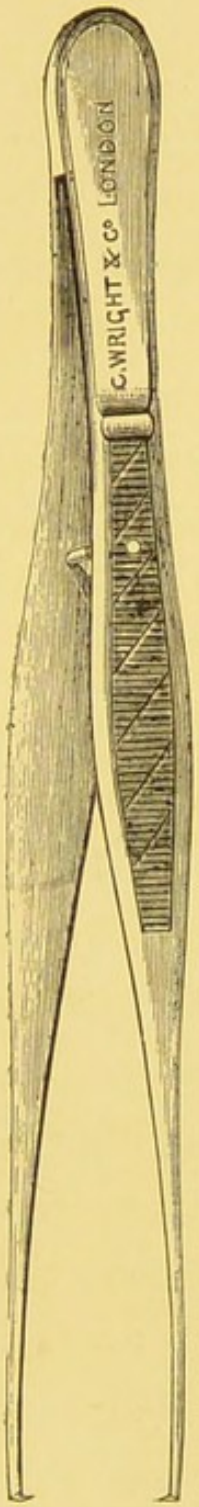

Fig. 15.—Pair of holding forceps.

forceps in his other hand; but it is much more convenient to have this done by an assistant, who should be instructed to remove the forceps as soon as the counter-puncture has been made. In making the section the operator should hold the cataract knife lightly between his fingers and enter the point at the outer side of the cornea, close to its margin and in the line of its transverse diameter, carry it quickly and steadily across the

FIG. 16.—Section in flap extraction.

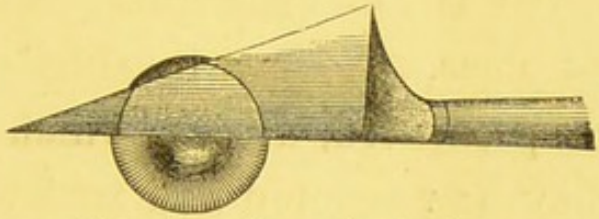

FIG. 17.—Operation by flap.

anterior chamber, and with it make the counter-puncture at a point exactly opposite to the first puncture. Fig. 16 shows the position and size of the section, and Fig. 17 shows the knife in position after the counter-puncture has been made. The blade of the knife must not be rotated or the *aqueous* will immediately escape, but must be pressed steadily on, the back of the knife being kept carefully pressed against the extremities of

the incision and in the line of the transverse diameter, until the cornea has been almost completely divided. The knife should then be gradually withdrawn, at the same time dividing the small bridge of cornea which was not divided by the onward movement of the blade. As soon as the section is thus completed the upper lid should be allowed to fall gently over the wound, taking care that the flap of cornea is not folded down over the lower half of the cornea, but lying properly in its place. A short interval of rest should then be permitted, during which time the patient may be reassured and told to look downwards towards his feet, and also to keep the mouth slightly open to prevent any straining which is sure to be present if the jaws are firmly pressed together. The operator will then gently raise the upper lid, and introducing the pricker or cystotome beneath the corneal flap and into the pupil, make with its point a crucial incision in the anterior capsule of the lens. It is necessary to avoid wounding or entangling the iris with the pricker, and to make the incisions in the capsule freely but without roughness, or the hyaloid may be

ruptured and the lens dislocated. If there is much soft lens matter it will escape through the pupil, and some of it from the wound. The instrument may then be reversed, and the curette, which is generally fixed in the same handle with the pricker, should be used to exercise gentle pressure through the lower lid upon the lower part of the globe. This, if the finger through the upper lid gently supports or depresses the upper margin of the wound, will cause the nucleus to become slightly tilted and to present its upper margin through the pupil and towards the corneal section. Nothing like force should be used, but the gentlest pressure is sufficient to expel the lens if the section be sufficiently large. If the section be too small, so that the lens does not readily escape, the wound must be enlarged. This may be easily done by the probe pointed scissors, by means of which the section may be enlarged at one or both extremities of the wound. Some operators prefer the blunt pointed secondary knife, of which there are straight and curved varieties, for enlarging the section; but the scissors will generally be found to be more convenient and

less liable to produce any mishap. The extrusion of the lens is the critical point of the operation, and requires great care and judgment or *vitreous* may be lost; and it is therefore most important to remember to instruct the patient to maintain during this stage a relaxed condition of all the facial muscles.

After the escape of the nucleus, and the careful removal with the curette of any fragments of lens which remain in the anterior chamber, the flap must be carefully adjusted, the upper lid gently lowered over the wound, and both the eyes at once closed. If any prolapse of the iris has taken place through the wound, it should previously be gently replaced with the curette, or if it does not easily return it should be cut off. Any fragments of lens matter should be carefully removed from the wound. When the lids have been closed they may be kept in apposition by a small piece of strapping, but a light compress over each eye, kept in position by a bandage, is generally preferred, as giving more comfort to the patient, and a sense of support to the wounded eye. The compress

should consist of a piece of very soft linen or cambric and a small pad of cotton wool carefully adapted to the orbital hollow. The best form of bandage is a linen band which should be double and about fourteen inches in length by two and a half inches in width. To this band are attached tapes for tying, one of which is longer than the other, and double for the first six or seven inches of its length, so as to form a loop to fit over the occiput and keep the bandage in position. This bandage is exceedingly light and comfortable, and is quickly adjusted or removed. This form of bandage may be improvised by taking about two and a half feet of ordinary calico bandage, two and a half or three inches wide, and making in it, at a short distance from one end, a central longitudinal tear about six or seven inches in length, thus forming the loop to fit over the occiput.

From the foregoing description of its several steps, the operation will appear to be a tolerably simple one, and the same impression would probably be received by seeing the operation performed in a case where every step of the proceeding has been completed without com-

plication or mishap. Unfortunately, however, difficulties may occur at every stage of the operation, and do occur so frequently, that the surgeon has to be constantly prepared to meet each complication as it arises. It is thus that the operation has acquired the reputation of being one of the most difficult and complicated manipulations in surgery.

Difficulties and Dangers of Flap Extraction.

The description then that I have given will be very incomplete if I do not give you some account of the difficulties that may arise during the progress of the operation, and the duty of the surgeon in presence of each complication. The first step of the operation is the section of the cornea, and it may be divided into three periods. The puncture, the counter-puncture, and the section of the cornea, have each its special difficulties. The movement of the patient may cause the puncture to be made in a bad position. The operation may, however, be proceeded with if it allows room for a good-sized section, as even if it should not be sufficiently large, the wound may subsequently be enlarged with

scissors. A more serious difficulty is the premature escape of the aqueous humour. This may happen either by a sudden movement of the patient, or by the rotation of the knife on the part of the operator. If the *aqueous* escapes before the counter-puncture has been made, it will be better to withdraw the blade and postpone the extraction to another day, in order that the wound may close and the anterior chamber be refilled by a re-secretion of *aqueous*. Secondly, the counter-puncture may be made in a bad position. If it is too far back, you will very likely lose *vitreous* from a diminution of the support to the hyaloid. If it is too far forward, the section will be of bad shape, and may be of insufficient size. These difficulties may be avoided by carefully ascertaining the position of the point of the knife before it is thrust onwards, as its position may then be easily changed. It cannot be changed, however, after the counter-puncture is complete, as some *aqueous* generally escapes, and the withdrawal of the point of the knife would be immediately followed by a further considerable escape, and the iris and lens

