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AIDS TO OPHTHALMIC MEDICINE



J. HUTCHINSON, JUN.

THIRD EDITION

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BAILLIÈRE, TINDALL & COX.





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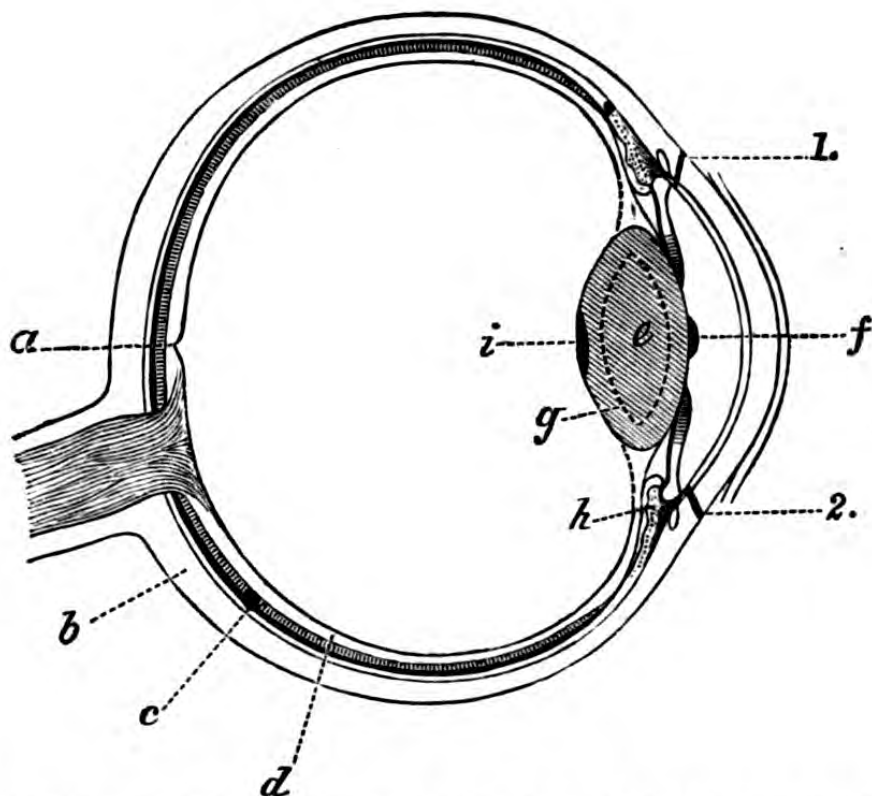


FIG. 1.—Diagram of a horizontal section through the eye: *a*, the fovea centralis or yellow spot; *b*, sclerotic; *c*, choroid; *d*, retina; *e*, the lens in which the dotted line *g* marks the position of a lamellar cataract; *f*, anterior polar cataract; *i*, posterior polar cataract; *h*, ciliary body. The lines 1 and 2 indicate roughly the position of the sections made through the cornea in iridectomy and extraction of cataract, though both are really made in the upper segment of the cornea.

A I D S
TO
OPHTHALMIC MEDICINE
AND
SURGERY.

BY
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THIRD



EDITION.

LONDON :
BAILLIÈRE, TINDALL & COX,
20 AND 21, KING WILLIAM STREET, STRAND.

EDINBURGH : LIVINGSTONE ; THIN. DUBLIN : FANNIN & CO.
GLASGOW : STENHOUSE.

1900.



PREFACE TO THE THIRD EDITION

WHILST rare diseases of the eye are intentionally omitted from this short work, it is hoped that no point essential for the student to know in reference to the ordinary ophthalmic diseases and injuries has escaped notice.

The advanced student is advised to consult Liebreich's Atlas with regard to diseases of the retina and choroid, etc.

It has not seemed necessary to give a special chapter on the methods of examining the eye, since they can only be learnt by practice ; the student is recommended to obtain a Morton's or other good ophthalmoscope, with a large convex lens, and to practise examinations by oblique illumination, and by both the indirect and direct methods of ophthalmoscopy on every suitable case.

15, CAVENDISH SQUARE,
LONDON W.
Sept. 1, 1900.

AIDS

TO

OPHTHALMIC MEDICINE AND SURGERY

I.—DISEASES OF THE CORNEA.

A VERY large proportion of ophthalmic cases consist of ulceration of the cornea of one or other type, the following being the most common ; 1. Phlyctenules, or phlyctenular ulcers ; 2. Strumous, or asthenic ulcers ; 3. Serpiginous ulcers ; 4. Ulceration accompanying disease of the palpebral conjunctiva, such as purulent ophthalmia, or granular lids.

1. A **phlyctenule** consists of a small yellowish-white elevation on the surface of the cornea or the conjunctiva at or near the sclero-corneal margin. It often tends to advance towards the centre of the cornea, in which case a narrow leash of vessels runs to it from the margin. The phlyctenule consists at first of an accumulation of lymphoid cells immediately beneath the raised epithelium, and these may be absorbed without going on to ulceration, although very commonly the latter ensues. Ultimately a small nebula is left, and the little band of vessels ceases to be pervious, although its track may be recognised long afterwards by means of direct examination with the ophthalmoscope.

Phlyctenular ulcers are usually accompanied by a fair amount of congestion of the eye, often cause considerable photophobia, and show a marked tendency to relapse. Those occurring

around the corneal margin are the most difficult to cure ; usually healing takes place under treatment in the course of one to three weeks. In some cases muco-purulent conjunctivitis supervenes on an attack of phlyctenules, or *vice versâ*. Although occasionally seen in adults apparently of perfect health, phlyctenular ulceration is met with generally in children, especially following measles, or some other eruptive disorder. Blepharitis, pustular eczema of the head and face, and enlarged cervical glands are common accompaniments.

Treatment.—Relieve photophobia by the use of a shade in front of both eyes ; improve the general health by outdoor exercise, good plain food (especially plenty of milk in the case of young children), and give cod-liver oil, syrup of phosphate of iron, or some other tonic, if the patient is obviously out of health. In nearly all cases the use of the yellow oxide and atropia ointment will be found to answer well. Formula :

Hydrargyri Oxidi Flavi	-	-	-	gr. iv. to viij.
Atropiæ Sulphatis	-	-	-	gr. i. to iv.
Vaselini	-	-	-	℥i.

With a small brush a little of this ointment is inserted within the lids twice daily ; **in cases in which no photophobia exists the atropine may be dispensed with**, and if the application produces pain, a weaker ointment should be used. Should this treatment fail, a little calomel may be dusted into the eye once a day. Some authorities recommend the occasional application of nitrate of silver solution (ten or twenty grains to the ounce), but I have not seen any advantage follow from this painful method of treatment ; others advise the use of eserine instead of the atropine. It is well to go on with the use of a weak yellow oxide ointment for some time after the inflammation has subsided.

2. Strumous Ulcers of the Cornea.—Much that has been said of phlyctenules applies to these, although many cases present a greater extent of ulceration, and are more difficult to cure. A bad case of strumous ulcer may go on to perforation of the cornea, whilst a phlyctenule is always superficial. Strumous

ulcers are commonly situated away from the corneal margin, phlyctenules at or near the latter. The opacity left by a healed strumous ulcer ('leucoma') is denser and more persistent than that resulting from a simple phlyctenule.

Symptoms.—Photophobia is nearly always present in the early stages, and may be extreme, especially in young children with small central ulcers; the lids are then kept so tightly closed that it is very difficult to get a view of the ulcer. Pain, congestion and lacrymation usually accompany the ulcer, and the irritation leads to the patient frequently rubbing the eye, and thereby aggravating the complaint.

Treatment.—In addition to the measures advised for cases of phlyctenular ulceration the following are useful: Boracic acid lotion used as a fomentation, as warm as the patient can bear it; or the Fomentum Belladonnæ in cases in which the photophobia is marked. Setons applied at the temples have been almost superseded, but in very obstinate cases are, perhaps, worth trial; blisters are of but little use. Internally cod-liver oil and steel wine are valuable tonics, and, whenever possible, the child should be given the benefit of country air.

3. Serpiginous Ulcer (synonym, Hypopyon Ulcer).—Occurs, as a rule, in elderly people, following an abrasion of the cornea by injury, and tends steadily to progress, both in depth and extent. It has been shown to be due to the presence of septic micro-organisms, and the results of treatment have much improved since the introduction of antiseptics. The following features have to be noted: (1) The ulcer may be either marginal or central, and is usually sinuous or curved in outline; (2) the edge of the ulcer is swollen and raised, and there is extensive infiltration of the cornea around it; (3) hypopyon is a frequent complication (see Fig. 2 *d*), whether perforation of the cornea occurs or not; (4) severe pain, photophobia and congestion of the eye are nearly always present.

Not only are the subjects of serpiginous ulceration of the cornea as a rule elderly, but most cases (especially those not starting in an injury) occur in poor, ill-nourished patients. In such iritis, hypopyon, and even inflammation or shrinking of

the whole eye, may follow ; and every case should be regarded as of grave prognosis, and demanding most careful treatment.

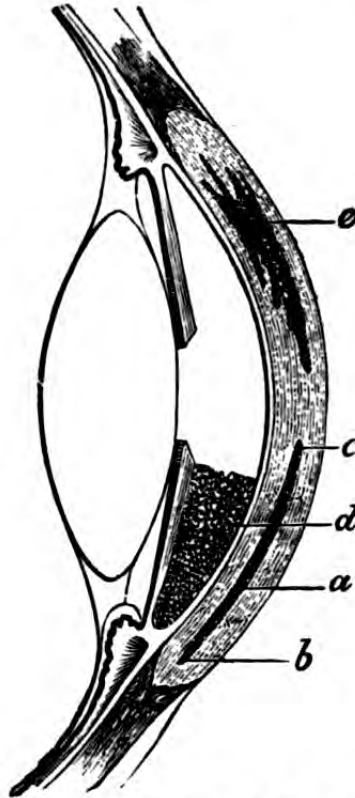


FIG. 2.—*a, b, c*, pus in the substance of the cornea (onyx); *e*, a more extensive deposit; *d*, pus in the anterior chamber (hypopyon)—a more common condition than onyx.

Treatment.—In its early stage the ulceration may be cut short by the very frequent use of warm boracic lotion, or of carbolic lotion (1 in 500), or of bichloride of mercury (1 in 5,000). When iritis is present, atropine must be used, and the following solution is recommended for frequent application as drops : Neutral Sulphate of Quinine 8 grains, Liq. Atropiæ Sulphatis 1 oz. The quinine has a marked antiseptic effect. A generous diet and quinine internally are indicated ; and if the pain prevents sleep, a hypodermic injection of morphia may be useful in the evening.

If inflammation of the lacrymal sac be present, it should be combated by slitting up the lower canaliculus and washing out

frequently with antiseptic and astringent lotions, of which one containing five grains of sulpho-carbolate of zinc to the ounce is one of the best.

If in spite of this treatment the ulcer spreads, it should be touched with the galvano-cautery wire, or a fine-pointed actual cautery, along its whole extent, or what is known as Sæmisch's operation performed. This consists in the division with a Graefe's cataract knife of the borders of the ulcer, both puncture and counter-puncture being placed in healthy corneal tissue, and the section (which opens the anterior chamber) is made to traverse the diseased area from behind forwards, crossing the ulcer at its centre.* Eserine is dropped in after the section has been made, and mild antiseptic lotions employed. It is remarkable what relief follows this operation in many cases, the ulcer healing in the course of a week or two; but should it not be successful, the wound may be opened daily for a few days with a fine probe, and atropine used instead of eserine. Even if the ulcer heals satisfactorily, a considerable nebula will be left; and should this obstruct vision, a subsequent iridectomy for optical purposes may become necessary.

4. Ulceration Secondary to Disease of the Conjunctiva.—In the course of purulent ophthalmia the cornea is very liable to ulcerate or slough, partly owing to interference with the vascular supply, partly to the action of the pus and contained micrococci. This complication is to be feared if, on separating the lids, the cornea is seen to be hazy, and 'like the eye of a dead fish' (Nettleship). No special treatment is indicated, but if the cornea be ulcerated in a case of ophthalmia neonatorum, great care should be employed in everting the lids, for fear of making the thinned part give way. It is remarkable how some cases in which the cornea appeared to be wholly opaque clear up, and the eye retains some degree of sight.

In cases of granular lids the cornea is often involved, either with superficial ulceration or with pannus (or both). **Pannus** consists in the presence of new vessels and cell-exudation on

* The incision may be made radially in the lower part of the cornea and directly into the hypopyon.

the surface of the cornea, and usually starts at the upper part, owing to the friction of the upper lid ; indeed, the condition may be confined to the upper half of the cornea. It is very slow in progress, and when the granulations have become scar-tissue the cornea may remain for many years vascular on its surface, a condition kept up by the entropion and the consequent inversion of the lashes.

Ulcers of the cornea may also complicate chronic conjunctivitis not of the true granular type ; and here mistakes in diagnosis are readily made ; unless the lids are examined and their inflammation treated with astringents, it is practically useless to treat the corneal ulceration.

Treatment.—In every case in which vascularity or ulceration of the cornea is suspected to be secondary to granular conjunctivitis, etc., the lids should be everted, and if any active granulations are found they should be touched with blue-stone or mitigated nitrate of silver-stick every few days. It should always excite suspicion if the corneal lesions are confined to its upper half ; for, though granular conjunctivitis generally affects both lids, the upper one is most severely involved, and has most influence in producing pannus or corneal ulcers. If the granulations have cicatrised, it is, of course, useless to continue with astringents, and care should be taken to ascertain that there are no ingrowing lashes which are irritating the cornea. If present, they should be either pulled out with epilation forceps from time to time, or the hair-bulbs may be destroyed with electrolysis, or in bad cases a special operation is required (see Entropion, p. 20). In performing electrolysis the negative pole (a fine needle) is thrust into each hair-bulb, the lid being raised by a bone or ivory elevator ; the positive pole is placed on the temple or forehead, and as the current passes minute bubbles will be seen to rise from the negative pole.

If pannus persists after the condition of the lids which produced it has subsided, the operation of **peritomy** is sometimes useful. The patient is anaesthetized, a speculum introduced, an incision is made through the conjunctiva about $\frac{1}{8}$ " from the corneal margin all round, and the part within this removed

with scissors and forceps going down to the sclerotic. The surface is left to granulate under boracic dressings, and the scar produced gradually leads to obliteration of the corneal vessels. The use of jequirity-seed infusions, or of inoculation with pus taken from a case of purulent ophthalmia of infants, has been tried in bad cases of pannus, and the latter has sometimes been successful, but both measures are very uncertain in their results, and are now rarely employed. With inoculation there is a risk of causing sloughing of the cornea, or panophthalmitis, a danger from which peritomy is free.

Herpes of the Cornea.--Sometimes small vesicles are met with in the course of herpes frontalis or nasalis, with or without iritis. In old glaucomatous cases, or in eyes lost from some other cause, small bullæ may form on the cornea, and occasionally herpetic vesicles develop in connection with a febrile attack (as in herpes of the lips). Finally, herpes of the cornea appears to occur very rarely as an independent affection, the cause of which is perfectly obscure.

It may be noted that impaired nerve supply to the cornea is one cause of ulceration of its surface, as in paralysis of the fifth nerve. If the lids cannot properly meet over the eye, as in facial paralysis, or severe exophthalmic goitre, ulcers may form on the cornea, and the whole eye may occasionally be lost.

INTERSTITIAL KERATITIS.

This peculiar form of corneal disease generally affects both eyes, though not always at the same time, and is most common between the ages of six and sixteen, though sometimes it develops as late as thirty or thirty-five. Relapses, though infrequent, are not unknown, sometimes occurring after an interval of many years. Two chief types are met with : 1. A ground-glass opacity of the whole cornea. 2. Vascularity of the substance, the great number of minute vessels giving a red or pink colour. The term 'salmon patch' is applied to the appearance of the cornea under such conditions. These two conditions are, however, frequently seen together. Typical

interstitial keratitis may be considered to be always due to inherited syphilis, which reveals itself by one or other of the following signs. The most important, perhaps, is the malformation of the permanent teeth, especially the upper central incisors. These are narrower at their cutting edge than at the base, and present a notch in the centre of the former. This narrowing is sometimes described as the screw-driver deformity, and may be present also in the lateral incisors or the canines of either jaw ; but (as Mr. Hutchinson insists) the upper central incisors are the test teeth of inherited syphilis. The palate is generally high and narrow (though this malformation is not peculiar to inherited syphilis), the forehead grooved horizontally just above the eyebrows with a transverse projection above this. About the time the eyes become inflamed, a very obstinate form of

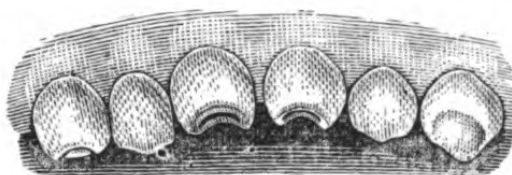


FIG. 3.—Teeth typical of Inherited Syphilis (permanent set, upper row). Central incisors notched and narrowed at their cutting edge.

deafness is liable to develop, and occasionally periosteal nodes are met with on the tibia or other bones. In a small proportion of cases one or both knees become affected with chronic synovitis, comparatively painless, and entirely clearing off after a few weeks or months. The bridge of the nose is often sunk and radiating scars around the mouth are not uncommon.

There is generally a history of syphilitic symptoms in infancy (snuffles, rash, condylomata ani, etc.), and the mother has very likely had repeated miscarriages or still-births, and if there are older children living than the patient in the family, they may also have suffered from interstitial keratitis or other suspicious symptoms.

Sometimes, however, interstitial keratitis is the only symptom of the diathesis,

Its course is always slow, from three to twelve months (often longer) elapsing before the cornea clears; and not only are nebulæ frequently left, but myopia is a not uncommon sequel. Years afterwards the keratitis may be recognised, although the cornea has apparently cleared, by the presence of numerous fine lines in the cornea, detected by direct ophthalmoscopic examination with a high convex lens.

In a few cases the cornea remains permanently opaque, but generally a very fair amount of vision is regained, and frequently no trace remains but the fine lines mentioned, which do not materially interfere with vision.

The chief **complications** are the following: 1. Iritis is frequently present, and, since it may be masked by the corneal opacity, the use of atropine is nearly always advisable during the active progress of the disease. 2. Choroiditis—generally of the patchy or disseminated form, but sometimes simulating retinitis pigmentosa. 3. Inflammation of the ciliary region—leading to secondary glaucoma in some cases, and always gravely affecting the prognosis.

Ulceration of the cornea is very rarely met with, but does occur in a few cases.

Myopia, as a not infrequent result of interstitial keratitis, has already been mentioned, depending on slight bulging of the weakened cornea. If the disease is very severe, a more marked yielding may ensue, producing anterior staphyloma. In some cases a glaucomatous condition may arise, the anterior chamber remaining very deep, and the cornea sometimes becomes oval instead of round. In fact, a condition allied to buphthalmos (see Appendix) may be set up.

Treatment.—A prolonged course of mercury given in small doses is certainly of value, and many surgeons combine iodide of potassium with it. Thus:

Liq. Hydrargyri Bichlor.	-	-	5j.
Pot. Iodidi	-	-	gr. iij.
Aquæ Destill.	-	-	℥i. t.d.s.p.c.

If the patient is anæmic, syrup of the iodide of iron should be

given instead of the potassium salt. Atropine should be used so long as the inflammation is in the active stage, and a convenient form is the Ung. Hyd. Ox. Flav. cum Atropiâ. In a few cases, however, permanent dilatation of the pupil has followed the prolonged use of atropine in interstitial keratitis, and it is therefore best to discontinue it as soon as possible. The corneal opacity clears very slowly, and sometimes iridectomy is performed, but is rarely required. The increase of tension sometimes present does not indicate this operation unless very pronounced.

OTHER DISEASES OF THE CORNEA.

Arcus Senilis.—Just within the corneal margin two lines of white opacity are formed, one in the upper part of the cornea, the other in the lower (the former being often the most marked). These lines ultimately meet to form a ring, which may gradually increase in width so as even to interfere with vision in a few cases. The pathology consists in a deposit of fat in the corneal cells, and the patients are usually over fifty years of age. Arcus senilis, however, is by no means always present in very old subjects; there seems to be a family predisposition to its early development. Frequently it is met with in patients with atheromatous vessels; still, its presence does not materially alter the prognosis of an operation on the cornea, *e.g.*, cataract extraction.

Conical Cornea.—The centre of the cornea becomes thinned and pushed forwards whilst retaining its transparency, and in severe cases the conicity may be easily recognised by looking at the eye from the side. Long before this can be effected, however, conical cornea may be detected by keratotomy,* the pupil having been dilated. Instead of the usual shadow moving from side to side a circular or crescentic shadow is obtained. It is most important to recognise the early stages of conical cornea, since it gives rise to irregular astigmatism and considerable defect of vision, which cannot be benefited as a rule by glasses. Generally both eyes are affected, and the patients are most

* Keratotomy, see Refraction (p. 81).

commonly young women ; the pathology is quite obscure. No treatment is of much avail unless the disease is so advanced that vision is greatly impaired ; an operation is then justifiable. The summit of the cone may be excised with a Graefe's knife, or cauterized, or trephined with a very small special trephine. In all these operations the anterior chamber is penetrated, and there is risk of an anterior synechia forming ; the pupil should hence be well dilated with atropine before the operation.

Lead Deposits on the Cornea.—If a case of corneal ulcer or abrasion is ignorantly treated with lead lotion, a white deposit of a salt of the metal is formed, which persists as a characteristic opacity ; it can be scraped off with some difficulty. Hence the rule never to use lead lotion in any case where the suspicion exists of loss of corneal surface. Nitrate of silver, if used for long in ophthalmic cases, may produce a brown stain of the conjunctiva, and, to a less extent, of the cornea.

II.—DISEASES OF THE CONJUNCTIVA.

1. **Muco-purulent Ophthalmia** (syn., Catarrhal Ophthalmia).—A contagious form of conjunctivitis, characterized by slight muco-purulent discharge, pain and irritability (a 'feeling of grit in the eye' is a common complaint of the patient), and tending to spontaneous recovery after a week or two's duration (sometimes less, sometimes more). Generally both eyes are affected ; the lids are stuck together in the morning ; and even if photophobia be not marked, any attempt at work is almost unbearable during the first few days. It is most prevalent in the spring and autumn, attacks persons of all ages, and often is seen to affect all the members of a household in greater or less degree. It is quite distinct from true purulent ophthalmia, but is often accompanied by the formation of little pustules or phlyctenules around the corneal margin, or by ulcers on the cornea. Severe nasal catarrh, or blepharitis, is also not very infrequent.

Treatment.—*Lotio Zinci Sulphatis* (two grains to the ounce), *Lotio Acidi Boracici cum Zinco* (one grain of sulphate of zinc,

boracic acid ten grains to the ounce, with perhaps a little glycerine), or Lotio Argenti Nitratis (one to two grains to the ounce), may be used three times daily ; some simple ointment, such as the Unguentum Cetacei, being applied along the lids in the evening. An ointment containing four grains of yellow oxide of mercury to the ounce of vaseline is useful if the case be obstinate and phlyctenules are present.

2. **Purulent Ophthalmia.**—A severe and dangerous form of conjunctivitis, due in nearly all cases to contagion from gonorrhœal or vaginal discharge. The most common examples

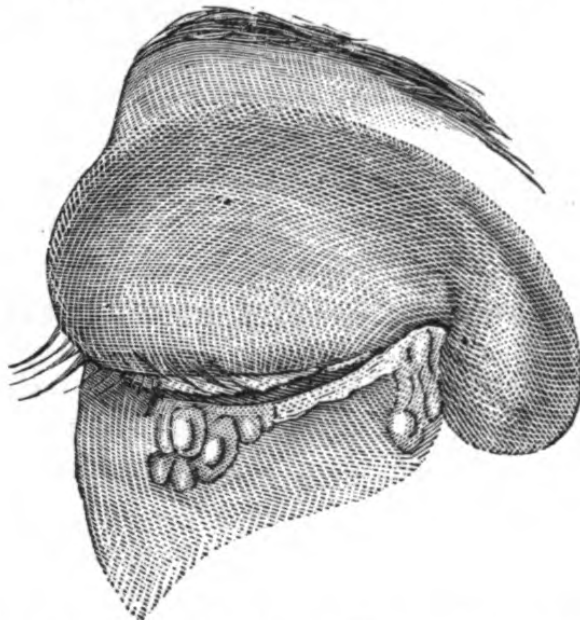


FIG. 4.—Purulent Ophthalmia—swelling and excoriation of lids, discharge of pus.

are in infants infected at the time of delivery (*ophthalmia neonatorum*). The discharge is noticed about the third day after birth ; the lids become swollen, and their edges stuck together ; on opening them yellowish pus and lymph exude, and on everting the lids the conjunctiva is seen to be extremely congested and granular. There is great risk to the cornea from ulceration or sloughing if the disease be neglected, and many cases of incurable blindness are due to this cause.

In *gonorrhœal conjunctivitis* of adults the contagion is generally conveyed by the finger, etc., from the urethra ; the

symptoms are similar, but there is perhaps even more liability to chemosis, and even greater risk to the cornea. One or both eyes may be affected ; if only one, the other should be protected by the use of a Buller's shield (a watch-glass secured thoroughly in front of the eye by perforated strapping), or covered up by an antiseptic dressing.

Treatment.—The lids should be separated and the discharge thoroughly washed away by very frequent use of an antiseptic and astringent lotion (carbolic acid 1 in 150, or the boracic and zinc lotion, or sulpho-carbolate of zinc four grains to the ounce, or nitrate of silver one to three grains to the ounce). Carbolic acid is well tolerated by the cornea even as strong as 1 in 40 solution, and the constant use of compresses soaked in iced carbolic solution is perhaps the best continuous treatment for gonorrhœal ophthalmia in adults. The lids should be prevented from adhering by the use of vaseline or Ung. Cetacei, so as to give a free vent to discharge, and once a day the surgeon should carefully evert them, and having washed or irrigated all lymph and pus away, examine the state of the cornea and apply a solution of nitrate of silver to the whole conjunctival surface with a brush. Twenty grains to the ounce may be used, and a rather weaker solution as the case improves (ten to fifteen grains). Sometimes nitrate of silver seems to lose its effect, and then a change should be made to chloride of zinc (five grains to the ounce) ; but on the whole nitrate of silver is by far the most effective. If the swelling of the lids and spasm of the orbicularis are very great, and prevent the proper examination of the conjunctiva, cutting through the outer canthus (the outer union between the lids) with scissors is recommended, but it is very seldom necessary.

Thorough cleansing and frequent application of weak antiseptics, and the daily use of a strong solution of nitrate of silver constitute the treatment, which rarely fails. In midwifery practice amongst the poor, attention should be paid to the infant's eyes within the first few days, and it would seem that applying a weak solution of nitrate of silver to the conjunctiva at birth may prevent the onset of ophthalmia.

Results.—Although the cornea may clear entirely, the subjects of purulent ophthalmia in infancy sometimes reveal in adult life its previous occurrence by the presence of a small *pyramidal cataract*, or by *nystagmus*.

A number of the cases recover very good vision, even though there has been ulceration of the cornea with adhesion of the iris ; it is, indeed, wonderful how far recovery can take place after the cornea looks to be lost. A deep diffused haze, or a number of separate ulcers, or a single circular one round the corneal margin, however, are dangerous signs, and may forerun complete sloughing or formation of an anterior staphyloma, etc. If a large perforating ulcer have formed, the lens may escape and the eye shrink.

3. Granular Ophthalmia (syn., Trachoma).—This is often spoken of as ‘granular lids,’ since the inflammation involves

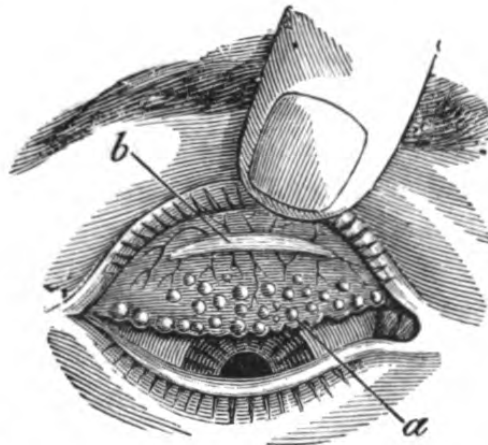


FIG. 5.—Granular upper lid everted : *a*, granulations ; *b*, scar-tissue.

chiefly the palpebral conjunctiva. It is a contagious, very chronic form of conjunctivitis, seen chiefly amongst the poorer classes in this country, and characterized by the formation of little nodules (composed of lymphoid cells) in and just below the conjunctival surface. The term ‘sago-grain granulation’ is often used ; it must be remembered that the little nodules, which are best seen towards the back part of the lids on everting them, are sometimes gray and semi-transparent, but of a reddish

colour as a rule. It is apparently due to a micro-organism, and it occurs in epidemics amongst ill-fed children (being especially common in Dublin, amongst the poorer class of Egyptians, or in pauper-schools in this country). The contagion may be conveyed by means of washing-towels, etc., and probably in hot countries by the medium of flies. The inflammation, whether treated or not, as a rule drags on its course for many months or even years, and from time to time its subjects are liable to purulent or muco-purulent attacks, which may endanger the cornea. The chief complications are: 1. Pannus (see Diseases of the Cornea, p. 5), which begins in and is sometimes limited to the upper half of the cornea; 2. Scarring of the lids, which, if deep, produces entropion and ingrowing eye-lashes (see Fig. 5); 3. Nebulæ, or ulcers of the cornea.

During the progress of granular ophthalmia the patient complains of more or less photophobia and discharge from the eyes, with some lacrymation; the edges of the lids look congested and thickened, and any use of the eyes is hardly possible in severe cases. When in a very chronic condition, however, there may be merely irritability, with congestion on attempting to do much reading, etc., or on exposure to the wind. An eye that has gone through an attack of granular ophthalmia is left weak and irritable for long.

Treatment.—No treatment is known which will produce a rapid cure, and attempts to effect this by too vigorous cauterization, or scraping away the granulations, usually lead to excessive scarring and entropion. On the other hand, much good may be done by improving the patient's general health, and methodically using astringents to the everted lids for a period of many months. The application should be made twice or thrice weekly in severe cases; less often in milder ones and those which are recovering. Cocaine applied a few minutes before somewhat eases the pain, as does freely bathing the eyes with cold water subsequently. The astringent should be applied to all the granulations, and especially to what is known as the retrotarsal fold. The best forms are the following: 1. Lapis Divinus—Sulphate of copper, nitrate of potash, and alum,

equal parts fused together, with a little camphor added. 2. Mitigated Nitrate of Silver—One part of the salt with two parts of nitrate of potash. 3. Pure Carbolic Acid, applied with great caution. 4. Solutions of Nitrate of Silver (ten or twenty grains to the ounce). 5. Crystallized Sulphate of Copper. 6. Powdered Subacetate of Lead.

The patient may be ordered astringent drops or lotion of nitrate of silver (one to three grains to the ounce), of sulphate of copper (one to two grains), or the boracic and zinc sulphate lotion. But it need hardly be said that to apply astringents properly to the diseased surface requires eversion of the lids by the surgeon.

For the special treatment of pannus see p. 6.

Sometimes very small 'granulations' are seen in association with chronic conjunctivitis and irritability of the eyes in cases which can hardly be regarded as true granular ophthalmia, but which require a somewhat similar treatment.

4. Chronic Conjunctivitis.—Persistent slight congestion and lacrymation with irritability of the eyes is met with under a variety of conditions, sometimes associated with lacrymal obstruction (which see, p. 23), sometimes with uncorrected errors of refraction; or it may be set up by prolonged work in ill-ventilated rooms, or from exposure to great heat or glare of the sun. In senile patients this form of conjunctivitis is often seen with a relaxed condition of the conjunctiva or slight ectropion. Removal of the cause, if any can be found, the use of mild astringent lotions, protective tinted or smoked glasses, and improvement of the patient's health, are the chief measures of treatment.

The term *diphtheritic conjunctivitis* is sometimes applied to cases in which a tough pellicle of lymph is formed on the conjunctiva, which bleeds on its removal, but its relation to true diphtheria is in most cases doubtful. The disease is very rare in England. Astringents should not be used in its treatment, but warm antiseptic lotions are advisable. Quinine lotion (four grains to the ounce) continuously applied is recommended by Professor Tweedy.

DISEASES OF THE EYELIDS.

Of these, by far the most common is **blepharitis** (syn., **Tinea** or **Sycosis Tarsi**: **Tinea** is a bad term, since the disease is not due to a cryptogamic cause). It is generally met with in strumous children or otherwise unhealthy subjects, and varies greatly in severity, showing little or no tendency to spontaneous cure. An attack of measles or scarlet fever is often the predisposing cause. Sometimes the disease is part of an eczematous eruption on the face; at others, the hair-bulbs and adjoining glands are the chief seat of the inflammation. Slight gummy discharge, minute ulcers, deposit of crust along the edges of the lids, and dropping out of the hairs are the chief symptoms. In inveterate cases the hair-bulbs are destroyed, and a condition known as *lippitudo* produced; there may then be epiphora, due to eversion of the lids. The longer the disease has existed the more difficult it is to cure. Ulcers of the cornea and phlyctenular conjunctivitis are not infrequent complications.

Treatment.—Order the patient to remove all the scab by bathing with warm alkaline lotion (five grains of carbonate of soda to the ounce) two or three times a day, and afterwards to apply a dilute mercurial ointment (the *Unguentum Hydrargyri Nitratis Dil.*, or one containing four to eight grains of the yellow oxide to the ounce of vaseline or lard). Borax or a solution of tar (*Liq. Carbonis Detergens*, five drops to the ounce) may be added to the lotion. Painting the edges of the lids with a twenty-grain solution of nitrate of silver often does good, and in cases where the hair-bulbs are obviously inflamed epilation may be required at intervals. Attend to the patient's general health, and if marked hypermetropia or other error of refraction be found on testing, order the appropriate glasses.

Dermoid Cysts.—The favourite position for congenital cysts about the orbit is over the external angular process of the frontal bone, to the periosteum of which they are nearly always attached, and often they somewhat indent the bone. As they lie under the frontalis muscle the skin over them is movable; their fibrous wall is very variable in thickness, and their con-

tents consist of cholesterin, sebaceous matter, abortive hairs, and more or less fluid. They often reach the size of a hazelnut in the first year, and show little tendency to increase subsequently.

Treatment.—Remove the whole cyst through an incision parallel with the eyebrow; avoid opening the cyst during the operation if possible, and if it is opened be careful to remove the last remnants. Sew up the wound with fine sutures, and dress with iodoform, spirit lotion, or some other antiseptic.

Syphilitic Ulcers.—Both primary chancres and tertiary syphilitic sores are occasionally met with. Chancres are always accompanied by characteristic gland enlargement in the preauricular or sub-maxillary region. Tertiary ulcers are difficult to cure and tend to relapse; the patients are most often women who have had syphilis severely. Iodoform applied locally, with iodide of potassium given internally, with tonics, constitute the chief methods of treatment.

Chalazion (syn., Meibomian Tumour or Cyst).—Small rounded tumours in the substance of the eyelid, which commence in the Meibomian gland layer. They were formerly wrongly supposed to be glandular cysts due to duct-obstruction, but are

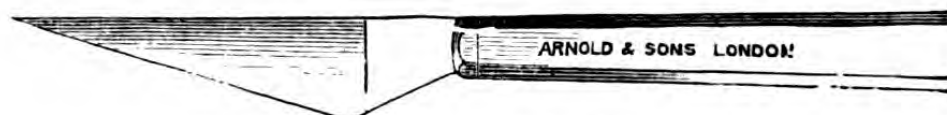


FIG. 6.—Beer's knife.

really made up of a gelatinous mass of small cells, which tends to inflame and suppurate. Occur most often in young adults, and are noticed as firm rounded lumps under the skin of the eyelid. Some patients show a marked tendency to their repeated development.

Treatment.—Evert the eyelid (generally the upper one), make a crucial incision with a Beer's knife into the tumour from the conjunctival aspect, introduce a small sharp scoop, and by means of this and of pressure on the eyelid remove the granulation mass. Pass the finger over the eyelid to ascertain that the

tumour is completely removed. It is very rarely necessary to make the incision through the skin instead of the conjunctiva.

A Sty is a pustule or small abscess at the margin of the lid, probably around one of the sebaceous or other glands at this part. It has nothing to do with the Meibomian glands.

Treatment.—Touch the inflamed point with nitrate of silver stick if the case is seen early ; otherwise apply warm boracic fomentations, and incise when there is a definite abscess. Attend to the patient's general health, as styes tend to recur.

Molluscum Contagiosum.—Occurs in young children, and is characterized by little round or oval projections, which generally show a dark spot at their summit. They occur in crops on the face (the eyelids being a favourite site) or other parts of the body, become pedunculated, as a rule, and may then inflame and drop off. They are certainly contagious in a mild degree ; for example, they are sometimes seen on an infant's face and on its mother's breast or hands, and can be inoculated with difficulty. Microscopically they consist of lobulated masses of peculiar cells, resembling sebaceous matter, but they do not appear to originate in sebaceous glands.