would become pressed forward against the blade. The next difficulty is that sometimes during the rapid escape of *aqueous*, the iris is carried in front of the edge of the knife. When this is the case, it may often be pressed back by the finger, the patient's lid being used in gently manipulating the cornea. If the portion of iris does not readily slip back beneath the blade, it may be boldly cut off by the onward progress of the knife in completing the section. I have already mentioned the importance of deliberation in completing the section. There should be nothing like hurry or force, neither must there be the slightest straining on the part of the patient. Otherwise the section may be completed with somewhat of a jerk, and this is sometimes followed by the sudden extrusion of the lens in its capsule entire. If this is all that happens it is well, but more generally the sudden extrusion of the lens will be followed by a gush of vitreous humour. At other times the escape of *vitreous* may take place without the extrusion of the lens, the lens falling back into the vitreous chamber. When this untoward

event occurs, the lens may sometimes be caught by a hook and removed, but it is often a matter of extreme difficulty, every attempt being attended by a fresh escape of *vitreous.* If therefore the lens is not readily caught it must be left, and the wound having been placed in position, the lids should be closed and a light compress adjusted. What is most to be feared in these cases, whenever much *vitreous* has been lost, is hæmorrhage from the retina. This fortunately does not frequently occur, but when it does occur acute pain suddenly comes on, and blood begins to escape from beneath the bandage, the contents of the globe being evacuated by the flow of blood and the eye will be thus destroyed. The hæmorrhage would seem to depend upon some diseased condition of the tunics and vessels of the retina, and must be restrained by a firm compress, or much blood may be lost.

If, however, the section has been completed without any mishap of this kind, the next step of the operation is to divide the capsule of the lens, so as to liberate the nucleus and the rest of its contents as before

described. If this step be performed roughly, the lens may be displaced, and loss of *vitreous* ensue, or the lens may be completely broken up, so that it may become difficult to remove all the fragments. On the other hand the division of the capsule may not be sufficiently free to allow the nucleus to present on the application of slight pressure. This will probably be found to be the case if the lens presses the iris forwards, and does not readily present itself at the pupil, which will generally be a sign that the pricker should again be used.

When the nucleus has partially emerged through the pupil and has then come to a stand-still, it will generally be because the corneal section is too small. It is a matter of great nicety to adapt the section to the size of the nucleus, and yet this may often be done very accurately, as by the use of atropine to dilate the pupil we are able with the ophthalmoscope to estimate the size of the nucleus. Care on this point is important, as there is always some risk in subsequently enlarging the corneal wound. It is, however, far better to do so, than to

use too much pressure and run the risk of loss of vitreous humour, or of bruising the uveal structures.

Such then is the flap operation which for a long period held its position as the best mode of extracting a hard cataract. It was an immense improvement upon the old operation of couching, but it was not without its defects, although there are some surgeons who still maintain that, in spite of them, it is the best operation.

Subsequent Causes of Failure of Flap Extraction.

The causes of failure besides those enumerated as incidental to the operation itself, are:—iritis from bruising of the iris whilst making the section or removing the lens, or from the swelling up of particles of lens matter left behind; closure of the pupil; imperfect coaptation of the edges of the corneal wound, from various causes, and consequent non-union—an occurrence favoured by the shape and size of the section; gaping of the wound; prolapse of the iris; interference with the nutrition of the cornea, and sloughing; escape of the contents of the eyeball by rupture of the hyaloid, sometimes

produced by want of dexterity on the part of the operator, or by muscular spasm, and sometimes occurring from the giving way of the wound during the subsequent treatment; hæmorrhage; and suppuration. Further, the large corneal wound necessitates a long period of quiescence and confinement after the operation, which is of itself exceedingly irksome to the patient.

The formidable risks and objections thus enumerated, and also the difficulties of the operation itself, led surgeons to consider how they might be avoided or diminished; and we shall see that the various modifications that have been devised, are so many attempts to get rid of one or other of these risks. The difficulty is, however, whilst removing one defect, to avoid introducing another, equally or even more dangerous to the eye. The modifications suggested have been mainly in two directions: in that of attempting to lessen the risk of prolapse of the iris and of iritis, and the consequent defects in the pupil; and in that of diminishing the risks produced by the size and shape of the corneal wound. The main elements of the

improvements which have been brought about were a shorter and linear form of section originated simultaneously by Professor A. Von Graefe, and Mr. Bowman, and next the removal of a portion of the iris, suggested by Von Graefe, and practised by him in exceptional cases. One or both of these suggestions, the most important since Mr. France suggested in 1858 the use of the forceps for fixing the globe in cataract extraction, were eagerly seized upon by the majority of operators; and certain of them who published their modifications obtained considerable notoriety for their methods, and perhaps credit for more originality than strictly belonged to them. Three of these I will mention.

Mooren's Method.

Dr. Mooren performed iridectomy five or six days before the ordinary flap extraction. His published cases testified that this method was attended with considerable success, and in a direction of a diminution of the frequency of subsequent iritis. This plan of a preliminary iridectomy was adopted by many surgeons, and was, I believe, long practised by Prof. Wolfe of Glasgow, although latterly with a diminished corneal wound.

The chief objection to it is the infliction of two operations upon the patient instead of one, an inconvenience which in my opinion far exceeds any small advantage there may be in the method.

Jacobson's Method.

Professor Jacobson, on the other hand, performed the ordinary flap extraction and the iridectomy at the same time, and he also published a long list of successful cases to show the value of his method. With so large a section, however, the iridectomy could not be made without considerable risk of rupturing the hyaloid and losing *vitreous*, a result which very often happened.

Schuft's Scoop Extraction.

Professor Schuft (Waldau), modified the operation very considerably. He adopted the reduction in the size of the corneal wound as well as the iridectomy, making his section of the linear or curvilinear form, and as the lens would no longer escape spontaneously, or with gentle pressure, he used, in order to facilitate its removal, peculiar forms of spoon, of different sizes, which were called by his name. The operation which he introduced in 1860 was briefly as follows: The lids having been

separated by a wire speculum, a curvilinear incision was made with a large spear-shaped knife, in extent corresponding to about one-third of the circumference of the cornea, but so placed that while the ends of the section were in the corneo-sclerotic junction, the middle portion was well within the cornea, and half a line from its margin. A small portion of iris opposite the wound was then excised, and the anterior capsule of the lens

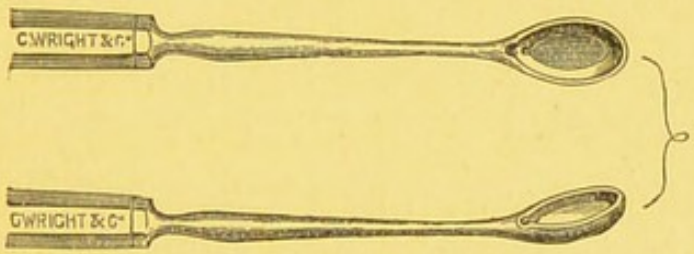

FIG. 18.—Schuft's scoop.

lacerated in the ordinary way. The next step was to remove the cataract by introducing Schuft's scoop (Fig. 18), passing it at first backwards and then downwards behind the nucleus and gently drawing it through the wound, subsequently removing any soft lens matter there might have been surrounding it. This proceeding was one of some difficulty, and especially in cataracts that were immature, or in which the nucleus was of considerable

size, and it was soon found that Schuft's scoop was too bulky and difficult of introduction to render it suitable for general use. The high margin and sharp edges of its dish-like cavity rendered its use dangerous even in the most experienced hands, it being often impossible to avoid rupturing the hyaloid membrane, or breaking up the lens substance, or both, whilst introducing it behind the nucleus, and in some cases bruising the iris or the edges of the wound. The diminished size of the wound and the possibility of the administration of an anæsthetic led, however, to a favourable reception of this method, and its trial at the hands of almost every ophthalmic surgeon, by none more completely than by those distinguished surgeons, Mr. Bowman, and the late Mr. Critchett. They have both placed their opinions and experience with regard to it on record in Vol. IV. of the *Ophthalmic Hospital Reports* (1865).