Treatment.—If pedunculated, snip them off with scissors ; if not, cut into the little tumours and squeeze out their contents.

The small ulcer with inflamed base left after a molluscum contagiosum has dropped off has been mistaken for a chancre.

Rodent Ulcer.—Is a peculiar form of epithelioma characterized by the following features : (1) Very slow growth, but in some cases, if left alone, it tends to eat steadily into the tissues below, destroying the globe and lids, and even invading the bones ; (2) The ulcer has a raised, sinuous, 'rolled' edge ; (3) the lymphatic glands are not involved, however long the disease has lasted ; (4) microscopically there are down-growths of epithelium derived from the rete mucosum, or deeper layer, and not containing cell-nests like ordinary epithelioma. The cells in the down-growing bands are smaller and less defined than those of epithelioma. Although it may start at any part of the eyelids or adjoining skin, the commonest place is the lower lid towards the inner canthus.

Treatment.—If possible, excise the whole ulcer ; scraping or cauterization is less likely to prove effectual. If it be necessary to excise one eyelid, a flap should be turned down from the forehead to take its place.

Horns.—Grow generally from the middle of one or other eyelid ; they are usually met with in elderly people, and seem always to commence in connection with a sebaceous gland. Hence though towards the apex they may be very hard, at their base they are comparatively soft.

Treatment.—Excise with scissors or knife, taking care to remove the base of the horn to prevent recurrence.

Xanthelasma Palpebrarum.—Depends upon the presence in the true skin of the eyelids of cells containing a peculiar yellow fat, in and just beneath the rete mucosum. The favourite site is the inner part of the upper eyelid, and the affection is generally symmetrical. A yellowish patch (not unlike washleather in appearance) is seen, slightly raised, and supple to the touch. Develops usually after middle-life, especially in those who are prone to deep pigmentation of the lids (patients who suffer from frequent bilious headaches, etc.). No treatment is required.

Lupus is occasionally met with on the conjunctival surface of the lids, nearly always in association with other patches on the face. Its chief peculiarity is the formation of large soft granulations. Its treatment consists in scraping and cauterization.

Entropion.—Consists of inversion of one or both lids, and is nearly always due to scarring of the conjunctiva and subjacent tissues. Its most frequent cause is granular ophthalmia, and hence it is especially met with in the upper lid. The eyelashes become turned inwards towards the globe, so as to keep up constant irritation of the cornea, and this often leads to, or is associated with, pannus. Spasmodic entropion is sometimes met with after operations on the eye—*e.g.*, cataract extraction—and it is also occasionally seen in very old people without obvious cause. Both these are much milder forms of entropion than the persisting one resulting from granular lids, in which the tarsal ‘cartilage’ may be much curved and deformed. In

such cases relief can be given by operation, there being a great number of methods of performing this. One of the best is the following : The patient is anæsthetized, and a broad lid-elevator



FIG. 7.—Entropion of both lids.

inserted and held by the assistant. With a Beer's or other kind of knife the surgeon cuts a groove along the whole border of the lid, one or two millimètres inside the row of eyelashes, avoiding

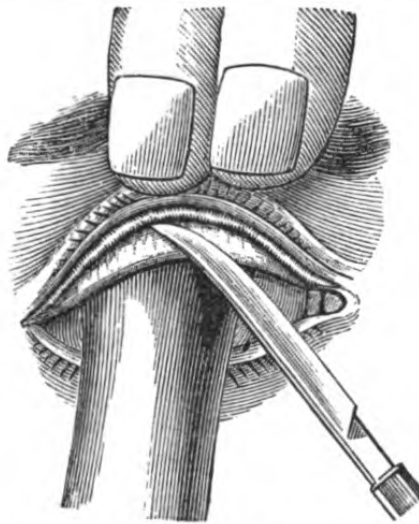


FIG. 8.—Operation for Entropion—grooving the lid.

the punctum lacrymale. The incision must go down into the edge of the tarsal cartilage. He then excises a semilunar strip of skin from the lid, the lower border of the incision being

about two millimètres outside the ciliary border. The amount of skin removed should depend on the degree of entropion. Sutures and simple dressing are applied, the wound in the conjunctiva being, of course, left open, and allowing the edge of the lid to be drawn outwards.

Another operation (Burow's) consists in simply making a deep groove parallel with, and three millimètres inside, the ciliary border along its whole length by means of scalpel and scissors. The incision should go down through the tarsal cartilage, but not the orbicularis muscle.

A third operation, suitable for mild cases (*e.g.*, senile entropion), consists in excising a strip of skin from the lid, in the same manner as just described.

Ectropion.—Persistent eversion of the lid (nearly always the lower one), which usually produces displacement of the lacrymal punctum, and more or less epiphora. Mild degrees are seen in



FIG. 9.—Ectropion of both lids, with conjunctivitis.

old people with chronic conjunctivitis ; more severe forms are due to scarring from various causes—burns, strumous periostitis of the upper jaw, wounds with loss of substance, operations for removal of rodent ulcer, etc. The first class may be treated by excising a strip of conjunctiva or by the V Y operation. In this two incisions are made, which meet below, and detach a flap of skin, with its base towards the edge of the lower lid. The apex of the flap is then displaced upwards, and by sutures the V-shaped wound is converted into a Y. If there is a scar fixing the lower lid to the upper jaw, it should be freely divided

subcutaneously. When there has been much loss of substance of the lid, nothing short of transplantation of skin will be of any service. The flap taken should be decidedly larger than would appear at first sight necessary, since it always shrinks, and should include the whole thickness of the true skin.

The results of these operations for ectropion are rarely perfect, and very severe cases, such as result from burns of the cheek or lupus, are practically incurable.

III.—LACRYMAL OBSTRUCTION, ETC.

It will be remembered that the tears, after leaving the ducts of the lacrymal gland beneath the outer end of the upper lid, are swept across the eye by the action of the orbicularis palpebrarum, which has its chief fixed point at the inner canthus.

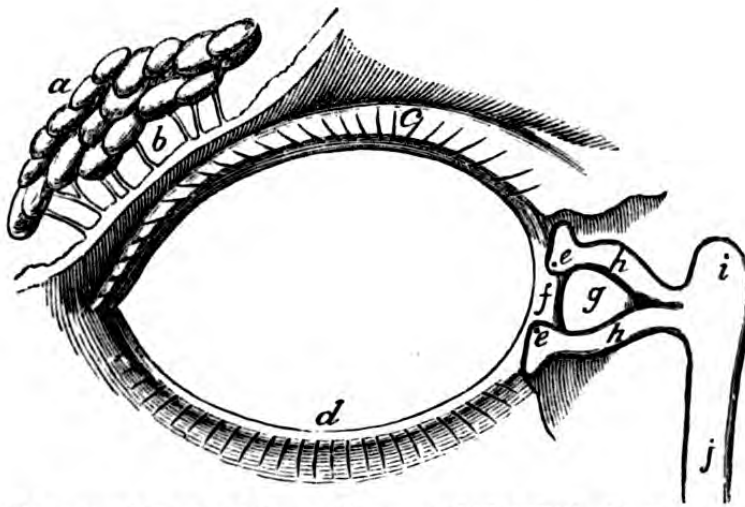


FIG. 10.—Lacrimal apparatus. *a*, Lacrymal gland; *b*, ducts; *c*, *d*, margins of lids; *e, e*, puncta lacrymalia; *g*, caruncle; *h, h*, canaliculi; *i*, lacrymal sac; *j*, nasal duct.

At the same time, partly by the action of the tensor tarsi, the two puncta at the inner border of each lid are opened and directed to receive them. They then pass along each canaliculus into the lacrymal sac, and down the nasal duct to the inferior meatus of the nose. Any interference with the muscular mechanism, with the position of the puncta, or any obstruc-

tion to the drainage-apparatus, will cause the tears to flow over the cheek—a condition known as *Epiphora*. Hence epiphora is met with from a variety of causes, facial paralysis (involving the orbicularis and tensor tarsi), chronic blepharitis or ectropion (displacing or obstructing the puncta); perhaps the most common cause is chronic inflammation of the nasal duct leading to stricture. The latter is occasionally due to disease of the bones forming the nostril (as in inherited syphilis), but generally no obvious cause can be found. It may develop at any age, and is most common amongst females (80 per cent.—Nettleship). The tears collect in and distend the lacrymal sac (forming mucocele), and this can be recognised by pressure at the inner canthus

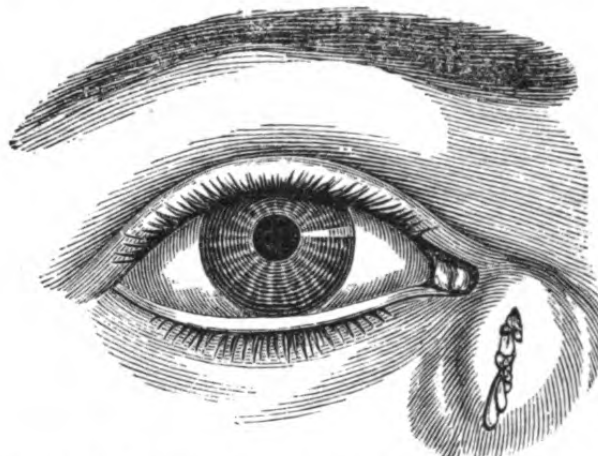


FIG. 11.—Lacrymal Abscess, which has burst below the tendo oculi.

emptying the sac backwards through the canaliculi. Inflammation in and around the sac may readily occur, and thus a lacrymal abscess form, which points below the tendo oculi, and which is usually very painful and accompanied by much surrounding inflammation. In cases of lacrymal obstruction without abscess, epiphora is the chief complaint, slight conjunctivitis being often set up.

Treatment.—Where the disease is due to blepharitis, etc., or where there is no mucocele, and hence probably no obstruction to the escape of tears, astringent lotion or drops should be tried. Sulphate of zinc two to five grains to the ounce, chloride of zinc

one to two grains, or weak nitrate of silver lotion (in cases of blepharitis only), may be ordered to be used two or three times a day. In cases due to displacement of the puncta the treatment should be directed to the cause; but sometimes relief is obtained by slitting up the lower canaliculus with a Weber's probe-pointed knife. In this operation the surgeon stands behind the patient, insinuates the probe-point within the punctum, makes the lower lid tense, and straightens the canaliculus by drawing the lid outwards with one index-finger, while he pushes on the blade of the knife, at the same time raising its handle, so as to cut through the whole length of the upper wall of the canaliculus. It is necessary to prevent the edges of this wound from uniting during the following week or two.

If a mucocele or threatening lacrymal abscess be present, the canaliculus should be slit up, and as soon as the inflammation has subsided under the use of mild astringent or sedative lotions



FIG. 12.—Weber's canaliculus knife.

(*Lotio Plumbi*, or *Lotio Acidi Boracici*) the nasal duct should be probed.

The treatment of stricture of the duct by means of dilatation with probes is similar to, but more unsatisfactory than, the treatment of urethral stricture by dilatation. It is very painful, the obstruction is very liable to relapse, and much care is required in passing the probes to avoid injuring the walls of the duct. A more satisfactory method than the occasional passage of probes is to introduce a leaden style, the upper end of which is hooked down and rounded off, so as to prevent it slipping in. The style can, of course, only be introduced after a moderate-sized probe has been got through, but it can be worn for months at a time without causing much discomfort. An antiseptic lotion should be used whilst the style is kept in, and it may also be of advantage in some cases of dacryocystitis (inflammation of the lacrymal sac) to frequently wash out the sac with a

syringe, the point of which is introduced along the previously slit-up canaliculus.

If a lacrymal abscess be on the point of bursting, it may be opened by a puncture just below the *tendo oculi* ; but as soon as practicable the canaliculus should be laid open and the cause treated.

Cases of obstruction due to previous necrosis of bone are, as a rule, unsuited for operation.

IV.—DISEASES OF THE IRIS.

Iritis.—It will be remembered that the iris lies immediately in front of the lens capsule, its pigmented or uveal surface resting against the latter (see Fig. 1). In all forms of inflammation of the iris the tendency is to contract adhesions with the lens ('posterior synechiæ'), and often to leave deposits of the uveal pigment upon its surface. The pupillary margin is the part of the iris in which its capillaries are most plentiful, and hence the inflammatory process is generally most marked at this part. By the use of mydriatics (of which atropine is the strongest) it is possible to draw away the inflamed iris, and so prevent adhesions being formed, or sometimes even to rupture them ; but the treatment, to be effective, must be commenced early in the case. Hence the great importance of recognising the onset of iritis, of which the chief symptoms are the following :

1. The pupil is altered in shape ; it may be a little smaller than that of the other eye, and does not dilate so well when the eye is shaded ; it is either sluggish or immobile. If homatropine be applied, and the eye examined twenty minutes later, the difference in shape becomes marked, the pupil being oval, or quite irregular, owing to adhesions. If a circular adhesion exist all round the pupillary border, of course no dilatation takes place, unless the adhesion be of very recent date.

2. The colour of the iris is altered, a greenish tint being the most usual, but an originally brown iris does not change much. In some cases little nodules of lymph are seen, and sometimes minute red streaks (vessels) running towards the pupil. At the border of the latter, by careful focal illumination, one or more

little projections can be often observed, generally of a white or brown colour. The reticulated surface of the iris is blurred, owing partly to turbidity of the aqueous and cornea, partly to congestion and effusion of lymph into its substance.

3. There is generally marked congestion of the eye, especially immediately around the corneal margin, and the deeper vessels are evidently involved in this congestion. But frequently the whole conjunctiva is red, and the character of the congestion is by no means a safe guide as to the presence of iritis. The mistake is often made of supposing a case of iritis at first to be simple catarrhal ophthalmia, a mistake which would nearly always be avoided by using homatropine and examining for the first-mentioned symptom.

4. Besides pain in the eye and more or less photophobia, there is generally pain referred to the forehead or nose. This referred pain is due to the fact that the iris is supplied by the nasal branch of the ophthalmic nerve (long ciliary twigs), and, as a rule, the pain in acute iritis is most intense in the distribution of the supra-orbital division.

These are the cardinal symptoms of iritis which are present in acute cases. In mild cases, however, one or more of them may be very little marked, and in such the action of the pupil to light, and still more to homatropine, is the only conclusive test. The tension of the globe in iritis is not infrequently somewhat raised, and the question of glaucoma may be suggested. It is, of course, the worst possible treatment to use atropine in a case of glaucoma, but occasionally it is necessary to employ it in iritis, although the tension may be increased. We now have to consider the causes of iritis. Of these by far the most important are secondary syphilis and rheumatism.

1. **Syphilitic Iritis.**—Occurs usually from three to six months after the chancre (in congenital syphilis at the same date from birth); rarely affects both eyes simultaneously, but very often the two in succession. The second eye may become affected although the patient is under full mercurial treatment for iritis in the other eye. It very rarely relapses, and is rapidly improved by thorough mercurial treatment. It is in this form that the

so-called gummata of the iris are met with; little pinkish-white nodules, on which new vessels can be made out. Sometimes single, they are generally multiple, and tend to form large posterior synechiæ. Lymph in the anterior chamber may accompany them.

Secondary syphilis probably accounts for about fifty per cent. of the total number of cases of iritis. Syphilitic iritis in infants is decidedly rare; as already mentioned, it occurs within six months of birth (probably in a few cases it comes on in utero), and is much more common in female children than males. The same tendency to free effusion of lymph is seen here as in adults, and the pupil may become occluded from it. Besides these infantile cases, we have to remember that iritis from inherited syphilis may come on at or after puberty, as a complication of interstitial keratitis.

2. Rheumatic Iritis.—Is met with in adults; generally affects only one eye at a time; tends to form firm adhesions, but not to develop nodules of lymph, and very frequently relapses. Its subjects are generally those with a history of rheumatic or 'gouty' symptoms (in which lumbago may be included), and the iritis is often brought on by exposure to wet or cold. The congestion, photophobia, and pain are all more severe than in syphilitic iritis; but the tendency to relapse is perhaps the best-marked feature. In some cases the diagnosis is difficult between the two forms, and it must be based on the consideration both of the symptoms and the previous history of the patient. To recapitulate the chief points in the differential diagnosis:

SYPHILITIC IRITIS.	RHEUMATIC IRITIS.
1. Frequently small nodules of lymph present.	1. Tends to produce tough adhesions without nodules of lymph.
2. History of secondaries within about six months of the attack, or presence of syphilitic symptoms.	2. History, perhaps, of previous attacks, or of rheumatic symptoms.
3. Does not tend to relapse.	3. Pain, congestion, etc., very severe.
	4. Frequent relapses.

3. **Serous Iritis.**—Occurs, as a rule, in women ; is extremely slow in progress, and is characterized by the deposit on the back of the cornea of a number of little whitish dots of lymph, which form a triangle, with the base downwards, and the apex towards the centre of the cornea. The disease is regarded as a lymphangitis of the eye (De Wecker), and frequently its subjects are anæmic, or run-down in health (sometimes with glandular enlargements in the neck, or giving the history of other scrofulous symptoms).

One or both eyes may be affected ; as a rule, it is symmetrical.

Serous iritis is sometimes accompanied with patches of disease in the periphery of the choroid, or with vitreous opacities. Compared with syphilitic or rheumatic cases it is a more chronic form of iritis, and, as already noticed, the lymph-deposit generally persists for many months, or may never wholly disappear.

Serous iritis may occur as a symptom of sympathetic ophthalmia (which see), or occasionally in rheumatic subjects.

4. **Iritis from Inherited Gout.**—This, though a rare disease, deserves notice from its peculiar features. It is very insidious (*i.e.*, pain and congestion may be but little marked), and the ciliary body is inflamed at the same time, so that the eye is often very seriously impaired, apart from the formation of iritic adhesions. It may come on quite early in life, and though the patient may never have had any other gouty symptom, there is a history of gout in the parents.

In 5, **Gonorrhœal Iritis**, there is the same tendency of the ciliary region to be involved, so that dusky patches of congestion and exudation are seen in this part (cyclitis, or sclerotitis). In other respects it is closely allied to rheumatic iritis, and its subjects are nearly always those with gouty or rheumatic tendencies. In such a patient every attack of gonorrhœa may be complicated with iritis.

6. **Traumatic Iritis** is met with after penetrating wounds of the cornea and iris, sometimes after cataract or other operations on the eye. It presents nothing peculiar in its symptoms.