Extraction by Traction Instruments.

A recognition of the risks I have mentioned soon led each of these surgeons to give up the use of Schuft's scoops and to substitute for them a "traction instrument" of his own devising;

both instruments being reduced in size, by getting rid of the deep sides of the cuplike cavity, and by the substitution of another provision for grasping the cataract. This latter took the form of a "small receding edge" in Mr. Critchett's traction instrument (Fig. 19), and of a bend at a very obtuse angle to the body of the spoon in Mr. Bowman's (Fig. 20. *a*). These traction instruments occupied much less space behind the cataract, and were

FIG. 19.—Critchett's traction instrument.

therefore easier of introduction and more free from the risks that I have mentioned. Mr. Bowman contrived another form of spoon,

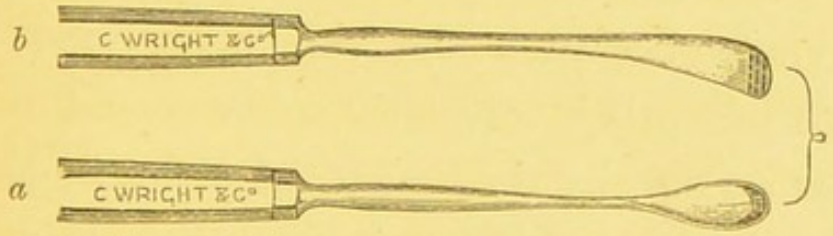

FIG. 20.—Bowman's traction instruments.

taking less room still, for use in cases where, from the almost complete absence of soft lens matter, there was very little space for the

introduction of any instrument between the nucleus and its capsule. In it the cuplike form was still more completely abandoned (Fig. 20. *b*). I may best describe it in Mr. Bowman's own words: "This form is nearly flat from side to side, and but slightly concave from end to end. The end has a very thin, though not a sharp edge, only slightly incurved, and the concave surface at the end is roughened by transverse lines. It is thus fitted to insert itself readily between the nucleus and the posterior capsule, particularly if poised, as it were, only by the thumb and a single finger, and made to advance with a gentle laterally wriggling motion. Then when the handle is lowered, its end rises in the lens substance beyond the nucleus, and obtains an excellent hold on it for its extraction." Mr. Bowman preferred also to make the section in the corneo-sclerotic junction throughout, and therefore more curved than that of either Waldau or Critchett; and in most cases also to make a large iridectomy, the better to avoid the risk of bruising the iris during the later steps of the operation.

These, then, were the forms of extraction

of cataract by a traction instrument. The old flap extraction was still recommended in favourable cases, but the traction operation was considered suitable in all cases where a hard nucleus was present, when it was desirable to administer an anæsthetic. The results obtained by this method, both as regards subsequent vision and rapidity of recovery, compared favourably, on the whole, with flap extraction, but there was still much to be desired. Destructive inflammation of the eye, suppurative or otherwise, ensued far too frequently, and a not unfounded objection to the use of a scoop or traction instrument gradually but steadily gained ground. It was during this period that the late Professor Von Graefe was maturing his operation of *linear extraction*, and introducing those modifications which soon after brought his method into favour with ophthalmic surgeons.

LECTURE V.

Von Graefe's Modified Linear Extraction.

Von Graefe conceived that sclerotic wounds healed more rapidly and satisfactorily than corneal wounds; and therefore his first mode of performing the operation [1] was with the section situated in the sclerotic, although he subsequently preferred to make it slightly more forward

Fig. 21.—Von Graefe's knife.

in the part where the sclerotic overlaps the margin of the cornea. The section was made with a long narrow blade (Fig. 21). Chloroform was recommended in exceptional cases *only*, to counteract spasmodic or excessive action of the ocular muscles, Von Graefe's

[1] *Archiv. f. Ophthalmologie*, vols. xi. and xii.

opinion being that a moderate and controllable action of the ocular muscles was favourable to the escape both of the nucleus and softer portions of the lens.

The patient having been placed in the recumbent position, and the lids fixed open with the wire speculum, the surgeon standing behind the patient's head, the conjunctiva was seized with the fixation forceps,[1] close to the margin of the cornea and

The Section.

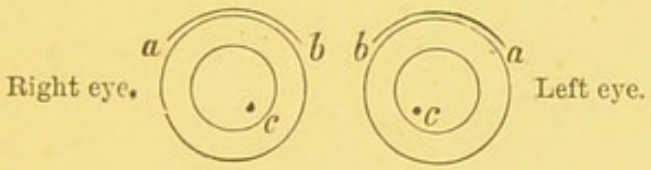

FIG. 22.—Diagram of Graefe's sections.

exactly in a line with its vertical meridian. The knife was held in the right hand for the right eye, and in the left hand for the left eye, and the point of the long blade, with the edge turned upwards, was entered at the point *a* (Fig. 22) in the sclerotic, a little more than half a line (1 mm.) outside the margin of the cornea, and in a position outwards and upwards. As

[1] See Fig. 15.

a guide to the position of the point of entrance, let it be remembered that the section should be opposite to the upper third of the corneal margin. When the puncture has been made the knife should be carried, not in the direction of the intended section, but towards the point *c*. This makes the section of the internal surface of the sclero-cornea as free as the section of the outer surface. The knife having been carried towards the point *c*, and for a distance of

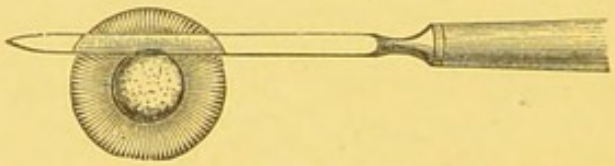

FIG. 23.—Graefe's operation.

three and a half lines into the anterior chamber, the handle is depressed and the blade pushed onwards, so as to make the counter-puncture at the point *b*, taking care that this should not be too far back in the sclerotic. As soon as the counter-puncture is made, the bulging up of the conjunctiva shows the escape of some of the aqueous through the apertures. Fig. 23 shows the position of the knife after the counter-puncture has been made. The blade is passed onwards for a few lines, and then its

edge should be rotated forwards, in order that the cutting of the section may be completed in such a way that its centre shall be slightly nearer to the cornea than are its extremities, and therefore straighter than the curve of the corneal margin. The completion of the section is effected by pushing the knife onwards to the length of its blade and then drawing it backwards, the operator being careful to hold the instrument in the position above described. This sawing motion may be repeated if necessary. When the sclerotic section is complete, it will be found that the edge of the knife will be covered by a strip of conjunctiva, which should in its turn be divided with the same sawing motion, the edge of the blade being turned still more forwards, so that the anterior flap of conjunctiva may be very short. This is important, for if the section of the conjunctiva be made too far back, or more than a line and a half from the cornea, there will be some bleeding, and the anterior flap will get rolled, or otherwise impede the subsequent steps of the operation.

Fig. 24 shows a later modification in the position of the section, the puncture and

counter-puncture occupying the same position, but the centre of the section is exactly at the corneal margin. This is made by rotating the edge of the blade still more forwards.

Fig. 25 shows yet another position of the section, and one that is very frequently practised. The puncture and counter-puncture are slightly lower, and not more than half a millimetre from the corneal margin. The edge of the blade, turned forwards to the

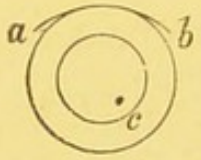

FIG. 24.

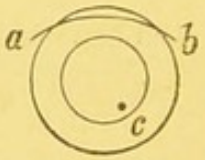

FIG. 25.

Diagrams of Graefe's later sections.

same extent as before, will make the middle of the section entirely corneal and just within the corneal margin.

The position of the several sections are well shown in a diagram (Fig. 26) of the cornea and ciliary region. A, B, and C show the position of the sections in Figs. 22, 24, and 25, respectively. Section A is outside the cornea, B in the corneo-scleral junction, and C within the cornea. D shows the position of

the section in Warlomont's and Liebreich's operations, which will be referred to presently.

The next step is the iridectomy. The holding forceps may be given to an assistant, who should maintain gentle traction upon the globe to keep it depressed. *The Iridectomy.* The conjunctival flap must be carefully reflected over the cornea, in order that it may not be curtailed, and the iris should then be seized

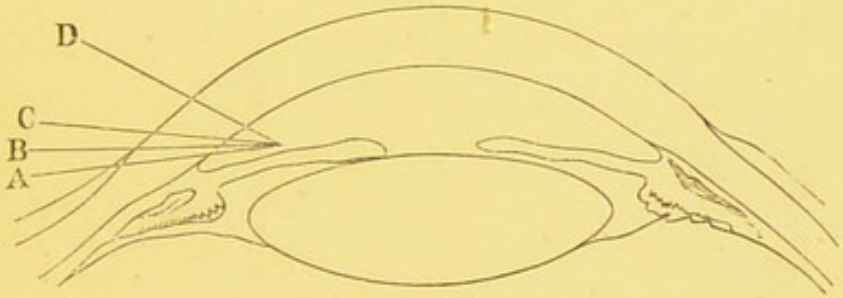

FIG. 26.—Diagram of sections.

with the points of a straight pair of iris forceps (Fig. 27) at about the middle of the section. It will generally be found to be prolapsed, and at this point bulging from contained aqueous humour. The iris, being well drawn from the wound and put on the stretch, is divided as close as possible to one end of the section, separated by several snips with the scissors (Fig. 28) from its peripheral attachment, and then divided at the other end of the section

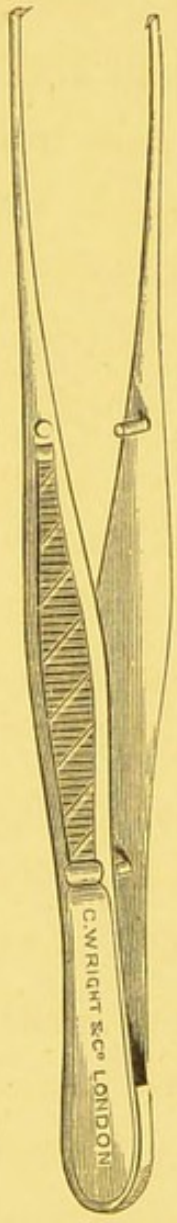

FIG. 27.—Straight iris forceps.

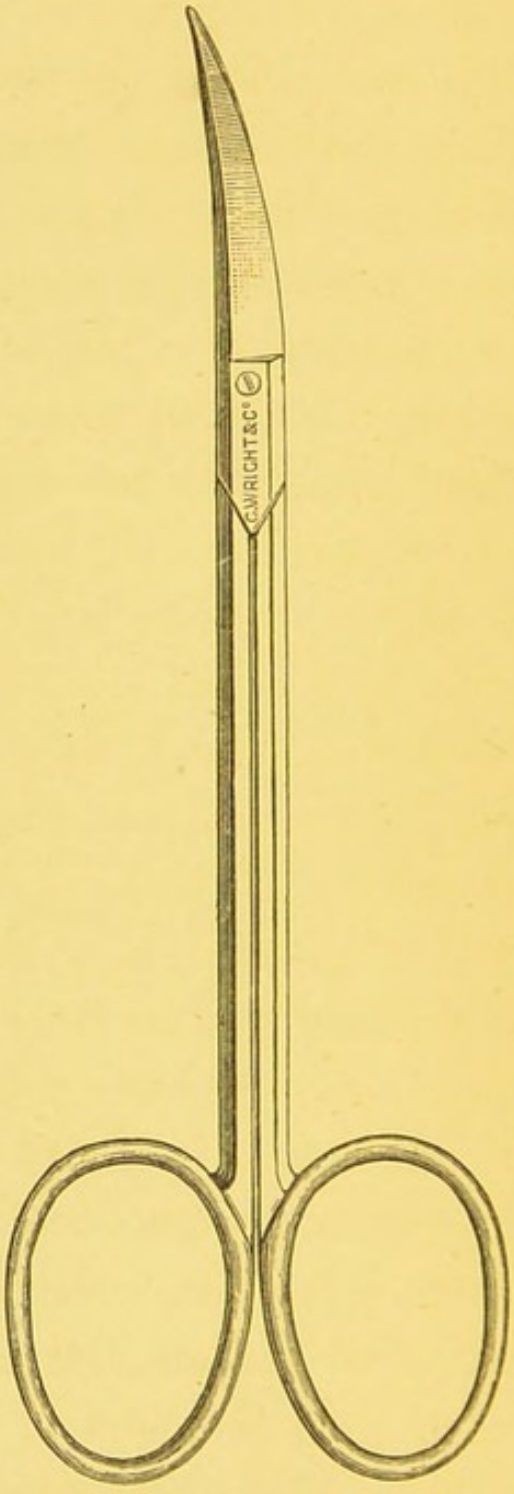

FIG. 28.—Iris scisors.

and removed. If any fragment remains in either end of the wound, it is either carefully seized with the forceps and cut off, or gently returned to the anterior chamber. Von Graefe insists very strongly upon the iridectomy being complete up to the angles of the wound. If there be any bleeding from the cut iris into the anterior chamber, the closed lids may be pressed upon for a few minutes with a pad of charpie; and then the bleeding will soon cease, and slight pressure on the sclera above the section will cause the blood to escape. The pressure of blood in the anterior chamber would otherwise interfere with the accurate performance of the next step of the operation.

Laceration of Capsule.

For the next step, that of laceration of the capsule, the operator resumes the fixing forceps, and exercising slight pressure with them upon the globe so as to steady the lens and afford the necessary resistance to the cystotome (Fig. 12), he divides the capsule freely by two or three incisions, commencing at the lower margin of the pupil and ascending to the peripheral margin of the lens. It is important that this laceration should be complete.

Removal of Lens.

For the removal of the lens a traction instrument is not generally necessary. When there is much soft lens matter and the nucleus is small, all that is required is the gliding pressure of the back of the curette (Fig. 12) or a vulcanite or other spoon upon the sclera above the wound, so as to make the wound gape. This manœuvre is usually sufficient to make the edge of the nucleus present itself at the wound, and continuous gentle pressure will be speedily followed by

FIG. 29.—Graefe's hook.

the escape first of soft portions of the lens, and then of the nucleus. When the hard nucleus is large, it does not so readily escape, and pressure must be speedily abandoned and the hook resorted to. Von Graefe's hook (Fig. 29) was small, with a bend similar to Bowman's traction instrument, in order to facilitate its introduction behind the nucleus. Whilst the lens is escaping, the lower cortical portion may be made to follow the nucleus by gentle gliding pressure with the back of the

spoon upon the lower part of the cornea. Von Graefe subsequently used a vulcanite spoon for this purpose as possessing a greater amount of elasticity. He, however, trusted largely to the use of the ends of the fingers for evacuating the portions of cortical lens that remained after the escape of the nucleus, and only in very exceptional cases introduced a spoon for this purpose. After the removal of the lens, the patient was directed to turn the eye upward, a movement which promoted the closure of the wound and facilitated the removal of the spring speculum.