We have to remember as rare causes of iritis prolonged over-

work of the eyes, and tubercle, whilst some cases cannot at present be explained by any known cause. It is important to bear in mind the great difference which exists in the severity of the symptoms in different cases. The term 'quiet iritis' is used when pain and congestion are wholly absent; this insidious form is generally due either to inherited gout or syphilis, but may arise from almost any other of the causes mentioned.

Results of Iritis.—If a severe case of iritis be neglected, blindness is liable to result from the blocking of the pupil with lymph (occlusion), or from the formation of total posterior synechia (exclusion). In the latter case, the fluid in the two chambers does not circulate and escape in the normal manner; the outer part of the iris becomes bulged forwards, and secondary glaucoma may supervene. Even if thoroughly treated, iritis will probably leave slight impairment of vision owing to uveal deposit on the lens, etc., but in some cases the recovery is almost perfect. The most obstinate forms are serous iritis, that due to inherited gout, and sympathetic iritis.

Treatment.—In all cases, without exception, use atropine so long as the attack is in an active stage. A solution of four grains of atropine to the ounce should be applied every two hours the first day or two, and less frequently afterwards if the adhesions yield. The strongest known mydriatic is a combination of atropine and cocaine (2 per cent.), and the surest way of having it thoroughly applied is to use them in vaseline (the purest), inserting a little of the ointment within the lids. Occasionally atropine irritates, increasing the congestion, and causing some swelling of the lids and eczema around them. These cases are very exceptional; in them sulphate of daturine (four grains to the ounce), or sulphate of duboisine (one grain to the ounce) may be tried instead of the atropine. After an attack has fully passed off it is worse than useless to persist with mydriatics in the hope of breaking down old adhesions, as they may then produce irritation and congestion of the eye.

In cases of syphilitic iritis, the patient should be brought thoroughly under the influence of mercury, either given internally (Hyd. c. Cretâ, two grains; Pulvis Ipecac. Comp., one grain,

thrice daily in pill ; by Calomel or Blue Pill, or the Liquor. Hydrargyri Bichlor. in one-drachm doses), or by inunction, subcutaneous injection, etc. Of these methods, probably the internal administration of grey powder is the most convenient and as efficacious as any. If the gums become touched, the dose of mercury should be diminished, and a weak solution of chlorate of potash, or of carbolic acid and rectified spirit, used as a mouth-wash.

Of course stimulants should be forbidden, and the eyes should be kept at rest by means of a shade or confinement to a darkened room. In serous iritis, or where one eye only is affected, however, the latter measure is unnecessary.

In rheumatic iritis the application of warm dry heat by means of cotton-wool and bandage is of value, whilst in traumatic iritis cold should be used by means of small ice-bags, etc. Traumatic iritis is the only form in which cold should be employed. When the rheumatic or 'arthritic' tendency is present, salicylate of soda with iodide and bicarbonate of potassium should be given ; in gouty iritis Vinum Colchici may do good. In serous iritis with anæmia give iron and cod-liver oil, and endeavour to improve the general health as far as possible. In the obstinate cases of relapsing irido-cyclitis due to inherited gout, probably nothing will be found to effect a cure except change of climate (a warm dry one, such as some parts of New Zealand, being the best).

In acute iritis attended by severe pain the latter is generally relieved to some extent by atropine, but belladonna fomentations (one drachm of the extract to a pint of warm water) are also of use. If, in spite of these measures, the pain persist, blistering the temple should be tried (some recommend leeches), and morphia or chloral may be required at night-time in order to obtain sleep. Antipyrin has also been found effective in relieving the pain.

A brisk purge is advisable in commencing the treatment of acute rheumatic or syphilitic iritis.

If, in spite of treatment, many firm adhesions remain, and especially if complete posterior synechia, with increase of

tension, be present as the result of iritis, an upward *iridectomy* is usually indicated. The operation, however, is often rendered difficult by the iris having become soft, or 'rotten,' as well as by the fact of the adhesions, and sometimes the artificial pupil becomes again closed by firm lymph. It used to be thought that adhesions in themselves led to relapses of the iritis, and that to prevent the latter an iridectomy was necessary, but this view is now doubted. However, it is quite justifiable to perform the operation in cases of rheumatic iritis in which relapses are frequent, and it would seem to have some influence in preventing them, as well as exclusion and occlusion of the pupil. Iridectomy, however, should not, as a rule, be performed on an eye so long as it is inflamed, but in an interval between the attacks. In cases of old iritis and interstitial keratitis, too, it is sometimes followed by an improvement of vision, especially if the artificial pupil can be formed behind a comparatively clear part of the cornea. Here again, however, the operation should not be done whilst the eye is inflamed, but only when the adhesions of the iris and the corneal opacities are obviously permanent.

Tumours of the Iris.—The iris, like other parts of the uveal tract, is occasionally the seat of melanotic sarcoma: curious cystic formations have also been met with, and tuberculosis of this structure is not unknown. These affections are too rare to require further notice here, but it is worth bearing in mind that the little gummata due to inherited syphilitic iritis have, in a few cases, led to the erroneous diagnosis of tubercle.

V.—CATARACT.

It is most important to recognise the different forms of cataract, since they vary greatly in prognosis, some steadily advancing to complete opacity of the lens, others remaining absolutely stationary. In all cases where cataract is suspected the eye should be examined by oblique focal illumination; the fundus should be examined with the ophthalmoscope so far as is possible, and in cases of partial opacity of the lens the best

view of it will be obtained (after dilating the pupil with homatropine) by using a magnifying lens of 12 D to 20 D in the ophthalmoscope and carefully focussing.

In every adult with the advance of age the lens becomes harder, less elastic, and yellow ; in some cases a cataract may be suspected at first by using only oblique illumination—the ophthalmoscope proving that none exists, by the perfect view of the fundus that is obtained. If the opacity commence about the centre of the lens, it is called a nuclear cataract ; if at the periphery, a cortical one. Nuclear cataracts generally occur in old patients (senile form); as do many cortical ones, but a large proportion of the latter develop at an early age. Cases of cataract come under one of two groups: the hard form, for which extraction is the only operation, and the soft, for which operations involving absorption by means of the aqueous humour (needling, suction, etc.) are performed. Roughly speaking, cataracts occurring under the age of thirty or thirty-five are of the soft variety.

1. Senile Cataract.—Is commonly seen after the age of forty-five or fifty. No cause can generally be assigned ; it has, however, been stated that a considerable number of the patients present atheromatous changes in the carotid vessels, or other evidence of impaired circulation. As already noticed, it may commence in either cortex or nucleus, commonly the latter. The first symptom is dimness of vision, especially in the distance ; sometimes the near vision is at first unusually acute, owing to the development of slight myopia. The patient may complain of seeing two or more images with the affected eye (monocular diplopia) when the changes are incomplete. The rate of progress is very variable ; usually one to three years elapse before the cataract is mature or ripe, though some cases are very much slower ; as a rough rule, the senile form of cataract advances most rapidly when it occurs in a comparatively young patient (*e.g.*, forty to fifty years old).

Varieties.—A *Morgagnian cataract* is one in which a very hard nucleus is surrounded by liquid or very soft lens matter, and is nearly always an over-ripe one.

A '*black cataract*' is very rare ; the lens is universally hard, and dark brown in colour ; it is less easily detected by direct illumination, and the patient usually retains more vision when it is complete than in the ordinary yellowish-white or white form (*i.e.*, he can count fingers held at the distance of a few feet). An '*atrophic cataract*' is due to shrinking, and sometimes calcification of a lens which has been opaque for many years ; it is most unfavourable for operation.

Prognosis of Operation for Senile Cataract.—Taking the statistics of the modern method of extraction, it may be said that usually 5 per cent. (1 in 20) are complete failures, owing to suppuration, severe iritis, etc. A considerable number of the 95 per cent. of successful cases do not attain perfect sight after the operation, owing to persistent irritability of the eye, irregular astigmatism, slight iritis, etc. And in a few cases sympathetic inflammation of the other eye follows an apparently successful extraction. As a general rule a senile cataract should not be operated on until it is ripe, and until the opacity is so great in both eyes that the patient can no longer see to do his work ; only one eye should be operated on at a time, and operations should be avoided, if possible, in very old and feeble patients, and during extremely hot or cold weather. It is most important to remember that the existence of a muco-purulent discharge (generally from chronic inflammation of the lacrymal sac) will almost certainly lead to suppuration after cataract-extraction, and hence the operation should never be undertaken until the inflammation is cured by appropriate treatment.

The following are forms of cataract which are more or less unsuited for operation, or in which a perfect result cannot be expected :

1. Secondary cataract—after iritis, glaucoma, etc. In highly myopic patients with cataract the vitreous is often abnormally fluid, and there may be detachment of the retina, or other degenerative changes.

2. Diabetic cataract. Here everything depends on the patient's state of health ; if he has lost much flesh, is affected

with lung disease, or if the quantity of sugar in the urine be very large, no operation should be undertaken.

3. Cataract in a lens dislocated by injury. If operated on, the scoop will have to be used, and more or less escape of vitreous (from previous rupture of the suspensory ligament) must inevitably follow.

4. Anterior polar (pyramidal) cataract.* The opacity is very small, and, as a rule, remains stationary, and requires no treatment. Similarly no case of cataract should be operated on if the opaque parts are so limited as not to prevent the patient retaining fair vision.

When is a Case of Senile Cataract ready for Operation?—

As a rule, one eye fails before the other, and so long as the patient sees well enough to do his work, etc., with the best eye, it is wise to defer operating on the other. For, apart from the slight risk of sympathetic ophthalmia following the operation, supposing that all goes well, the operated eye will of course require a strong convex glass, and the image formed on its retina will be of a different size to that formed in the other eye, and hence binocular vision cannot be well carried out. Supposing the cataracts to be so advanced that the patient can no longer see to do his work (in fact, is practically blind), the following tests should be tried before deciding upon operation :

1. Examine by focal illumination. If the opacity comes forward to the iris, if the latter throws no shadow on the lens, then the cataract is probably mature.

2. Throw a strong light suddenly on the eye, the other being covered ; the pupil should contract to the illumination.

3. The patient should have distinct perception of light ; should know when the eye is shaded or not.

4. He should have fair peripheral vision, *i.e.*, in a dark room, when looking straight forwards, he should be able to tell the position of a lighted candle when moved about in different positions at the distance of several feet from his eye.

NOTE.—In some cases of very slowly advancing cataract, the

* See Fig. 1. Pyramidal cataract is often the sequence of an attack of ophthalmia neonatorum.

sight being greatly impaired, a preliminary iridectomy may be done upwards, and extraction performed later. The same applies to cases in which special risk or fear of complications exists (*e.g.*, myopic cases ; or those in which the other eye has previously been operated on with complete failure).

2. Traumatic Cataract.—If the lens capsule is wounded by a penetrating instrument, as a rule the whole lens becomes opaque within a few days, owing to the soaking in of the aqueous humour. The lens matter swells and protrudes more or less into the anterior chamber. Iritis is very liable to occur, and the pupil should therefore be kept dilated with atropine. Should however, the tension rise and the eye become painful, owing to the rapid swelling of the lens, it is best to make a corneal section with a narrow keratome (usually on the outer side of the eye) ; introduce a curette just within the wound, and let out as much of the white matter as will come. Ice or iced water continually applied over the closed lids is a useful adjunct to the atropine, which should be used three or four times a day until all trace of iritis has subsided, whether any operation be performed or not. If the cataract is gradually absorbed by the action of the aqueous, the pupil will nearly always remain blocked by the remains of opaque capsule and lens matter ; but provided the patient can see well with the other eye, it is best to leave this alone, since an operation done for appearance' sake on such an eye is by no means free from risk of causing (1), inflammatory or suppurative changes in the eye itself ; (2), sympathetic mischief in the other one.

Concussion Cataract is a form of traumatic cataract in which the opacity of the lens (generally extremely limited, and in the form of dotted opacity on the anterior or posterior pole) is due to a blow on the eye (*e.g.*, with the fist), without penetrating wound of the cornea. It is probable that in most of these cases the capsule is very slightly ruptured. Of course, being usually opposite the centre of the pupil, these small opacities may considerably interfere with vision ; but the rest of the lens may remain quite clear, and no treatment is then indicated. In other cases the opacity slowly invades the rest of the lens ; an

operation may then be called for, owing to the cataract interfering with the patient's work, etc., and will consist either in needling in young subjects, or extraction in old ones.

3. **Lamellar Cataract** (syn., Zonular c.).* — The nucleus and cortex of the lens are clear, but between them intervenes a layer (lamella) of opaque matter, with, in most cases, little spicules projecting into the clear peripheral part. This peculiar form of cataract is either congenital, or comes on soon after birth; affects both eyes, and does not tend to spread to the whole lens. Its subjects have in nearly all cases been liable to convulsions in infancy, and present peculiar malformations of the permanent teeth. These (especially the incisors and canines) are more or less dwarfed or grooved horizontally. It is held that this horizontal wearing away of the enamel is due to the mercury which has been given for the convulsions (Hutchinson). The amount of visual defect in a patient with lamellar cataract varies much; as a rule it is only noticed when the child begins to learn to read. Occasionally its subjects are mentally defective. To see the cataract properly the pupil must be dilated, when the white circle with the little projections of opacity are seen by focal illumination, or by using the ophthalmoscope. The patient sees better when the pupil is dilated, since then the rays can pass through the clear part of the cortex, and in attempting to read, etc., he holds the object near to the eye, in order to compensate by the increased size of the image for its want of clearness.

Treatment.—If the vision is sufficiently good to enable the patient to read moderately well (*e.g.*, $\frac{6}{18}$ and 4 J) no operation



FIG. 13.—Cataract-needle. (The end is represented too wide.)

should be performed. But in most cases either an iridectomy or the needling operation is required; if the use of atropine much improves the vision, the former should be done (down-

* For diagram of lamellar cataract see Fig. 1, *g*.

wards and a little inwards); if not, the latter. Here may be described the chief operations for soft cataract.

1. Simple needling. The pupil is to be well dilated with atropine, a speculum introduced, or the lids held open by the fingers, and a sharp cataract-needle inserted obliquely through the periphery of the cornea and into the lens at the centre of the pupil. The needle-point is moved about so as to tear the capsule and part of the lens, and then quickly withdrawn, carefully avoiding touching the iris. Atropine is again applied, with ice, for a day or two.

The lens matter imbibes the aqueous, swells up more or less, and is gradually absorbed. At the end of six or eight weeks the needling will probably require to be repeated, and sometimes the case will need three, four, or even more operations; tough opaque capsule, which is sometimes left at the end, being either torn with two needles, or cut across with De Wecker's special scissors, introduced through a small peripheral corneal wound.

This tedious, but, as a rule, very safe, method of treating soft cataracts may be replaced by:

2. Suction. In this method a free needling is performed; then a keratome or broad-cutting needle introduced through the cornea on the outer side, and through this wound the nozzle of a special form of syringe is passed into the lens, and the cataract gently sucked out. After-treatment similar to the last.

3. A curette is used instead of the syringe, and by pressure exerted with the index-finger the soft lens matter is squeezed gently out along the curette, the end of which is introduced just within the anterior chamber. This operation should be performed after a free needling has caused the lens matter to swell up and soften.

VI.—GLAUCOMA.

The essential feature of this disease is an increase of tension of the globe, due to obstructed filtration of fluid from the eye.

and possibly to hyper-secretion within it.* In the normal eye there is a constant filtration of fluid from behind forwards through the suspensory ligament of the lens and part of the ciliary processes and iris into the angle of the anterior chamber, the spaces of Fontana and the canal of Schlemm. Thus a sort of equilibrium is kept up, the tension of an eye, however, varying very slightly from time to time. Any obstruction to the outflow, either from inflammatory changes at the ciliary angle, from increase in size of the lens (which Priestley Smith has found to occur as age advances), or from congestion about the ciliary region, impeding the escape into the bloodvessels, is liable to set up glaucoma. Further, glaucoma is more common in eyes with a firm, unyielding sclerotic (elderly patients, especially those previously hypermetropic) than those with a yielding one (myopic eyes). If glaucoma comes on apparently spontaneously it is called *primary* (nearly all cases of acute glaucoma are primary); if following some other disease of the eye, it is said to be *secondary*. Amongst the causes of *secondary glaucoma* are: 1. Traumatic cataract, in cases where the lens swells up rapidly. 2. Dislocation of the lens, where it presses on the ciliary region. 3. Severe iritis, followed by occlusion or exclusion of the pupil. 4. Intra-ocular tumours. 5. Cyclitis (inflammation of the ciliary region), or irido-cyclitis, such as is occasionally due to inherited syphilis. 6. Sympathetic ophthalmia.

Glaucoma is divided into the acute and chronic forms, typical cases of which differ extremely; but intermediate stages are met with, and it is not uncommon for a chronic case to have acute, or sub-acute, attacks. Acute glaucoma is much more common amongst women than men, and about 75 per cent. of the total number of glaucoma cases are met with between the ages of forty and seventy years, so that glaucoma is chiefly a disease of advanced adult or old age.

Predisposing Causes of Primary Glaucoma.—1. An inherited

* It has lately been discovered that the ciliary body is partly glandular in structure, and concerned in the secretion of the aqueous humour.—
. T. COLLINS.

tendency is observed in some cases. 2. The advance of life. We may almost speak of the period after forty years of age as the 'glaucomatous period'; this may be connected, perhaps, with the increase in size of the lens (Priestley Smith). 3. Excessive use of the eyes, leading to congestion; prolonged strain, as in night-nursing, etc., grief, or mental emotion (especially if the patient weeps or 'frets' much) or sudden mental shock, are all circumstances which may bring on an attack in a patient predisposed to glaucoma. 4. There is certainly a connection between gout and glaucoma, and it will be found that acute glaucoma is especially frequent in the autumn, as the cold weather comes on, and the patient's change of diet and habits renders him liable to an attack of either acute gout or glaucoma. 5. The use of atropine in elderly patients (and even of homatropine) has occasionally been followed by acute glaucoma, and hence it should be avoided if possible. The reason is to be found in the atropine causing the iris to obstruct filtration by being forced up into the angle of the anterior chamber.

Symptoms of Acute Glaucoma.—Often there are premonitory signs, of which the following are the most important: Rapid increase of presbyopia, attacks of passing congestion, pain and dimness or 'fogginess' of vision, haloes (coloured rings) seen when looking at a distant light. Finally, acute glaucoma develops, the vision becomes suddenly much worse (all degrees up to complete blindness), there is very severe pain in the eye and head, with frequently a feeling of sickness or actual vomiting, and the eye presents the following features: Congestion of the globe and lids, with perhaps chemosis; dimness or steaminess of the cornea and aqueous, which obscures the iris, etc.; pupil moderately dilated and fixed, or acting but very slightly to light or shade; if the fundus can be seen there is a depression (cupping) of the whole disc; the veins are engorged, and there is arterial and venous pulsation, and the tension is raised (often the globe cannot be indented at all, then $T = +3$). The cornea is frequently anæsthetic. The visual field is found to be much narrowed, its inner side going first, and the patient generally himself notices this narrowing, being unable to see

objects unless held in a line with his eye. If the loss of vision is almost complete, the narrowing of the field may still be recognised by moving a lighted candle in front of the patient as he looks straight forwards. The lens looks turbid, or grayish, and not uncommonly, in acute glaucoma, no view of the fundus at all can be obtained. The anterior chamber is generally very shallow, but this is not constant.