Clearing of Pupil and Closure of Wound.

The last step of the operation is to clear the pupil of any cortical portions of lens which remain, and to arrange the wound and conjunctival flap. After waiting a minute, Von Graefe effected this by the use of the ends of the fingers, so as to exercise gentle pressure through the upper and lower lids alternately, and by their means gradually to urge the fragments towards and through the wound. The conjunctival flap was then arranged with the end of the curette, any blood clot or lens matter having been previously removed from the wound, the lid closed and a

carefully arranged compress and bandage immediately applied, with sufficient firmness to press together the edges of the wound and to prevent any bleeding. Fig. 30 represents the eye some weeks after this method of extraction, and shows the usual form of pupil.

The bandage was generally allowed to remain for six hours, when a second was applied less firmly, so as to allow of transudation. Ten hours later a third bandage was

FIG. 30.—Eye after Graefe's extraction.

fixed, and drawn more firmly than the second, and especially so, if there were any sign of swelling. Von Graefe pointed out that the period from the sixteenth to the thirtieth hour was the most critical, and that then firm pressure was of especial value. The bandage was continued for four or five days, and then laid aside gradually, first for an hour or so in the day, then for longer, and lastly at night, the ocular vessels being more distended at night. The treatment of untoward symptoms

was similar to that recommended after other forms of extraction, the risks, however, being much less, and the necessity for long rest diminished by the smallness of the wound and the iridectomy. Von Graefe states that in his linear extraction the risk of suppuration scarcely extends beyond the thirty-sixth hour, whilst in flap extraction it extends to the sixth day.

The results of this operation were speedily found to be a great improvement upon previous methods. Whilst nothing could be more perfect than the result of a completely successful flap extraction, the proportion which successful cases bore to the number of operations left much to be desired. As a result of the smaller wound in linear extraction, and the diminished risk of iritis and prolapse of the iris, and also of the graver mishaps of cataract extractions, no less than ninety per cent. of the eyes operated upon were attended with success, having an acuity of vision of from 1-6th to 5-6ths; of the ten per cent. that were unsatisfactory, the majority were improved by subsequent operation. Von Graefe's own conclusions, after a considerable

trial of his operation and without any selection of his cases, were :—

1. That, in eyes favourable for flap extraction, the prospect of success was certainly equally great by the new method ;

2. That, in eyes unfavourable for flap extraction, the prospect of success was considerably greater ; and

3. That, in consideration of the diminution of inconvenience to the patient and of duration of treatment, the new method of operation might be accepted and practised to the entire exclusion of the flap method.

These conclusions were accepted by the great majority of ophthalmic surgeons, and the main features of Von Graefe's operation are still very largely followed. It is true that numerous modifications have been introduced and tried with the view of counteracting the difficulties of individual operators, but few of them have been accepted as general improvements. There has, however, been a very general desire to accept the proposal of making the section entirely in the cornea. With the sclerotic section, or even with the sclero-corneal section, it happened to some operators that

vitreous humour was frequently lost. And in unsuccessful cases, where a sclerotic section has been followed by destructive inflammation of the eye, sympathetic mischief in the other eye has not been altogether unknown. Still it must be borne in mind that some corneæ are intolerant of so large a wound, and slough. In such cases the sclerotic section is to be preferred.

My own Modifications of Graefe's Operation.

To give you the result of my own practical experience, I may say that after trying for a time Warlomont's method of extraction, which I have yet to describe, I have reverted with satisfaction to the method of Von Graefe, with certain modifications of my own, which might not suit every one's mode of operating, but which in my own hands have been attended with a very considerable success. I append a table of 100 consecutive cases to show the results.[1] The points to which I attach importance are these :—(1) I always give an anæsthetic, unless I can be sure of the complete quietude of my patient. Less than ten per cent. of my cases have been operated upon without. (2) The

[1] Appendix, p. 123.

section is usually corneal, but sufficiently peripheral to be subconjunctival (Fig. 24 or 25), the puncture and counter-puncture, which are a little lower than in Graefe's operation, alone being just outside, or in, the sclero-corneal junction, according as there is reason to believe that there is a large or small nucleus. (3) The section is made with extreme deliberation, with scarcely more pressure than the weight of the knife, and in making the middle of the section the edge of the blade is not turned much forwards, the desire being that the middle of the section should be only just within the margin of the cornea. It is important that the knife be sharp, in order that no force be used in making the section, thereby avoiding all risk of disturbing the coats or contents of the eye. (4) Sometimes, but not always, after the completion of the section, the end of the section answering to the counter-puncture is just touched by the end of the blade of the Graefe knife, so as to make the section of the internal surface of the cornea correspond with the section of the outer surface, as is already the case at the point of puncture. This is important only

where the section is somewhat small, or the nucleus large. (5) A period of rest of nearly a minute between each step of the operation, to give the eye time to adapt itself to the new conditions of circulation and tension. (6) A free crucial incision in the anterior capsule. (7) A gentle coaxing out of the nucleus and of all the soft lens matter with the smooth back of the curette, taking care that the surface of the cornea is moist before passing the curette over it, avoiding at the same time all force, and using the hook at once if the nucleus does not readily escape. (8) A careful tucking-in with the curette of any portion of iris or uvea that may be occupying the angles of the section. A neglect of this precaution sometimes postpones the healing of the wound and leads to the formation of a cystoid cicatrix, which may at some future time be a cause of irritation in the eye.

I use the same instruments that are mentioned in describing Von Graefe's operation, except that I prefer to use the iris forceps curved at the points instead of straight (Fig. 31), and the iris scissors made in the form of forceps (Fig. 32), as they are as

convenient to use with the left hand as with the right.

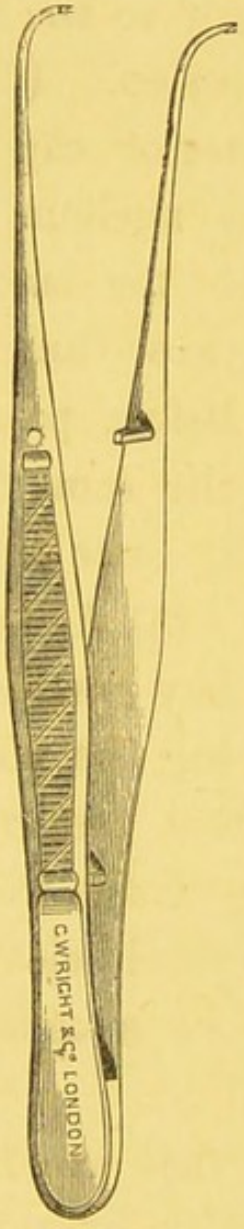

FIG. 31.—Iris forceps bent.

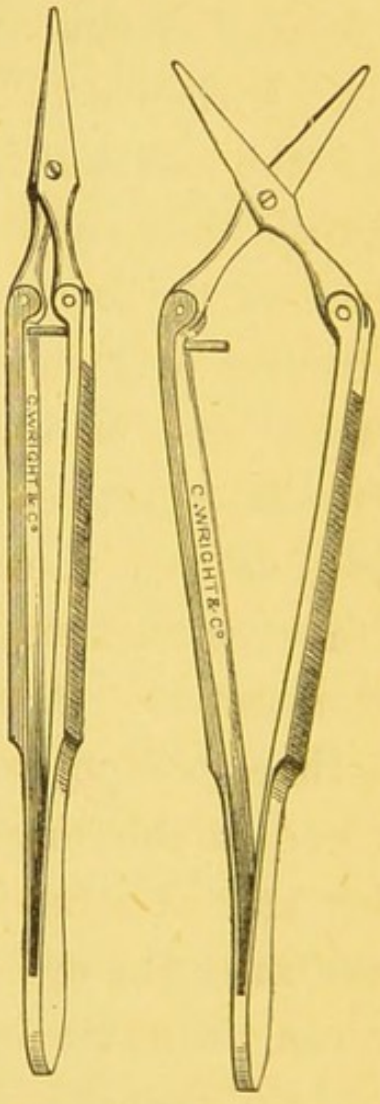

FIG. 32.—Forceps iris scissors.

As a result of an attention to these minute details, and every surgeon knows that it is on

these that the success of operations in a large measure depends, I claim (1) an immunity from rupture of the hyaloid, or what does duty as a hyaloid, and from loss of *vitreous*, except in cases where the latter is unhealthy, *i.e.*, about 5 per cent.; (2) the still less frequent occurrence of iritis and other inflammatory conditions; and (3) an increased proportion of cases in which the patient is able to read brilliant type (No. 1). The after treatment is the same as above described as recommended by Von Graefe. It is rarely necessary that the patient should be kept in bed beyond the third day, or confined to the house beyond the fourteenth. I most rigidly abstain from looking at the eye before the fourth day, and often wait until the fifth or sixth. I have already laid stress upon the injurious effect of keeping the patient in a darkened room. I have long discarded it, from the conviction that the healing of the wound takes place more readily, and that the health of the patient is better maintained, if, whilst eyes are carefully shielded from the light by the proper pads and bandage, and a light shade of good size and perhaps a screen between the patient and the window

or light, the body be placed under its usual conditions of light and air.

Mr. Streatfeild's Section.

Mr. Streatfeild, having a strong objection to the reduced size of the section of the inner surface of the cornea at the point of counter-puncture when Von Graefe's knife is used, prefers to make the section with the point of a Sichel's knife without any counter-puncture. The point of the knife, which may be held in the right hand for both eyes, is introduced at the proper point of puncture, and then with a sawing movement is carried along the margin of the cornea to the required extent. The manœuvre is difficult and requires some dexterity, the wrist following the fingers and keeping the knife at right angles to the section through its whole length. The whole section is corneal, as Mr. Streatfeild does not recognise any advantage in its being subconjunctival.

M. Galezowski's Lateral Extraction.

M. Galezowski proposed to extract through a semilunar incision in the sclero-corneal border at the outer margin of the cornea, prolonged a certain distance beneath the conjunctiva, as described in the *Annales d'Oculistique* (1871,

p. 102). His knife was slightly curved towards the point like a pruning-hook. The advantages he claimed were—(1) The wound is corneal, and being covered by a conjunctival flap rapidly heals; (2) the wound is at the outer part of the cornea, where escape of vitreous humour is least likely to occur; (3) facility in making the section.

Dr. Bribosia's Modifications.

Dr. Bribosia of Namur has suggested some modifications in the operation of linear extraction under certain circumstances, with a view to diminish some of the difficulties which have occurred to him in nervous irritable patients in making the iridectomy and in opening the capsule, and thus to avoid sometimes the risk of loss of *vitreous*, and the contusion, pulling and injuring of the iris. His proposals were as follows:—1. Before making the section a crucial incision is made in the anterior capsule with a point of a Bowman's stop needle, the pupil having been dilated with atropine. The needle must be a very fine one in order to avoid the escape of *aqueous*. In this way the laceration of the lens capsule can be performed more completely, and with

less risk of escape of *vitreous.* 2. The puncture and counter-puncture of the ordinary upward incision is made with a very slender Graefe's knife. After a short period of repose the blade is slightly rotated, so as to allow the aqueous to escape and a portion of the iris to be carried in front of the knife. 3. The section is completed, the knife cutting off the portion of iris in front of it and thus making the iridectomy at the time of making the section, and thus getting rid of one stage of the ordinary operation. Under some circumstances the conjunctival section is not quite completed, but a little bridge is left uncut at the centre, which may subsequently be divided if necessary by probe-pointed scissors. 4. The last steps are the same as those of the modified linear extraction.

Dr. Bribosia has himself mentioned one objection to the process: viz. the occasional premature escape of aqueous on withdrawal of the needle, and the consequent impossibility of entering upon the second step of the operation. It is to avoid this that he recommended the use of the finest needle, and that the kerato-nyxis should be made in an

oblique direction. Should much of the aqueous humour escape in spite of these precautions, he recommended waiting a short time for some re-secretion.

He claimed for his operation the following advantages :—" 1. Facility and rapidity of execution, the eye being fixed throughout by the operator himself. 2. The opening of the capsule performed with more thoroughness and neatness. 3. Less frequent escape of the vitreous humour, on account of the rapidity of the operation. 4. Adaptation to persons of a nervous and susceptible temperament, whose docility cannot be depended upon, as also to those patients whose eyes are very much depressed in the sockets."

I may say that I have had no experience of Dr. Bribosia's ingenious operation, as in the same class of cases I prefer to use an anæsthetic, and have obtained all the advantages claimed by him by the precautions that I have already described.

LECTURE VI.

The early objections to Von Graefe's linear extraction led, as I have before said, to the section being made almost entirely in the cornea, a change which for the great majority of cases was undoubtedly a great improvement. But still many surgeons looked upon the second step of the operation, the iridectomy, as an unnecessary mutilation of the eye, and there were many attempts to modify the proceeding in such a way as to render the removal of a piece of iris unnecessary. This account of the operations for extraction will be incomplete if I omit a description of some of the chief of these proposals.

Dr. Warlomont of Brussels and Mr. Liebreich late of St. Thomas's Hospital devised a crescentic form of section, the only difference being that the former made it upwards and

the latter downwards, of a sufficient length and in such a position that the lens might be extruded through the uncut pupil. A narrow Graefe's knife was used, the puncture and counter-puncture being made as in Graefe's operation, at a distance of about 1 mm. or half a line external to the sclero-corneal junction, in such a way that a curved or crescentic section was made, the centre of which was $1\frac{1}{2}$ mm. within the margin of the cornea, or

Dr. Warlomont's and Mr. Liebreich's Operations.

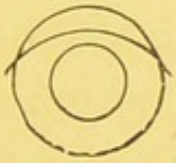

FIG. 33.—Warlomont.

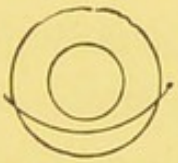

FIG. 34.—Liebreich.

opposite to the margin of the pupil in a middle state of dilatation,—to the upper margin of the pupil in Warlomont's operation (Fig. 33), to the lower margin in Liebreich's (Fig. 34). Fig. 26, D, also well shows the position of the section. (2) The capsule was then freely lacerated; and (3) the nucleus was, by means of pressure with the curette or with the fingers, made to describe a half turn and present its margin through the pupil and corneal section.

(4) A gentle manipulation of the eye, with the fingers through the lid, coaxed through the pupil and the wound any soft lens matter that remained; and (5), taking care that the iris was not entangled in the wound, a pad and bandage were carefully applied. This operation had the advantage of being one of great simplicity requiring three instruments only for its performance. These Mr. Liebreich used fixed in one handle. Soon after its introduction I performed the upward section (Warlomont's) in thirty cases, and the opinion that I formed from this limited experience was that there were defects in this method which were avoided in Von Graefe's operation in its modified form. I have never had the advantage of seeing any published statistics of the results of these operations in the hands of Dr. Warlomont and Mr. Liebreich, but the defects which led me to abandon this method except in selected cases were these—(1) The greater risk of iritis. (2) The frequent adhesion of the margin of the pupil to the corneal wound:—this anterior synechia, with greater or less distortion of the pupil, occurred in no less than sixteen out of my thirty cases.