Diagnosis.—The importance of remembering the signs given above is very great, as an error of diagnosis is often made during the first few days, when immediate treatment can alone be expected to restore the sight. The headache and sickness may be thought to indicate merely a 'bilious attack'; or the congestion of the ciliary region and dimness of the media may be held to show 'iritis,' and atropine used with disastrous effect; finally, the chemosis and slight watery discharge may lead to the diagnosis of 'acute conjunctivitis.' The one essential test is the estimation of the eyeball tension.

Treatment.—May be summed up in one word—iridectomy. In a severe acute case the necessity should be urged on the patient of an immediate operation, which should be performed under an anæsthetic, if possible, the wound being made peripheral in the upper part of the sclero-corneal junction, and a considerable piece of the iris excised (see Operations—Iridectomy, p. 70). The pressure on the retina and optic nerve when unrelieved tends rapidly to destroy their functions, and hence, after acute glaucoma has existed some time, sight will not be regained, even if the tension and pain are lessened by an operation. The urgency for the latter in acute glaucoma is as undoubted as in strangulated hernia.

If, however, the patient will not consent to an operation at once, or if the attack is a sub-acute one, and has, perhaps, occurred before, eserine should be used. A solution of two grains of eserine to the ounce of water (to which cocaine may be added—2 per cent.) should be applied very frequently, and the eyes should be protected from light. Pilocarpine (four grains to the ounce), like eserine, diminishes tension and contracts the pupil, but its effects are less marked as a rule. Paracentesis of

the cornea (pricking it towards the lower border with a broad needle and letting out the aqueous humour) is of temporary use. Of these adjuvant measures the use of eserine is the most important, but all of them are quite secondary in obtaining a cure to early iridectomy.

Prognosis.—The rapidity with which complete and permanent blindness comes on in untreated cases varies much, and so long as there is some sight left in a case of acute glaucoma iridectomy should be tried. But when vision in the affected eye has been wholly lost for some time, the operation will, as a rule, merely relieve the pain, etc., without restoring the sight.

If done early and freely (the incision being placed as far back* as is safe), the results are generally very good. The patient may regain perfect vision (although some astigmatism, resulting from the operation, may need correction), and the tension remain normal, partly, no doubt, owing to the filtration which occurs through the thin scar.

In a few cases free retinal or vitreous hæmorrhages follow the sudden relief of tension by iridectomy; in a few others the lens is wounded during the operation (especially if a keratome be used), and cataract ensues: there is an appreciable risk of staphyloma and of sympathetic ophthalmia after the operation; and in some the glaucomatous symptoms recur. If the latter happens, or if the tension remains rather full, a careful trial of eserine may be made; and if this fails, a second iridectomy may be tried. The chance of cure or even improvement in these cases of severe recurrent glaucoma is but small, and if the eye become both blind and painful, excision of the globe is the best treatment.

Symptoms of Chronic Glaucoma.—In this the congestion of the conjunctiva and sclerotic is comparatively slight, or may at times be quite absent; but if the glaucoma has existed for long, there is a grayish-blue ring seen just behind the cornea, due to thinning of the sclerotic, and there may be slight bulging at this spot.

The media are usually perfectly clear, so that a good view of

* See Fig 1.

the fundus can be obtained (the lens, however, tends slowly to become cataractous); the pupils react to light (but often sluggishly), so long as the sight is retained, and there may be very little pain during the progress of the disease. The tension of the globe varies much from time to time, and the anterior chamber may be deeper than normal. The two most diagnostic symptoms are the state of the disc (cupping, sudden bending of the vessels as they emerge from the disc, pulsation of the veins and sometimes of the arteries, especially on slight pressure on the globe, grayness of the nerve from atrophy), and the narrowing of the visual field (as taken with a perimeter). With regard to the latter, the field for white may be concentrically narrowed; its inner part may be limited or absent, or there may be considerable irregularity in the outline.

Vision, both near and distant, tends steadily to deteriorate, though in some cases many years may elapse before it completely goes, and in a few it remains stationary for long. Rainbow-rings seen round a distant light, throbbing in the globe, headache, and attacks of 'mist before the eyes,' are frequent symptoms. The most prominent differences between acute and chronic glaucoma may be recapitulated in a table:

	ACUTE GLAUCOMA.	CHRONIC GLAUCOMA.
1. Conjunctiva, etc.	Great congestion, perhaps chemosis.	Congestion slight or absent; bluish circum-corneal ring in old cases.
2. Cornea.	Steamy, anæsthetic.	Clear.
3. Iris.	Pupil dilated and fixed.	Pupil normal, or rather sluggish, and slightly dilated.
4. Anterior chamber.	Shallow.	Generally normal or deep.
5. Disc.	Media often too hazy to see through; disc found cupped somewhat, and arterial pulsation present.	Media clear; deep cupping and whiteness of the nerve; pulsation marked as a rule.
6. Field, etc.	Vision rapidly lost; field extremely limited.	Field more or less limited; central vision may be fairly good for long.

Treatment of Chronic Glaucoma.—An operation is far less successful in this than in the acute form ; nevertheless, a free upward iridectomy should be done if the sight is steadily deteriorating in spite of treatment, or if an acute attack supervenes. It may be expected to result in the patient at least retaining what vision he had before the operation, and sometimes it improves it.

The avoidance of anything likely to cause congestion of the eyes, careful attention to the patient's health (avoidance of stimulants and regulation of diet if gout be present), and the long-continued use of weak eserine drops ($\frac{1}{2}$ to 2 grains to the ounce, applied once or twice daily), or of pilocarpine, are the chief measures of treatment. In some cases the patient is obviously anæmic, or out of health, and tonics may do good. The bowels should be kept regular in action.

Prognosis.—As a general rule, the younger the patient the worse the prognosis. As regards iridectomy, those cases in which the pupil contracts well on using eserine are much more favourable for operation than those in which it acts very little or not at all.

The prognosis of secondary glaucoma is worse than that of primary on the whole, and some cases (*e.g.*, due to tumour, old dislocation of the lens, relapsing cyclitis) can only be treated by excision of the eye.

In both acute and chronic glaucoma, if one eye has been affected there is considerable risk of the other becoming glaucomatous also, and a good many cases are symmetrical from the first.

VII.—INJURIES TO THE EYE.

With the various forms of injury to the eye and their treatment the student should be thoroughly familiar, as they are very often met with in practice. We may consider them under the following heads :

1. **Burns and Scalds.**—In recent cases of burn or scald of the lids it should be ascertained as soon as practicable whether the globe has escaped injury or not. Some non-irritating oint-

ment should be applied between the lids from day to day, and if there be much discharge syringing gently with boracic lotion is advisable; if conjunctivitis persists a mild astringent (two grains of sulphate of zinc or of nitrate of silver to the ounce) should be used. If there is much swelling of the lids, continuous cold applications give relief, and may save the eye.

If, however, the cornea has been severely injured, and subsequently slough, enucleation may become necessary. Burns of the conjunctiva, especially if due to caustic lime or strong acids, are almost certain to be followed by adhesion between ocular and palpebral layers (symblepharon), which in a few cases may be subsequently relieved by operation. But the great risk of such injuries is to the cornea, which is seen to be whitened and dim when the lids are separated. The opacity rarely clears; indeed, it generally becomes worse, and a most guarded prognosis should be given. The irritant should be completely removed by syringing with a weak acid or alkaline solution (depending on the nature of the caustic which has inflicted the injury), and castor-oil should be dropped in, or the Ung. Acidi Borici used for several days, the eye being lightly bandaged meanwhile. Pure cocaine (not its salts) will dissolve in castor-oil, and may relieve the pain if so applied after a burn of the conjunctiva.

Foreign Bodies.—Small sharp objects often become firmly fixed in the cornea, and if not readily seen by daylight should be examined for with the aid of a lens and artificial illumination. Apply a 2 per cent. solution of cocaine, until the conjunctiva is insensitive, and then, standing behind the patient, remove the foreign body with a small spud, or (if firmly imbedded) with a mounted needle. If a piece of steel or iron has been fixed for some time, a ring of rust will remain after it has been extracted; this can easily be removed. Bandage the eye up for twenty-four hours, and if the irritation is severe use atropine and cold compress. The removal is rendered easier by gently fixing the globe with the left index-finger, pressing through the lower lid. If 'something has gone into the eye,' and it is not found on the cornea or conjunctiva, look for it in

each palpebral fold, everting the upper lid, and making the patient look downwards, in order to expose the upper fold. It is very often found on the inner surface of the upper lid. Sometimes a foreign body of considerable size (*e.g.*, an insect) has travelled under the upper lid and set up conjunctivitis without the patient being aware of the cause of his trouble, the conjunctivitis being, of course, of one eye only, and thus exciting the surgeon's suspicion of its cause.

Occasionally an eyelash becomes fixed in one of the puncta lacrymalia, and sets up much irritation; in these cases the congestion being greatest on the inner side of the globe will attract attention. The offending lash should be pulled out.

A foreign body, especially a chip of iron or steel, is sometimes driven almost through the cornea, so that its end projects into the anterior chamber; it is then impossible to remove it by the



FIG. 14.—Cannula forceps.

ordinary way, and a broad needle must be entered towards the edge of the cornea, and its end used to press up the foreign body, whilst the wound is enlarged and the foreign body extracted. This operation requires much care, and it is perhaps best to give an anæsthetic before it is attempted. The foreign body may be driven right through, so as to rest in the anterior chamber, or to be fixed in the iris or lens. To remove it a small corneal section should be made, and the cannula or fine iris-forceps used. If of iron, the foreign body may be removed by the fine point of an electro-magnet introduced through a corneal wound. If the lens capsule has been wounded cataract will certainly follow; for its treatment see 'Traumatic Cataract' (p. 36). If fixed in the iris, a small piece of the latter may be excised, bringing with it the foreign body. It should be remembered that the patient is often quite mistaken about the size of the foreign body, and that the wound of entrance is often

difficult to find. I once removed a steel needle two-thirds of an inch long, which had traversed the lens and vitreous, and become fixed in the sclerotic ; the blunt end only showed in the anterior chamber, and the patient described the bit of steel as 'very small.' If there is any doubt as to penetration by a foreign body, and it cannot be seen on examination, homatropine should be used, and the fundus thoroughly explored. Fragments of iron have often been removed from the posterior part of the eye by means of an electro-magnet point introduced through a wound of the sclerotic, and sometimes with complete success ; but unfortunately in most cases inflammation supervenes, and vision is much deteriorated. Suppuration may follow penetrating wounds of the cornea or sclerotic, especially if some septic or dirty matter is introduced, and there is hardly any limit to the variety of foreign bodies which are occasionally imbedded in the eye. Bits of glass (from bursting of bottles) and shot are common ones ; in one case I excised an eye the anterior chamber of which was half-full of brick-dust. Air-bubbles in the vitreous after wound of the sclerotic are occasionally seen, and are somewhat difficult to distinguish from fragments of iron, etc.

If, in spite of treatment, the eye inflames severely, so that sight is lost, and especially if a foreign body is believed to be still in the globe, excision should be performed.

Abrasions of the Cornea.—Minute scratches of the corneal epithelium give rise to intense photophobia and lacrymation ; they are sometimes seen in women nursing infants, and due to the latter's fingers. Hypopyon-iritis may be set up, and, in elderly people, many cases of serpiginous ulceration (see p. 3) are started by an abrasion of the cornea.

Continuous warm belladonna fomentations, with cocaine (ten grains to the ounce of castor-oil or vaseline), form the appropriate treatment until the abrasion is repaired. If iritis supervene, atropine must be used to prevent adhesions.

Contusion or Concussion Injuries.—As is well known, in most cases of 'black-eye' the globe itself escapes injury. The best method of procuring rapid absorption of the ecchymosis is

to apply ice (or an evaporating spirit lotion) at first over the closed lids, and after twenty-four hours or less to use warm fomentations. After extensive ecchymosis of the ocular conjunctiva, the iris may be for a time discoloured or stained in part; or 'traumatic mydriasis' may be present for a few days. In this condition the pupil is dilated, and does not act on stimulation, or only very slightly, and the power of accommodation may be lost. Vision may at the same time be impaired from concussion of the retina without perceptible injury, perfect recovery ultimately ensuing. But more serious damage may be done by a blow on the front of the globe, the following lesions resulting in some cases:

1. Rupture of the eye, with, frequently, escape of the lens and some of the vitreous, either under the conjunctiva or

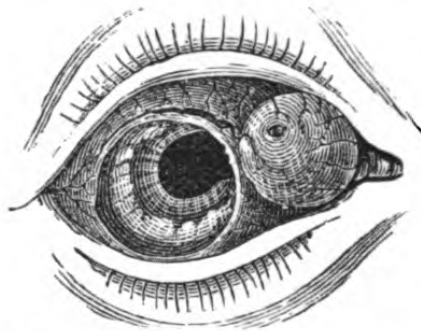


FIG. 15.—Rupture of Globe, with dislocation of lens inwards (beneath conjunctiva).

through the wound. The rupture is nearly always at the thinnest part of the sclerotic—that is, just behind the cornea, and often involves the latter. The tension of the globe is much lessened; excision is the only treatment.

2. Dislocation of the lens, partial or complete. This should always be suspected if the iris remains tremulous on rapid movements of the eye; or if one part is pushed forward and another depressed. Secondary glaucoma is very likely to follow if the eye is not excised.

3. Hæmorrhage into the vitreous or retina; the former can be detected as dark floating masses with the ophthalmoscope. They may be largely absorbed, but vision is nearly always much

impaired. Hæmorrhage into the anterior chamber is rapidly and completely absorbed.

4. Rupture of the retina or choroid at the posterior pole of the eye, by contre-coup.

5. Opacity of the lens, partial or complete. See Concussion Cataract (p. 36).

6. Dark pigmentary changes in the retina, with more or less atrophy of the optic nerve, may come on after a blow on the eye ; they also are most marked in the central region.

7. Detachment of part of the iris from its ciliary origin ('coredialysis'). There is no reason to advise excision after injury followed by the conditions 3 to 7, since some useful vision may be retained, and there is no risk of sympathetic ophthalmia.

Penetrating Wounds of the Eye.—Cleanly-cut wounds of the cornea unite rapidly, but with some impairment of vision in most cases. Wounds of the sclerotic and conjunctiva may be sutured with very fine silk, a mild antiseptic dressing being subsequently employed. It is, however, unnecessary to sew up small wounds in the sclerotic ; they unite well if gentle pressure be maintained on the eye by means of pad and bandage, after ice has been applied for a day or two, if possible. Wounds of the sclerotic at some distance from the cornea are less serious than those involving the 'dangerous area'—*i.e.*, for a quarter of an inch immediately behind the corneal margin. Inflammatory changes following wounds in this part (which corresponds to the ciliary processes) are extremely liable to be followed by sympathetic ophthalmia. Hence, if after such injuries sight is completely or almost completely lost (*e.g.*, if only perception of light is retained), there can be no question that immediate excision should be performed. If, however, a wound of the ciliary region be not followed by much impairment of vision, the question of treatment becomes very difficult. Excision should be advised, even if the wound of the ciliary region be small, if severe iritis follow ; and if it is probable that a foreign body is imbedded in this region, the operation is especially indicated.

In the case of recent wounds of the cornea, with prolapse of the iris, an attempt should be made to push back the protruding part with a small spatula. If this fails, the iris should be slightly drawn out and cut off (see Iridectomy, p. 68). Eserine should subsequently be used, unless iritis supervene, in which case atropine and ice should be employed.

It will have been seen that the danger of an injury to the eye is not always confined to the eye itself, but that, within an almost unlimited period (very rarely before three or four weeks have elapsed from the date of injury) the other one may become affected. We have to consider: (1) Sympathetic irritation; and (2) sympathetic inflammation, or ophthalmia. Either of these two is especially likely to follow a penetrating wound of the dangerous or ciliary region, but in rare cases they have developed after perforating ulcer with iritis or cyclitis, or even with an intra-ocular tumour. They may occur at any age, the usual period being between six weeks and six months after the injury.

Sympathetic Irritation.—Attacks of congestion and watering of the eye, failure of accommodation (shown by sudden dimness of the print), neuralgia of the globe or head, disturbance of vision, floating bodies seen before the eyes, etc., and irritability on exposure to moderate light, are the chief symptoms. These may recur repeatedly, and they do not necessarily indicate threatening sympathetic inflammation. If the exciting eye be excised, the symptoms do not, as a rule, recur. Hence, if the injured eye be still more or less inflamed, painful, and the vision bad, excision should be advised. For though sympathetic irritation does not apparently often pass on to sympathetic inflammation, we can never tell in which case it may happen to do so.

Sympathetic Inflammation.—Most cases of this terrible disease are essentially ones of plastic iridocyclitis, in which tough adhesions are formed to the lens, which becomes opaque, whilst the vitreous and retina becomes secondarily involved.

Pathology.—The method of transmission from the exciting

eye to the sympathizing one is still doubtful, the chief theories put forward to explain it being :

1. Germ-transmission through the circulation.
2. Lymphangitis travelling from one eye to the other, especially along the optic-nerve sheath.
3. Spreading neuritis by way of the ciliary nerves.

Free cellular exudation into the ciliary body, iris, choroid, and sometimes into the anterior chamber ('serous iritis,' see p. 29), is the chief feature in the pathology of sympathetic ophthalmia. Optic neuritis is present in many cases. The disease sometimes is recovered from with fair retention of vision (the cases of sympathetic serous iritis are the mildest, and occasionally leave hardly any defect of sight). But the prognosis of most cases of sympathetic ophthalmia is extremely bad ; the pupil becomes occluded by tough lymph, the iris universally adherent, the lens cataractous, and vision may be completely lost in the course of a few weeks or months.

Treatment.—Complete rest of the eyes in a dark room, mercurial inunction, extract of belladonna given internally, counter-irritation to the temple, atropine frequently applied to the eye. Or mercury may be given by the mouth, with belladonna and quinine, but the effect of internal treatment is rather doubtful. It is, of course, essential to use atropine if the case is seen fairly early ; after tough adhesions have been formed it is quite useless.