(3) The frequent existence of a white cicatricial opacity in the line of the corneal section. (4) A varying amount of irregular astigmatism, sometimes very considerable, depending apparently upon the nearer position of the section to the axial portion of the cornea.[1] And (5) must be mentioned also, the occasional somersault of the lens, and its disappearance into the vitreous chamber, thereby setting up irritation as a foreign body. This mishap occurred once to myself when extracting by this method, probably because the lens was loosely attached. In such cases, with Graefe's modified operation, the lens would be extracted in its capsule. For the above reasons, these methods of operation in my opinion compare unfavourably with the modified linear extraction.

This is perhaps a favourable opportunity to say a few words with reference to the occurrence of astigmatism of the cornea after operations for the extraction of cataract. Some years ago Dr. de Wecker of Paris called attention to the fact, that as many as 19·8 per cent. of his

Astigmatism after Extraction.

[1] I called attention to this in a paper read before the British Medical Association in London in 1873.

cases of extraction required cylindrical glasses. Nearly one in five seems a large proportion of regular astigmatism in the modified Graefe's operation which Dr. de Wecker employs, but my own experience confirms the opinion that astigmatism of the cornea is frequently induced by the operations for extraction of cataract, and that over and above the cases of regular astigmatism, there is frequently irregular astigmatism in which the vision cannot be improved by cylindrical glasses; and, further, that the more central and the further removed from the periphery of the cornea the section be made, the more frequently does astigmatism occur, and the more irregular it becomes. Hence its more frequent occurrence in the methods of extraction last described.

Mr. Macnamara's Operation.

With the same object of avoiding the iridectomy, my colleague, Mr. Macnamara, devised an operation for extraction, which I cannot do better than describe in the author's own words:—[1]

"The pupil having been kept widely dilated with atropine for two or three days before the

[1] *Manual of Diseases of the Eye*, by C. Macnamara, F.R.C.S. Fourth Edition. 1882.

operation, the patient is laid on his back and placed under the influence of an anæsthetic. The operator adjusts a stop speculum.

"Supposing the right eye is to be operated upon, the surgeon standing behind his patient

FIG. 35.—Macnamara's knife.

with a pair of fixing forceps, seizes a fold of the conjunctiva together with the tendon of the internal rectus, so as to have a steady, firm hold of the eyeball, and in the other hand takes a short, straight, and broad-bladed triangular knife (Fig. 35), and thrusts

FIG. 36.—Macnamara's section.

its point through the line of junction of the cornea and sclerotic, on the temporal side of the eye (Fig. 36). The blade of the knife is to be passed steadily onwards nearly up to its heel, so that the incision made through the sclerotic

is at least half an inch long. The point of the lance-shaped knife entering the eye at the junction of the cornea and sclerotic, it is evident that, as the blade of the instrument is thrust into the anterior chamber parallel to and in front of the iris, the extremities of the incision will extend into the sclero-corneal junction.

"The knife is to be withdrawn slowly from the eye, so as to prevent the sudden escape of the aqueous humour, which may cause the pupil to contract. An iridectomy is not to be performed unless in exceptional cases, to which I shall refer. The speculum and hold of the internal rectus being retained, the scoop is to be inserted so far into the anterior chamber as to enable us to reach the margin of the pupil; the handle of the instrument being raised and its rounded extremity depressed, the latter evidently rests on the capsule of the lens, immediately within the margin of the pupil. The scoop is now to be slightly withdrawn, still keeping its extremity on the lens, but so as to draw open the pupil far enough to enable us to exercise gentle pressure upon the circumference of the lens;

it frequently happens that the lens is thus rotated on its axis and comes to rest in the concavity of the scoop, and so may be withdrawn from the eye. In other cases, if the lens does not readily shift its position into the instrument, we must pass the scoop on behind it, until its bent and toothed extremity embraces the inner margin of the lens; in this way the lens comes to lie in the concavity of the scoop, and may be removed from the eye, if possible without breaking the capsule. Should the capsule of the lens be ruptured, however, during the above-described manipulation, the bulk of the lens must still be drawn out of the eye by means of the scoop; and subsequently, particles of lenticular matter remaining in the anterior chamber must be taken away."

It will be seen that Mr. Macnamara's aim is to remove the lens in its capsule, a most desirable proceeding when the lens is loosely attached, as is often the case amongst the older patients. He advocates iridectomy in all cases where the iris fails to respond fully to atropine. I have had no experience in performing this method of operation, as I confess to an

objection to the use of a scoop and to the lateral and scleral position of the section except in very rare cases. My opinions on these points I have previously expressed. Another objection in my mind is the frequency with which *vitreous* is lost. Mr. Macnamara is, however, of opinion that there is no objection to the loss of a moderate quantity of vitreous, and in fact now prefers to see vitreous present through the pupil before tying up the eye. So far as my own experience goes, I find that eyes in which more than a very small quantity of vitreous has been lost are not found to retain, for any length of time, the acuteness of vision with which they may be credited when only a few months have elapsed. This is a point, however, which can only be set at rest by the continued observation of a large series of cases.

Dr. Charles Bell Taylor's Method.

Another proposal by way of avoiding an iridectomy is the method of extraction suggested by Dr. Charles Bell Taylor of Nottingham. He has raised strong objection to "the mutilation of the pupil," and has proposed to avoid the frequent prolapse of the iris by separating

it from its peripheral attachment instead of removing a segment of that structure. I am afraid that Dr. Taylor somewhat exaggerates the defects occasioned by the sacrifice of a portion of iris, and at the same time substitutes for it a proceeding which is fraught with much greater danger to vision. Dr. Taylor's operation is as follows:—Contraction of the pupil having been induced by Calabar bean, he makes a small incision "at the summit of the cornea in the corneo-sclerotic junction, about two lines in extent." He then pinches up a minute portion of iris, and snips it off as close to the periphery as possible, and lacerates the capsule with a cystotome inserted into the pupil in the ordinary way. He next enlarges the corneal wound to a sufficient extent, and with a fine pair of iris scissors also separates that membrane from its peripheral attachment, and lastly extracts the lens through the enlarged opening in the same way as it would usually be removed through the pupil. For this purpose Dr. Taylor frequently uses a traction instrument (Fig. 37) which is called a vectis. It will be seen that the operation is a complicated and difficult one, that, whilst it

perhaps avoids prolapse of the iris, it certainly does not diminish the danger of iritis

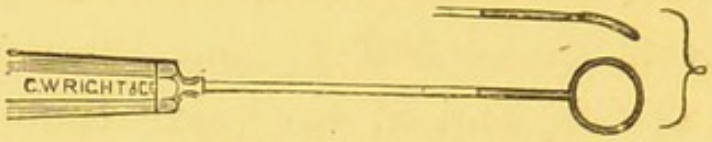

FIG. 37.—Taylor's vectis.

and closed pupil, and that it is not unattended with the risk of destructive inflammation of the eye operated upon.

Dr. Knapp's Extraction by Peripheral Division of Capsule.