It might be thought that the exciting eye should at once be excised, but, unless it is absolutely blind, it is perhaps wiser not to remove it, as ultimately it may retain the best vision of the two. No operation should be done on the sympathizing eye until the inflammation has quieted down, and then a free iridectomy (with extraction of the lens, if that is opaque) may do good, though it is to be feared that the aperture formed will become closed again by lymph. Operative interference should, of course, be avoided if any useful sight is retained.

VIII.—DISEASES OF THE OPTIC NERVE AND RETINA.

Optic Neuritis.—Inflammation of the optic disc ('papillitis') is characterized by hyperæmia, swelling of and exudation in the disc, with more or less involvement of the surrounding retina (especially the anterior or nerve-fibre layer). With the ophthalmoscope one notices (1) blurring of the disc-margin, with generally some radiating striation, and in some cases small extravasations of blood; (2) the abrupt bend of the vessels over the swollen edge of the papilla; (3) their tortuosity, and perhaps their obscurement by lymph, etc. The swollen optic disc can be best seen with a + lens in the ophthalmoscope, and supposing the patient to be emmetropic, the degree of swelling may be measured by the highest convex lens with which the details can be made out. The retinitis, which often accompanies neuritis, is indicated by a haze of that part of the fundus nearest the disc, by the presence of whitish streaks, dots or patches, especially in the neighbourhood of the yellow-spot, by peri-vascular lines of white colour, and by hæmorrhages, generally linear or flame-shape.

The whitish patches alluded to are due to cedema of and exudation into the retina, and may clear off to a large extent with the lapse of time; the hæmorrhages may also be absorbed (leaving often small black spots of pigment to mark their existence), and the inflamed nerve itself tends in most cases to become more or less atrophic.

Atrophy of the Optic Nerve is diagnosed by the abnormally white hue of the disc; sometimes by the shrinking of the arteries, and to a less extent of the veins. If it is a result of inflammation ('post-neuritic') there is usually some irregularity and pigmentation of the border of the disc, and fine white lines along the vessels are not infrequently seen. Further minute changes at the yellow-spot exist in a large proportion of the cases. Sometimes, however, atrophy of the optic nerve is primary, that is, not preceded by neuritis, and then the abnormal whiteness of the disc is the chief, and sometimes the only, ophthalmoscopic sign.

Symptoms.—Rapid failure of sight (both near and distant), with blurring of objects, is frequently complained of in acute neuro-retinitis, but it is most important to remember that severe optic neuritis may exist without any defect of vision whatever. More or less headache and pain in the back of the eye, sometimes photophobia, irregular limitation of the field of vision (as tested with the perimeter), a similar defect of colour-perception, imperfect action of the pupils to light, and the defect of vision being especially marked towards evening or in a dim illumination, are all symptoms which may be present in a case of optic neuritis or neuro-retinitis.

Gradual failure of sight (especially in the evening), contraction of the field of vision, with more or less colour-blindness (especially defect for red and green), are the chief symptoms of optic atrophy or of slowly progressing optic neuritis.

Causes and Forms of Optic Neuritis.—1. Cerebral tumours, gummata of the meninges or brain, cerebral abscess, and meningitis (tubercular, traumatic, etc.), are frequent causes of double optic neuritis. This is often pure papillitis, but in some cases the changes in the retina (hæmorrhages and white patches) are just as extensive as in renal retinitis (see No. 3). In the case of neuritis due to tubercular meningitis, tubercular nodules are occasionally developed in the choroid and retina, some way from the disc.

Optic neuritis (slight and soon clearing off) is seen in a few cases of severe concussion of the brain, and optic atrophy (probably from rupture of the optic nerve or hæmorrhage into its sheath) may occur on one or both sides after fracture of the anterior fossa of the skull.

2. Optic neuritis has been noticed in connection with most of the specific fevers, but especially during the secondary stage of syphilis. In the latter case it comes on six to eighteen months after the primary chancre; the retina, and often the vitreous, becomes blurred and hazy, but well-defined white patches of exudation are not often seen.

3. Certain morbid conditions of the blood and vascular system may give rise to neuritis and neuro-retinitis; of these the chief

are albuminuria, anæmia, and leucocythæmia, gout, diabetes, lead-poisoning, and the high tension of the arteries which goes with hypertrophy of the heart and sometimes chronic nephritis.

In the neuritis from all these causes there is an especial tendency to hæmorrhages into the retina, and when due to kidney-disease (including diabetes) there are generally many whitish patches of exudation and degeneration in the central part of the retina, often grouped in a radiating manner round the macula. In neuritis due to anæmia there may be extreme swelling of the retina and disc, which quite hides the vessels, as well as hæmorrhages. Finally, as rare causes of optic neuritis may be mentioned inflammation about the cavernous sinus (usually syphilitic), orbital tumours, periosteal nodes of the skull (invading the meninges), and possibly cerebral hæmorrhage, whilst some cases occur in which no cause can be found.

Treatment.—For optic neuritis due to the causes mentioned in No. 1, it is obvious that not much can be done unless the intra-cranial cause is syphilitic in origin. Hence the treatment almost resolves itself into giving iodides of potassium and sodium, with mercury freely, if there is the least suspicion of syphilis in the case. Thus, for instance, if there is a history of previous syphilitic symptoms, one may order :

Potassii Iodidi	...	...	...	...	gr. v.
Sodii Iodidi	...	...	...	...	gr. v.
Spiritus Ammoniaë Aromat.	...	...	...	...	m. xv.
Aq. Destillatæ	...	...	...	...	℥ i.
Ter die.					

And increase the doses in a few days to gr. x., gr. xv., and so on. At the same time, mercurial inunction may be used, and the patient kept in a dimly-lighted room, etc.

For optic neuritis in secondary syphilis mercury should be freely given (see Treatment of Specific Iritis), stimulants forbidden, and the patient must shade the eyes or wear protective goggles, of course refraining from any work with them. The

prognosis, if the case be seen early and the treatment be thorough, is very good.

The treatment of neuritis due to renal or vascular disease, or the other causes mentioned in No. 3, is a matter which belongs to general medicine. It may be mentioned here that the discovery of neuro-retinitis in a case of chronic nephritis is of very serious nature, as affecting the prognosis, most of the cases (at any rate amongst hospital patients) ending fatally within six to eighteen months after the eye-affection has been noticed. The prognosis of neuritis due to anæmia is, on the other hand, favourable as a rule; if proper dieting and hygienic measures are adopted with the administration of iron (and purgatives if required), perfect recovery may result.

Retinitis Pigmentosa.—In this peculiar disease there is symmetrical progressive failure of sight (especially marked in the dusk, severe cases having 'night-blindness') and narrowing of the visual field; the ophthalmoscopic signs consist in atrophy of the discs with shrinking of the vessels, and the development of a peripheral ring of coal-black pigment patches (in the retina, and often overlaying the vessels). These patches are stellate, or spider-like, with processes which join those of neighbouring patches. The disease comes on in childhood or early adult life (generally the latter), and is often seen in more than one member of the family. A history of consanguinity of marriage (the parents being first-cousins) is obtained in some of the cases. Retinitis pigmentosa tends to progress towards complete blindness, and no treatment is known to be of avail.

It may, however, be mistaken for syphilitic choroido-retinitis, which is greatly benefited by specific treatment; but in these cases there is distinct evidence of old neuritis, and the pigment-patches are less regularly arranged and do not show the branching processes, which have been compared to those of bone-corpuscles as seen by the microscope.

The Causes of Optic Atrophy.—As already mentioned, any case of optic neuritis may go on to atrophy if the patient live long enough; but *primary* atrophy of the optic nerve has certain special causes not yet mentioned.

Of these, the chief is disseminated disease of the brain and spinal cord, especially locomotor ataxia (*tabes dorsalis*). Optic atrophy is also met with in disseminated sclerosis, and is occasionally the only symptom of nerve-disease. Primary atrophy is nearly always symmetrical. Its symptoms have already been mentioned, but it remains to point out the other symptoms of *tabes* which are usually present when the atrophy comes under notice. One of the most important is the condition of the pupils. They may be abnormally contracted (*myosis*), or unequal, and they will generally be found to contract with convergence of the eyes, but not to respond to light. This peculiar and important sign is known as the 'Argyll-Robertson symptom,' and should always be carefully tested for in any suspected case of *tabes*. Further, paralysis or paresis of one or more ocular muscles (*e.g.*, the levator palpebræ and one of the recti) is not uncommonly present for a time; the loss of knee-reflexes, the muscular inco-ordination, the darting pains in the limbs, etc., need here only be mentioned.

It is most important to diagnose these cases from what is known as *retro-bulbar neuritis* (inflammation of the optic nerve behind the globe). With the exception of certain rare cases, the cause of which is obscure, the chief form is that known as *tobacco-amaurosis*.

In amaurosis, or 'amblyopia,' from tobacco, a central band of nerve-fibres in the optic nerve is inflamed, and apart from pallor of the disc in advanced cases, the fundus looks quite healthy.

The following are the chief symptoms of tobacco-amaurosis:

1. Exact or almost exact symmetry of the visual defect—commonly the patient sees only about $\frac{1}{16}$ and 14 J when he comes under care. (A few rare cases are recorded in which one eye has failed some time before the other.)
2. The field for white is normal, but by testing with small pieces of coloured paper there is found to be a scotoma (blind area) for green and red, which involves the fixation-point, and extends outwards more or less beyond the normal 'blind-spot' (corresponding to the opti disc). Sometimes there is also a

scotoma for yellow, and still more rarely for blue ; and in severe cases the patient hardly distinguishes the colour of red and green patches in any part of his field. (In testing the field of vision, it is almost needless to point out that the other eye must be covered up.)

3. The patients are, of course, almost invariably men who have been addicted to smoking strong dark tobacco (shag, cavendish, or 'returns') for long periods and in large amounts. Generally they own to using half an ounce of shag daily—though in persons with special susceptibility to tobacco, smaller amounts will produce amaurosis.

4. If smoking be given up, or only mild, light-coloured tobacco used (if the patient cannot relinquish the habit), the vision will, as a rule, steadily improve, and in a large proportion of cases is perfectly recovered. Recovery appears to be hastened by giving *nux vomica* (tinct. *nucis vomicae* ℥v., ter die ex aquâ), as well as by the cessation of smoking and chewing tobacco.

The symptoms of tobacco-amaurosis have been described fully, since it is a fairly common disease, and if once diagnosed a very satisfactory one to treat. With regard to the treatment of primary optic atrophy due to tabes, etc., not much improvement can be hoped for, unless there is a fairly recent history of syphilis. In this case the energetic administration of iodides or mercury should be given a trial, and a few cases will be found to be greatly benefited by it. *Nux vomica* may also be ordered.

Retinal Detachment and Hæmorrhage, etc.—A severe blow on the front of the eye may produce either single or multiple extravasations into the retina, choroid, and vitreous, and if the patient be highly myopic, a slight contusion, or merely the strain of stooping, etc., may cause detachment of the retina. This is recognised by the sudden onset of blindness, which may only affect the upper half of the field, since the detachment is nearly always of the lower part of the retina. On ophthalmoscopic examination with dilated pupil, the retina is seen to come forwards into the vitreous, its surface being raised into ridges over which the branches of the central vessels can be distinguished. The appearance of the white furrowed surface is

quite characteristic, especially when taken with the history. No treatment is of much avail, though an operation (puncturing the sclerotic far back, so as to let out the fluid beneath the detachment) has been recommended, and is occasionally performed with apparent benefit.

Hæmorrhages into retina and vitreous sometimes occur spontaneously in young subjects, inherited gout and constipation being held to be the chief factors in their causation. Treatment with laxatives, etc., in such cases, is often followed by absorption of the hæmorrhage and recovery of good vision.

A linear streak in retina or choroid is sometimes the result of injury to the eye (rupture due to contre-coup, or stretching of the tunics, and hence generally met with near the centre of the fundus, opposite to the part struck).

The chief **tumour** met with in connection with the retina is a glioma, or glio-sarcoma. It develops in childhood, and tends not only to grow forwards into the vitreous, but to extend backwards along the optic nerve to the brain, or into the orbit. Increase of eye-tension, a white mass seen with the ophthalmoscope, blindness of the affected eye, and the early age of the patient, are the chief features. Excision of the globe with division of the optic nerve far back is the proper treatment, and may prove curative if done early. Glioma may be simulated by inflammatory degeneration of the retina and vitreous ('pseudo-glioma'), but the tension is then usually below normal.

IX.—DISEASES OF THE CHOROID.

It is often impossible to draw any line between choroiditis and retinitis, both layers being affected by the inflammatory change; but in some cases the deep pigmentation and sharp outline of atrophic patches, over which the retinal vessels are seen to run, makes it certain that the choroid is chiefly or solely involved.

Choroiditis may be either central (*i.e.*, situated at or near the macula) or peripheral; there may be one or two large patches or multiple small ones (disseminated). Central choroiditis may

greatly affect the vision, but peripheral changes may not interfere in the least with sight, and the surgeon frequently discovers them in eyes which the patient states have never 'had anything the matter with them.'

The chief varieties are the following :

1. Central atrophic choroiditis—in large patches round the disc and about the yellow spot—associated with high myopia, posterior staphyloma, often vitreous opacities, and sometimes with large pigmentary remains of hæmorrhages.

2. Central retino-choroiditis made up of a number of fine dotted changes, pigmentary or atrophic (light-coloured), and associated with considerable defect of sight. The disc being normal in these cases, the macular region looks as though it had been dusted over with black pepper, when seen with the direct method. The causes are quite obscure, and the treatment very unsatisfactory ; occasionally it appears to be syphilitic, sometimes (in the atrophic form) it is a senile change. In a few cases it is the result of a blow on the eye.

3. In contrast to the very fine changes mentioned in No. 2, larger patches of choroiditis are sometimes seen about the disc and macula, and if not due to myopia (see No. 1), are not infrequently syphilitic.

The more typical and really common form of choroiditis due to syphilis is that which is seen in disseminated patches scattered about the periphery. This disseminated choroiditis may affect one or both eyes (usually both), and is especially noticed in connection with inherited syphilis. The sharply-outlined patches of choroidal atrophy with black borders are very characteristic of syphilis, though not in all cases conclusive evidence.

Finally it may be mentioned that, since most cases with choroiditis come under notice long after the active inflammatory stage is past, treatment is of very little use ; if, however, the sight is deteriorating, and there is other evidence of syphilis, iodides of potassium and iron should be given a prolonged trial.

In other cases, such as the myopic form, tonics, rest of the eyes, and the careful avoidance of any work trying to them,

with the use of protective tinted glasses, are the measures to be recommended.

Other Diseases of the Choroid.—Tubercle is occasionally met with, usually in children, with general tuberculosis (especially with tubercular meningitis). Scattered roundish pale elevations are seen in various parts of the fundus, each patch being about the size of the optic disc, which may at the same time be inflamed.

In some cases of kerato-iritis (which see, p. 29) patches of exudation or degeneration can be detected in the periphery of the choroid.

The chief tumour of the choroid is a sarcoma, which is often deeply pigmented (melanotic sarcoma). It is usually of the spindle-celled variety, which is twice as common as the round-celled in this situation, the pigmented sarcomata being eight times as frequent as the white ones. The tumour may commence at any age, even in the senile period (contrast with glioma of the retina, which is nearly always met with in children), and pushes the retina in front of it, being noticed as a rounded prominence behind the lens, and tending to fill the whole eye. The tension is raised, and vision more or less affected, according to the extent to which the tumour bulges in front of the central area of the retina. The rate of growth is often rather slow, but after existing some months to a year or two the sarcoma grows through the sclerotic and invades the orbital tissues. But perhaps before this has taken place secondary deposits have been formed in the liver or other viscera.

Treatment.—As soon as the tumour is positively diagnosed the eye should be excised.

X.—PARALYSIS OF THE OCULAR MUSCLES, ETC.

Nerve-Supply and Functions.—Of the external muscles of the eye, the levator palpebræ, superior, internal, and inferior recti, and the inferior oblique, are supplied by the third nerve. The external rectus is supplied by the sixth nerve, the superior oblique by the fourth.

The superior rectus alone turns the eye upwards and inwards, rotating the globe slightly inwards.

The inferior rectus alone turns the eye downwards and inwards, rotating the globe slightly outwards.

The superior oblique alone turns the eye downwards and outwards, rotating the globe slightly inwards.

The inferior oblique alone turns the eye upwards and inwards, rotating the globe slightly outwards.

The internal and external recti simply turn the eye inwards and outwards.

In considering the movements of the eye it must be remembered that the muscles act in pairs or groups in producing any one movement ; thus, for instance, in looking straight downwards we use the inferior recti and superior obliques ; in looking downwards and outwards with one eye, the external and inferior recti and the superior oblique come into play. It will be noticed that the tendency to rotate inwards and to adduct of the superior rectus is counteracted by that of the inferior oblique to rotate outwards and abduct—the resulting action being one of simple elevation.

The action of the internal muscles of the eye is fortunately more simple. The ciliary muscle (supplied by the third nerve through the lenticular ganglion) draws forwards the suspensory ligaments of the lens, and by so doing allows the elasticity of the latter to render it more convex (accommodation). The contractor pupillæ is supplied by the third nerve ; dilatation of the pupil is accomplished through the medium of the sympathetic nerve. Cases occur in which all the external muscles of the eye are paralysed (*ophthalmoplegia externa*), others in which the internal ones are paralysed (*ophthalmoplegia interna*), or both may be present at the same time. If one-sided, the cause is probably about the cavernous sinus, in the wall of which all the oculo-motor nerves are grouped near to each other ; if on both sides, it is probably due to inflammation and degeneration of the nerve-origins in the floor of the aqueduct of Sylvius. In either case syphilis is frequently the origin of the disease, and more or less complete recovery may follow early and resolute

treatment with iodides and mercury. Aneurism of the carotid artery or tumour near the cavernous sinus may, however, be the cause of ophthalmoplegia, especially if one-sided; another cause may be meningitis (traumatic or tubercular, etc.).

As a rule paralysis of the oculo-motor system is not complete, but affects one or two muscles or one nerve. Thus, for instance, the sixth nerve may be paralysed, or the inferior oblique muscle. Squint or strabismus results on attempting to put the paralysed muscle into action (*e.g.*, in the case of the external rectus in making the patient look outwards, the head being fixed), and piplopia, or double vision, is usually complained of, except in

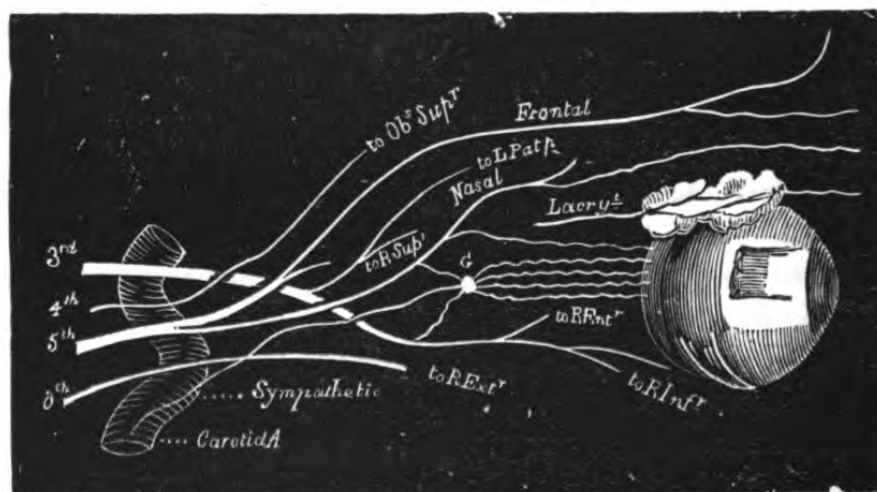


FIG. 16.—Diagram of the Nerve-supply to the Eye, etc.

long-standing cases in which the 'false image' is ignored. It is a frequent mistake of students to give as the most common cause of strabismus paralysis of one of the muscles; the convergent squint from over-action of the internal recti in hypermetropia (which see, p. 80) is very much the most frequent. Divergent strabismus due to weakness of the internal recti (not complete paralysis) is most often seen in myopic patients, or in emmetropic or even long-sighted women who have prolonged strain thrown upon their eyes in needlework, etc. The tendency to it ('latent divergence') is tested for in the following manner: An object is held before the patient's

nose at a distance of ten or twelve inches, and he or she is directed to look fixedly at it. A card is then placed before each eye alternately, so as to prevent it seeing the object, but not to conceal it from the surgeon's view. When thus covered the eye (if latent divergence be present) will turn slightly outwards, and on removing the card the internal rectus will again contract and draw it inwards. Such cases are to be treated with tonics, correction of errors of refraction, if present, and sometimes prisms with their bases inwards are of use. But the great thing is to avoid prolonged strain of the eyes, and to improve the general health by outdoor exercise, etc.

The term 'muscular asthenopia' is applied to these cases of weakness of the internal recti, as well as to irritability of the ciliary muscle; and both may be brought about by any debilitating cause, such as prolonged suckling.

Without going into all the varieties of paralytic strabismus and diplopia, the following points may be noted:

1. The smaller the degree of strabismus the more troublesome is the diplopia. (This is due to the image in the slightly deviating eye being then formed near to the macula, and hence being much more distinct than one formed in a peripheral part of the retina, as in high degrees of strabismus.)

2. When one internal or external rectus is paralysed, the false image (the one formed in the defective eye) of an object is not deflected, but simply seen at the side of the true image. The separation of the two images (a lighted candle held at 12 feet distance in a dark room is a good object to use in testing) becomes greater the farther the object is moved towards the side on which the paralysis is present.

3. If one of the other muscles (*e.g.*, inferior oblique) is paralysed when diplopia is present, the false image is inclined or deflected—the reason is obvious on considering the complicated action of the muscle which acts ordinarily in association with the paralysed one (see p. 61).

4. With diplopia there is frequently giddiness in walking, etc., which becomes most marked if the patient cover his sound eye.

Finally, it may be added that if the relative position of the two images corresponds to that of the eyes (*i.e.*, the patient has double vision, and obliterates the right-hand image on covering his right eye), the diplopia is said to be homonymous. If the reverse is the case, the term 'crossed diplopia' is used. Homonymous diplopia is met with in convergent strabismus, crossed diplopia in divergent.

Paralysis of one or more ocular muscles (including the levator palpebræ) may be (1) a symptom of locomotor ataxia, or tabes dorsalis; (2) due to syphilitic disease of the corresponding nerve-trunk, or nucleus; (3) a symptom of meningitis; (4) a result of injury to the orbit (in which case it probably passes off after a time) or to the skull (fractured base), etc.; (5) associated with tumour or hæmorrhage at the base of the brain; (6) due to some unknown cause.

If the *third nerve alone* be paralysed, the following symptoms are present: The upper eyelid droops; the globe can be turned outwards and downwards (to a less extent and with slight rotation inwards of the vertical meridian). The power of accommodation is lost, and the pupil is somewhat dilated, and does not contract to stimulation by light of either eye.

If the *cervical sympathetic branch to the eye* be paralysed (from pressure of a tumour or aneurism in the neck, rupture of the brachial plexus, etc.), the pupil is perhaps slightly contracted, and it will not dilate on shading the eye. It will be remembered that this nerve comes out from the spinal cord by the first or second dorsal nerve, and then joins the cervical sympathetic trunk, to ultimately reach the lenticular ganglion in the orbit by means of the carotid plexus. In paralysis of the cervical sympathetic the palpebral fissure may be slightly narrowed, and the globe a little less prominent than on the other side—due to loss of action of unstriated muscle in the upper lid and orbit.

Partial or complete paralysis of the ciliary muscle of both eyes is not infrequently seen after an attack of *diphtheritic sore-throat*. The affection comes on some weeks after apparent recovery from the diphtheria, nearly always in children or young adults, and is

associated with (1) loss of knee-jerks ; (2) sometimes paralysis of the soft palate, allowing fluids to regurgitate into the nose ; (3) rarely paralysis of the external rectus (Nettleship) or sluggish action of the pupil.

Distant vision is unaltered, but there is more or less defect of near vision, which can be overcome by using a convex lens equal to the amount of lost accommodation. The paralysis is recovered from in a few weeks as a rule, tonics (*e.g.*, syr. ferri phosphatis comp.) and country air hastening the recovery.

XI.—OPERATIONS ON THE EYE.

1. **Excision of the Globe** (syn. Enucleation).—Anæsthesia is necessary.

Instruments required. — Spring-stop speculum, forceps, scissors curved on the flat, strabismus-hook.

Position of operator—behind the patient's head.

Introduce the speculum and open it as wide as the orbit will allow ; fix it with the screw-stop. Pick up the conjunctiva with the forceps just above the cornea, cut it through, and then continue the division of the conjunctiva all round, keeping as close to the cornea as possible. Having then opened Tenon's capsule, pass the hook under one of the recti muscles and divide it with the scissors ; repeat this with each rectus. Keep the hook and scissors close to the globe, and divide whatever is picked up by the former, whether it be a complete muscle-insertion or a part of the fascia. Having thus gone all round the globe, press the speculum back and the globe should project forwards. Introduce the scissors on the right side of the eye operated on, with the blades slightly opened, until they meet the optic nerve ; divide this whilst steadying the globe with the fingers of the left hand. The latter now takes hold of the eye, whilst any remaining tissues are divided. Firm pressure over the closed lids is then applied by means of sponge and bandage. The chief difficulty of the operation lies in the division of the optic nerve.

The glass eye may usually be worn after three or four weeks have elapsed.

Modifications.—With a view to obtaining a good support for the glass eye, and thus enabling it to move well on contraction of the recti, a small glass or celluloid globe may be inserted into the cavity of Tenon's capsule, which is held open by forceps, and subsequently sutured over the globe by very fine silk. If this is done, a drain of a few horse-hairs should be laid across in front of the glass globe and under the capsule, to be removed at the end of twenty-four or thirty-six hours ; it is perhaps best to sew up the capsule and conjunctiva separately.

Not very infrequently the globe may work out subsequently, but it is generally well tolerated.

Dangers of the Operation.—Provided the tissues are divided close to the globe there is hardly any risk from hæmorrhage, If excision is done for acute suppuration (panophthalmitis), there is a certain amount of risk from acute meningitis, and hence if the operation must be done for this condition, the orbit should be washed out with some antiseptic solution after the operation.

2. **Tenotomy** may be done under cocaine, but in young children an anæsthetic should be given. The muscle divided is nearly always the internal rectus.

Position of the operator—on the right side of the patient.

Instruments.—Spring-stopspeculum, tenotomy-hook, forceps, straight scissors, blunt at the end. Introduce and fix the speculum, pick up a small fold of the conjunctiva at the junction of the inner and lower corneal tangents, and divide it with the scissors. Introduce the forceps within the little wound made, and seize Tenon's capsule and open it in the same manner with the scissors. It is, however, fairly easy to pick up both conjunctiva and fascia at once ; the scissors should be passed towards the caruncle and over the insertion of the rectus to free the latter from the sub-conjunctival tissue. Now, holding the wound open with the forceps (which have not left go the conjunctiva), introduce the hook, pointing its end directly backwards, so as to work under the lower border of the tendon. With a movement of the hook pass it right under the rectus, and raise the latter slightly on it ; then introduce the scissors

and divide the tendon between the hook and the insertion, close to the latter. If there is any doubt as to complete division of the muscle, introduce the hook again, and divide any band remaining. Observe the effect upon the position of the eye (a little divergence under the anæsthetic is common, and subsequently passes off).



FIG. 17.—Tenotomy hook.

It may be noted that after complete division of one internal rectus the globe can still be turned inwards at the time of operation, owing to the action of the upper and lower recti. Tie the eye up with a light pad and bandage, which may be changed daily, and left off after two or three days. Its use is to conceal the slight ecchymosis which nearly always results; and it is not absolutely necessary to use any bandage at all.

Difficulties of the Operation.—Especially when the patient is not anæsthetized, this operation is more difficult than it looks, and to do it well requires considerable practice. The first essential is to make sure that Tenon's capsule is opened before the hook is introduced, otherwise it cannot pass properly under the tendon. The second point where difficulty is met with is in the actual cutting of the tendon, which should be done boldly, and not with very little snips.

There are no special dangers about the operation, but it is worth remembering that just as the tendon is stretched and divided on the hook, the patient's pulse may flag or stop for a few seconds, especially in very young children. The sclerotic has been known to be divided by the scissors or hook (sometimes with a serious result to vision), and hence a hook with a sharp point should never be used.

Tenotomy of the external rectus, partly, perhaps, on account of its insertion being further back than that of the internal rectus, is both more difficult and less satisfactory, but the method of the operation is very similar.

It is not advisable, as a rule, to divide more than one internal rectus at a time, even if the squint is of high degree, for fear of divergence resulting. It is better to wait a few months and see the result of the first operation before performing a second. If, as in most cases of convergent strabismus, spectacles have been ordered, they should be resumed by the patient as soon as possible after the operation.

3. **Advancement or readjustment** of a rectus consists essentially in exposing the tendon by a vertical incision about 5 mm. from the cornea, and then passing three fine sutures through the conjunctiva and subjacent tissues (short of the sclerotic), and then again through the tendon at some little distance back, and finally the conjunctiva. The tendon is raised on a hook whilst the sutures are passed, and it is then cut across, or, if necessary, a small piece excised.

The sutures are then tightened and tied in order from above downwards, and the eye bandaged for a few days.

The operation is tedious and rather difficult, and needs to be seen to be understood.

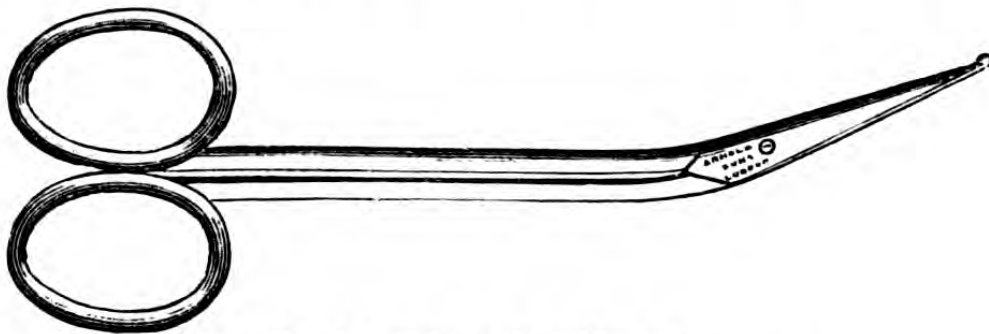


FIG. 18.—Scissors for iridectomy.

4. **Iridectomy.**—In cases of penetrating wound of the cornea with prolapse of the iris, if it is considered wise to try to save the eye (see 'Wounds of the Globe'), a speculum should be introduced, the prolapsing portion seized with iris-forceps and drawn well forwards, and then cut off level with the wound. Then with a curette gently press the iris back within the anterior chamber. This operation can only be done satisfactorily within a few days of the injury, and if there is definite prolapse,

the sooner it is done the better. Unless there is already iritis (in which case atropine and ice are necessary), it is perhaps best to use eserine freely for a day or two, in order to draw away the iris from the wound; this is especially the case in peripheral wounds. Whether eserine or atropine be employed, one border of the wounded iris will probably remain adherent to the cornea, but (provided the lens has not been originally wounded) perfect vision may be restored and the synechia give no future trouble.

Iridectomy for Optical Purposes.—The cases for which this operation is best adapted are those in which there is a dense central nebula of the cornea, with a clear (or comparatively clear) part downwards or to the inner side. It is also sometimes performed for lamellar cataract. It should, if possible, be performed opposite the inner and lower part of the cornea, and the iris should not be excised right up to its ciliary attachment.

Instruments Required.—Speculum, fixation-forceps, narrow keratome, iris-forceps and scissors, small curette or vulcanite

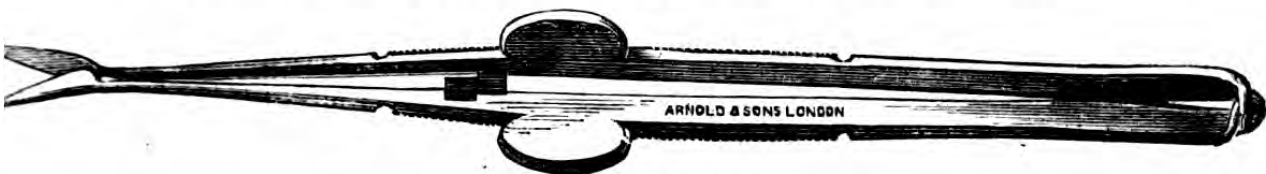


FIG. 19.—De Wecker's iris-scissors.

spatula. Fixing the globe with the forceps, which grasp the conjunctiva at the upper part, introduce the keratome just within the corneal margin, and keep the blade parallel with, or



FIG. 20.—Keratome.

a little anterior to, the plane of the iris. Take care not to introduce the point too far, and both enter and withdraw the keratome slowly, widening the wound slightly by a lateral

movement on withdrawing. These precautions are to avoid wound of the lens, which is projected forwards as the aqueous escapes. The fixation-forceps may be put down, or, if necessary, an assistant takes charge of them. Now introduce the iris-forceps closed, and opening them slightly when the points are opposite the inner part of the iris, seize the latter and draw it gently out; cut off the part outside the wound by one snip of the scissors. The curette is now very gently passed over the wound, and if the iris tends to prolapse, its end is insinuated so as to depress either side. This manipulation is to avoid future bulging or prolapse of the iris. The eye is then bandaged up for three or four days.

Iridectomy for Glaucoma.—This differs from the preceding operation in the following points: 1. A larger wound must be made further backwards, 1 to 2 mm. behind the apparent sclero-corneal junction (Nettleship). It will be remembered that the cornea is a little overlapped by the sclerotic, like a watch-glass by the rim of the watch—in fact, as long as the track of the incision is just in front of the iris-attachment, it cannot be made too far back. 2. A large piece of the iris must be excised right up to its ciliary origin. 3. The iridectomy should always, if possible, be performed upwards, so that the resulting coloboma may be concealed by the upper lid. 4. Whereas the previous operation may, in adults, be performed under the influence of cocaine, in the case of glaucoma it is better to give an anæsthetic.

Instruments Required.—Speculum, fixation-forceps, Graefe's cataract-knife (not too flexible), iris-forceps and scissors, curette.



FIG. 21.—Graefe's knife.

The speculum being fixed, and the conjunctival surface irrigated with boracic lotion (this measure is perhaps advisable in all operations in which the globe is wounded), enter the point of the Graefe's knife through the sclerotic, 1 mm. behind the corneal

margin (of course with the blade of the knife directed upwards), pass it directly across in front of the iris, transfix, and cut upwards, so as to include nearly one-third of the sclerotic margin, in which the whole incision lies. The cutting is done by a gradual to-and-fro movement of the knife, the globe being fixed by the fixation-forceps which grasp the conjunctiva firmly below the cornea.

The iris-forceps is now introduced and directed towards the right side of the wound, then opened and made to seize the iris and draw it out; the scissors then divide the membrane on the right side of the wound. The iris is now drawn steadily out as far as it will come, until a second cut can be made on the left side of the wound. Replace the edges of the cut iris with the curette or small vulcanite spatula, and bandage the eye for a week, changing the dressing once daily, and bathing the lids each time it is changed. Sometimes an iridectomy is performed for relapsing iritis or for occlusion or exclusion of the pupil. In this case it should be free, although the incision need not be quite so large as for glaucoma, and may well be made with the keratome (a broad and triangular one). In these cases the iris has generally become either tough or 'rotten' from the previous inflammation, and it is very difficult to draw it out; it may be necessary to introduce the iris-forceps more than once.

Dangers and Difficulties of Iridectomy for Glaucoma.—The anterior chamber being nearly always very shallow, and both iris and lens being pushed forwards, there is great difficulty sometimes in making the incision correctly, and if a keratome be used there is no slight risk of wounding the lens-capsule with its point, hence I have described the operation as performed with the cataract-knife, in which there is no such danger. Some operators, however, still prefer the use of a keratome.

The vessels about the sclero-corneal margin being engorged during acute glaucoma, considerable bleeding often occurs when they are cut across. If much extravasation occur into the anterior chamber, it may be mostly removed by pressure on the cornea with the curette, but a little blood in this situation is fairly rapidly absorbed.

Sometimes the sudden relief of tension causes free hæmorrhage into the retina and vitreous, and the eye will almost inevitably then need to be excised.

Eserine-drops may be used after an iridectomy for glaucoma if the tension still remains full ; atropine-drops after an iridectomy for iritis, etc.

5. **Extraction of Cataract** (the 'modified linear' method).—In a few cases (chiefly those of very slowly maturing cataract, or those in which one eye has been previously operated on and lost in consequence of the operation) an iridectomy is performed upwards, and some weeks or months afterwards the extraction is completed—that is, the operation is divided into two stages. But in most cases the iridectomy is made as one step of the operation.