At the International Congress in London in 1881, Dr. H. Knapp of New York described a method of extraction by peripheral division of the capsule. His method of operating was, he said, essentially that of Von Graefe —puncture and counter-puncture, 1 mm., in the sclero-corneal junction, with the apex of the section close below the upper transparent corneal margin. The iridectomy was extensive. When by gentle pressure the section was made to gape, a very sharp, angular, or sickle-shaped needle was passed horizontally through that part of the capsule which presented in the wound. In large cataracts with a tough capsule, a small vertical division, joining the horizontal in its

middle, was added. The lens was expelled with a hard rubber spoon, applied to the lowest part of the cornea and pressed directly towards the centre of the globe. Remnants of cortex, if left, were forced out, with the eyelids, after the removal of the speculum. Anæsthesia only in timid or uncontrollable patients —scarcely one in ten. Prolapse of vitreous occurred in about 10 per cent. of the cases. A traction instrument was necessary twice only in 166 cases. Dr. Knapp claims that the mode of healing was rapid, by first intention in half the cases, and with greater rarity of iritis and other inflammatory conditions. He obtained nearly 90 per cent. of good results, but secondary operations were required in nearly half the cases, of which discission of the opaque or wrinkled capsule with a needle was required in thirty-eight of the last hundred cases.

Antiseptic Method in Cataract Extractions.

Professor Horner of Zurich, Professor C. Reymond of Turin, Dr. de Wecker of Paris, and others have recommended the use of antiseptics in cataract extraction. The evidence on the subject is conflicting, the general impression

being that antiseptics are far too irritating for use in eye surgery. The above writers, however, recommend it, and have used a weak solution (1·75 per cent. of absolute phenol), and carried out Lister's method, with the exception only that hydrophile gauze was used which had previously been soaked for some days in the same solution, and was kept moist during the whole treatment. As a general rule, the dressing is not opened till the sixth day. "Several hours before operating, the beard and lower part of the forehead are shaved, the conjunctival sac is washed out with the carbolic water, and the eye is tied up with gauze and cotton-wool, soaked in the same solution, to be removed only at the moment of operating." The spray causes no inconvenience, and is useful, for, by making the eye anæsthetic, it materially aids us in dispensing with chloroform. It would be a great thing to abolish suppuration from the operation of extraction of cataract; but I am inclined to think that any advantage that may accrue from the adoption of the antiseptic method may equally be obtained from not opening the eye till the sixth day, and from

taking the greatest care as to the cleanliness of the instruments used.

We have now considered the chief of the operations for the extraction of cataract. It only remains to consider the treatment of cataract by the second form of operation before mentioned,[1] namely, by the formation of an artificial pupil, when it is possible to utilise some transparent portion of the lens in some non-progressive cases of partial cataract.

Treatment of Cataract by Artificial Pupil.

The form of cataract in which this method of operation is highly to be recommended is the lamellar, so common in childhood, and which was fully described in the Second Lecture.[2] There are a few rare forms of cataract, where a part only of the lens has become opaque, in which this operation may be desirable, but in most of the cases of lamellar cataract there is a sufficient width of the peripheral margin of the lens which is translucent, and which only requires the formation of an artificial pupil to enable the patient to avail himself of it, and to render the eye a very useful one. This fact is too often

[1] See p. 23.

[2] See p. 21.

overlooked. If the lens can be left untouched, the patient retains the power of accommodation, whilst the destruction of the lens which follows a needle operation is attended of course with the complete loss of that power so far as the lens contributes to it. This cannot be an unimportant consideration. The great proportion of lamellar cataracts are non-progressive. If they are carefully examined with the ophthalmoscope, they will be found to present a balloon-like appearance, and with a number of minute, glistening white dots around their margin. These are always non-progressive, and unless they are very large they should always be treated by artificial pupil and never needled. There are a few that have larger dots, and portions of opaque margin not quite distinct, but shaded off, or with striæ projecting from them; some of these are progressive. But even in them the possibility of the periphery of the lens permanently retaining its translucency would suggest the formation of an artificial pupil when the peripheral margin was sufficiently wide to permit of useful vision. Downwards and inwards is the best position in which to make the artificial

pupil. A small portion only of iris should be removed, as it is important that the pupil should be a narrow one. Fig. 38 shows the appearance of the eye after the performance of this operation. The section, which may be made with a keratome, a Graefe's or Sichel's knife, should be parallel to but just within the margin of the cornea. The iris should be seized with a fine pair of iris forceps at a point one-third nearer to the margin of the

FIG. 38.—Right eye after iridectomy for lamellar cataract.

pupil, and gently drawn through the wound and cut off. I prefer not to cut the iris too near its peripheral attachment, but to leave the outer margin of the artificial pupil with a rounded border of iris, perhaps rather narrower than is shown in the figure. Vision is then clearer than is the case when too many peripheral rays are admitted to the eye. It is usually only necessary to tie up the eye for twenty-four hours, and then for the patient to wear a shade for a few days. The operation is

without risk, a statement that can hardly be made with regard to the operations of needling the cataract. I trust that this way of treating lamellar cataracts will be more widely adopted, and that needling them will be more and more the exception. It is possible that the practice of making large artificial pupils has somewhat marred the results, and brought discredit on the proceeding. The plan of operation above described will, I think, leave nothing to be desired.

Treatment by artificial pupil is also indicated in some of the rare cases of partial cataract, when the position of the coloboma must depend upon the amount and situation of the opacity of the lens. It is also useful in some immature senile cataracts where vision is much diminished and reasons exist for postponing extraction, but in these cases the iridectomy should be upwards. In this position the coloboma will improve vision during the further progress of the cataract, and at the same time will form the first step in the operation of extraction.

APPENDIX.

TABLE OF 100 CONSECUTIVE CASES OF EXTRACTION OF CATARACT IN WHICH WERE CARRIED OUT THE DETAILS OF MY OWN MODIFICATIONS OF GRAEFE'S LINEAR EXTRACTION, AS DESCRIBED AT P. 97.

31	eyes could read	Brilliant No. ·3 (1) [1]
16	,, ,,	No. ·6 (2)
14	,, ,,	No. ·9 (3)
8	,, ,,	No. 1·2 (4)
4	,, ,,	No. 1·5 (5)
7	,, ,,	No. 1·8 (6)
3	,, ,,	No. 2·4 (8)
5	,, result good, but acuteness of vision not recorded	
2	,, could read	No. 4·8 (16)
5	,, ,,	count fingers
2	,, had perception of light	
3	,, were lost [2]	
100		

[1] Of these 31, 6 acquired $\frac{6}{6}$ ($\frac{20}{20}$); the rest were more or less astigmatic, the distant vision at the last examination varying from $\frac{6}{9}$ to $\frac{6}{24}$ ($\frac{20}{30}$ to $\frac{20}{70}$). Relying upon the gradual diminution of the astigmatism, I do not attempt to correct it until 12 or 18 months after the operation. The majority of patients, content, I suppose, with their spherical glasses, rarely return for further examination. I believe that nearly all the eyes that could read Brilliant could have been brought to $\frac{6}{6}$ with proper cylindrical glasses.

[2] One from sloughing of cornea from extreme feebleness, two from general inflammation.

21 cases required subsequent needle operation, but the resulting improvement was recorded in only a portion of the cases.

In 5 a slight amount of vitreous was lost.

Without counting the 3 eyes that were lost, iritis occurred in 11 cases.

NOTE.—The test types referred to in the above table are those for determining the acuteness of vision, drawn up by the writer of these lectures, to correspond with the series of large types of Dr. Snellen and others. The limbs are, in diameter, as nearly as possible one-fifth of the height of the letters, and the figures over each size give the number of metres and feet at which the letters are seen by a standard eye. Words of one syllable are chiefly chosen, as facilitating the testing of the eyes of those who read imperfectly. They were printed and published by Messrs. Harrison and Sons, of St. Martin's Lane.

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