Instruments Required.—Speculum, fixation-forceps, Graefe's cataract-knife (which should be ascertained to be extremely sharp along its whole length), fixation and iris forceps, iris-scissors, cystitome (perhaps the best is one with the point bent at right angles), caoutchouc curette. The following instruments should be had in readiness, although not usually required : scoop for extraction of the lens, lid-elevator.

The use of cocaine has practically superseded chloroform or ether in cataract extraction ; but in the case of very nervous patients it is better to give an anæsthetic for fear of a sudden squeeze or movement of the eye during the operation. Under cocaine the only really painful part of the operation is the iridectomy, and the patient should be warned of this before the iris is seized and drawn out.



FIG. 22.—Lid-elevator.

Position—the operator stands behind the patient, who lies down, with the head carefully steadied by the pillow, and who turns both face and eyes somewhat downwards.

The speculum is introduced and the conjunctiva irrigated with some non-irritating antiseptic solution (*e.g.*, weak boracic



FIG. 23.—Cystitome (rectangular).

acid lotion). All the instruments used should have been previously sterilized.

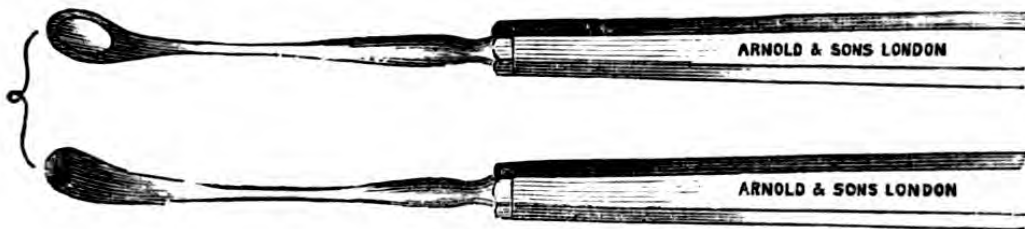


FIG. 24.—Curette.

NOTE.—Bichloride of mercury solution should not be employed, as it tends to corrode the instruments, as well as to produce haziness of the cornea, especially if the latter has been cocainized.

With the fixation-forceps in the left hand, seize the conjunctiva below the cornea exactly in the vertical meridian, fix the globe so that it looks somewhat downwards, and make the section at the upper edge of the cornea so as to include about two-fifths of its circumference. The cataract-knife is entered towards the outer side of the eye, at, or a very little behind, the sclero-corneal margin, with its point directed towards the centre of the pupil. As soon as it has entered the anterior chamber, the handle is depressed and the blade carried across in front of the iris, so as to transfix the cornea at the same level as its point of entrance. By a gentle to-and-fro movement of the knife, it is made to cut outwards; as it does so, the edge of the blade is sloped a little forwards, so that the middle of the incision is on a slightly anterior plane to that of either end. This is to favour the escape of the lens, which tends to emerge, not directly upwards, but forwards and upwards; *i.e.*, its upper edge is tilted forwards by the pressure on the lower part of the

cornea. Take care, whilst completing the section, not to press on the globe with the fixation-forceps; they should, on the other hand, be simply exercising downward traction. 2. Now lay down the knife, and with the iris-forceps in the left hand, and the scissors in the right, perform a medium-sized iridectomy (the assistant may, if required, continue the fixation of the globe). 3. Introduce the cystitome, held in the right hand, and with the blunt angle of its end first; then turn the instrument so that its point is directed towards the lens, and draw it across the capsule from side to side. Some operators add a vertical tear of the capsule; in any case, remember the convexity of the lens in using the cystitome. 4. Relax the pressure of the speculum—best done by the assistant drawing it forwards so as to keep the lids apart, but not to press on the globe.

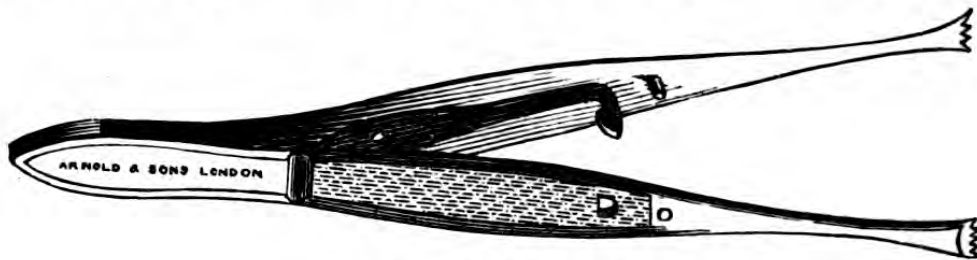


FIG. 25.—Broad fixation-forceps.*

Apply the curette over the lower part of the cornea, and exercise steady pressure with it by means of its convex surface. The lens should now present in the wound, and the pressure is kept up until it emerges, carefully relaxing after the widest part of the lens has come through. (At this stage injudicious pressure will be followed by escape of vitreous.) Remove the speculum. 5. Examine the pupil to see if it is uniformly black, or if any part of the lens has remained behind. If the latter, exert backward and upward pressure, with the index-finger placed on the lower lid. If the cataract has been a hard one and complete, this will probably not be required. Otherwise the remains of the lens should be coaxed out if they will come

* The fixation-forceps usually employed are more narrow at the ends, and have no catch.

without prolonged manipulation, which is decidedly dangerous ; and it is better to leave some lens-matter than to incur the

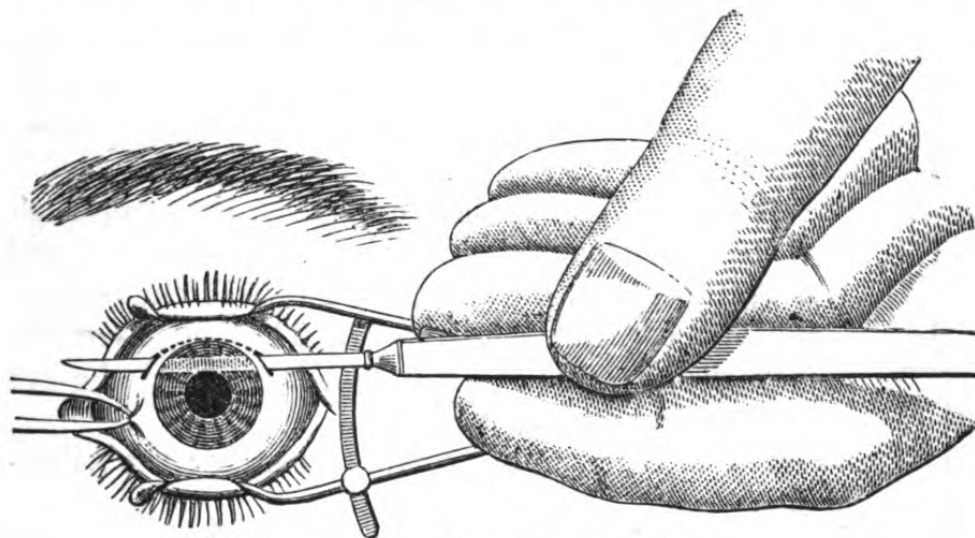


FIG. 26.—Peripheral linear section.*

risk of suppuration. 6. Ascertain that the iris does not tend to bulge into the wound ; if it does, depress each edge with the curette.



FIG. 27.—Outline of peripheral section.

Finally, place a pad (cyanide gauze, with absorbent cotton-wool, forms a good material) over each eye, and bandage both with a single well-adjusted fold, which must exercise slight pressure on the closed lids. A four-tailed bandage, the ends passing above and below the ears, is least likely to slip.

Difficulties and Dangers of the Operation.—If the left eye is operated on, the knife must be held in the left hand in making the section. An immature cataract is very prone not to come out cleanly ; on the other hand, an over-ripe one may also give trouble. The wound may be too small to allow of the exit of the lens, and in this case it must be enlarged with scissors. The rent in the capsule may similarly be insufficient (as shown by the lens not presenting on pressure), and the cystitome must

* The fixation-forceps should grasp the conjunctiva below, and not to the inner side, as drawn in this fig.

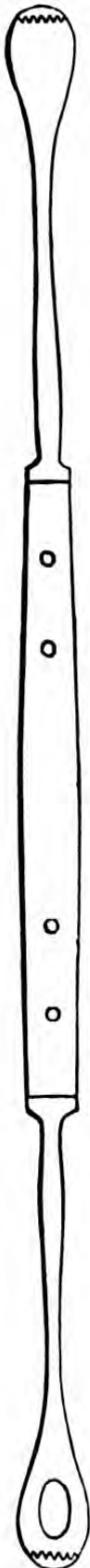


FIG. 28.—Scoop for extraction of lens.

be again used. But the chief accident which is to be dreaded at the time of operation is *escape of vitreous*. If the section is made too far back, or if the vitreous be too fluid, this may occur during the moment the pressure is applied, or it may follow the escape of the lens (generally due to the pressure being continued too long).

If vitreous present before the lens, the scoop must at once be introduced, passed behind the cataract, and the latter gently drawn out by means of the projecting lower edge of the instrument. The bead of vitreous may then be snipped off with scissors, and the eye bandaged as soon as possible.

The chief remaining complications are the following :

1. Vomiting or coughing, etc., during the next few hours, producing hæmorrhage into the eye, or escape of its contents. Hence the importance, where an anæsthetic is used, of carefully preparing the patient, and the great advantage of using cocaine.

2. Iritis coming on during the first three or four days ; it is to be suspected if the patient complains much of pain in the forehead and eye, and is to be treated by atropine and leeches to the temple.

3. Suppuration starting in the wound and spreading to the whole globe. Pain, restlessness, chemosis of the conjunctiva, and a yellowish tinge about the wound and pupil are the chief signs. As a rule, it leads to disorganization of the globe, and then requires excision ; but if recognised at first, the opening of the wound and irrigation through a fine nozzle with an antiseptic solution, or the application of the galvano-cautery to the wound (in the very earliest stage) has been occasionally followed by arrest of the process.

Severe iritis and suppuration are the chief causes of complete loss of vision after cataract extraction.

4. There is a very small risk of sympathetic oph-

thalmia, since the wound practically lies in 'the dangerous area.'

Modifications of the Operation.—Some operators dispense with the iridectomy; others make a wholly corneal section. The capsule may be cut with the Graefe's knife, and the use of the cystitome avoided, or the lens may be got out in its capsule entire by means of the scoop. There is some variety in the kind of knife used, and the old corneal flap operation was done with a Beer's triangular knife.

After-treatment of Cataract Cases.—The bandage and pad are changed at the end of twenty-four or forty-eight hours, the lids gently bathed with warm water, and the dressing again changed daily until six or seven days have elapsed, when a shade may be worn and the patient allowed up. Previous to this, it is best to keep the patient in a darkened room. At the end of a fortnight the patient may go out, wearing protective goggles, and as soon as the wound is soundly healed, and the eye quite quiet, the vision should be tested and glasses ordered. Two pairs of spectacles will be needed, one of from +10 D to +13 D for distant vision, the other +15 D to +20 D for reading. Astigmatism may interfere with these giving the patient good sight, and should be then corrected. Another frequent cause of defect after the operation is the persistence of opaque lens capsule; this is detected by oblique illumination (the pupil being dilated), and requires one or more needling operations.

The after-treatment just mentioned is only a rough outline, and must be modified to suit different cases. Surgeons are now becoming less rigorous in the restrictions as to darkness, etc., and some only cover up the eye operated upon.*

XII.—ON REFRACTION.

In what follows a purely practical review of the methods of testing for spectacles will be given, an elementary knowledge of optics being assumed. For fuller details the student may refer to the works of Landolt, Nettleship, and Morton. So complicated are some of the problems in connection with working

* For operations on soft cataracts see p. 38.

out errors of refraction, that only long practical experience can enable one to avoid errors, and it is impossible in the space at our command to give more than an outline of the subject.

An **emmetropic eye** is one in which parallel rays are brought to a focus on the retina when the eye is at rest, *i.e.*, when no accommodation is being used. Hence a patient whose accommodation is paralysed by homatropine, and who can then read $\frac{5}{80}$, may be considered emmetropic, since rays coming from a point at a distance of 20 feet, or 6 metres, may be practically considered to be parallel.

A **myopic eye** is one in which parallel rays come to a focus in front of the retina when the eye is at rest. Hence myopia

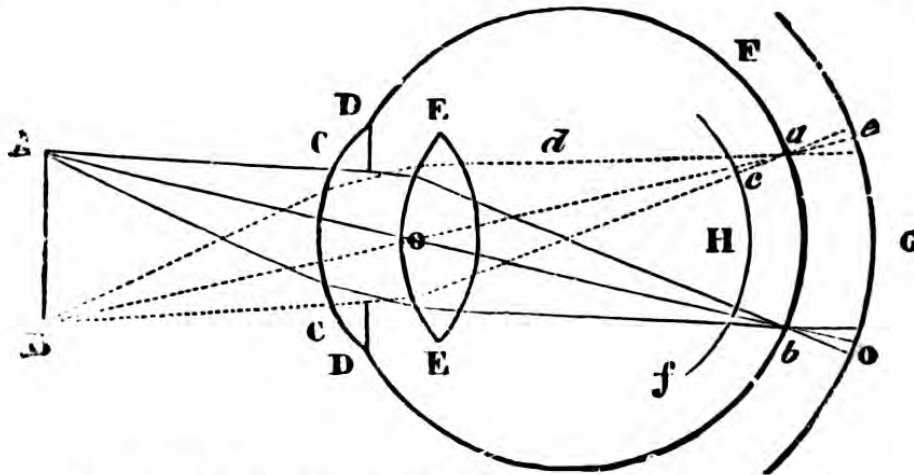


FIG. 29.—H, hypermetropia ; F, emmetropia ; G, myopia.*

is invariably accompanied by more or less defect of distant vision. Myopia usually comes on in childhood, or early adult life, when the eyes begin to be much used in near vision, reading and the like, and often tends steadily to advance. Strain of the eyes, as in reading bad or very small print, or in working in a bad light, favours its development and progress, though occasionally high degrees of short-sight are met with in patients who have never used the eyes much in near vision.

A short-sighted patient will be found usually to hold a book

* Fig. 29 is a diagram to represent the condition of an eye when looking at a distant object AB, the ciliary muscle being at rest. A clear image is then only formed in the emmetropic eye F, but by using the accommodation it can also be obtained in the hypermetropic eye H. G represents the back of the globe of a myopic eye, the image of the distant object formed there being blurred.

abnormally close to the eyes, as well as to have defect in distant vision.

In **hypermetropia** parallel rays, when the eye is at rest, are brought to a focus behind the retina. The defect depends upon the shape of the eye or the curvature of the cornea, and is often inherited, a large proportion of eyes being hypermetropic at birth. It usually remains quite stationary, but sometimes decreases, so that a hypermetropia of one or two dioptries may, in the course of a few years, disappear; this, however, is unusual. By accommodation (contraction of the ciliary muscle), rays from a distance passing into a hypermetropic eye can be made to converge on the retina; hence a young subject with powerful ciliary muscle can readily conceal a considerable degree of hypermetropia.

By **presbyopia**, or old-sight, is meant that stage of the gradual failure of accommodative power at which, in an emmetropic eye, reading small print becomes impracticable at a nearer distance than nine inches. The power of accommodation is at its maximum (14 D) about the age of ten years, and steadily decreases, until at the age of seventy-five no accommodation is possible. This gradual decrease depends both on failure of the muscle and loss of elasticity of the lens, especially the latter. At forty to forty-five years a normal eye possesses 4 or 4.5 D (dioptries)* of accommodation, and can read 1 Jäger print as near as ten inches. At or after this age it will require a convex lens to bring the print at this distance into focus. The practical deduction is that presbyopia usually begins at forty-five years, and steadily increases. Thus an emmetropic eye at forty-five will probably need +1 D for near vision, +2 D at fifty, and so on, with an increase of +1 D for each five years up to fifty-five or sixty, after which the increase is rather slower.

A hypermetropic, or long-sighted patient, will need glasses for reading sooner than an emmetropic one; thus a patient with +1 D of H. in each eye will probably need glasses of this strength for reading at forty years. In myopia, on the other hand, the near point is, to start with, abnormally near the eye,

* For explanation of 'dioptre' see p. 92.

and hence the onset of presbyopia is delayed. In high degrees of short-sight the patient may be able to dispense with glasses for reading until a very advanced age.

Astigmatism.—Not only may the cornea be abnormally curved in its whole extent, but it may be unequally curved in two meridians, the axes of which are at right angles to each other in 'regular astigmatism,' the usual form, and the only one which can be corrected by glasses. The horizontal meridian of the cornea is usually that which is least curved, the vertical one the most. In 'simple myopic astigmatism,' one meridian, usually the vertical one, is myopic, the other emmetropic. Various other terms are used with regard to astigmatism; thus in 'compound hypermetropic astigmatism' both meridians are hypermetropic, but one of them, usually the vertical one, is more so than the other. The meridians are, however, frequently not exactly horizontal and vertical, but inclined, still always at right angles to each other in regular astigmatism.

In testing for errors of refraction, always test each eye separately; note both near and distant vision, and *begin with the latter*. The younger the patient, the more important is it to remember that contraction of the ciliary muscle may give deceptive results, and to avoid this by the use of atropine or homatropine.

1. In **hypermetropic** cases the patient very commonly complains of aching in the eyes or forehead in reading or writing, due to the strain upon his ciliary muscle. The higher the degree of long-sight, the earlier will the patient probably complain. Thus he may not feel any inconvenience from H. of +1 or +2 D until he is forty years of age; but cases differ very much in this respect, women appearing to be more inconvenienced by low degrees of hypermetropia than men, and constant application of the eyes to fine work, reading or writing, causing a slight amount of hypermetropia to be early noticed. A frequent complication of hypermetropia in early life is convergent strabismus (the most usual form of squint). In this, whilst one eye is directed on an object the axis of the other is directed to its inner side. The squinting eye is frequently

amblyopic ; that is, whilst it retains some vision (*e.g.*, $\frac{2}{100}$ and 12 J), it cannot be improved much above this by any glass. No change can be found in the optic disc or retina to account for this defect of vision, which is probably congenital. In these cases the strabismus is constant ; it is always the defective eye which squints. In others the strabismus is alternating ; that is, sometimes one eye squints, sometimes the other, and then both eyes, as a rule, possess good vision. The degree of squint is by no means proportional to the amount of hypermetropia ; as a rule the cases with high H. (+ 8 D to + 12 D) do not squint. Sometimes, but only occasionally, convergent strabismus is found in emmetropic eyes.

Example 1.—A child is brought with convergent strabismus. The distant vision is found to be $\frac{2}{100}$, or $\frac{6}{6}$ in one eye, $\frac{2}{100}$ or $\frac{6}{36}$ in the other (the squinting one). Paralyze the ciliary muscle by the use of atropine for two or three days, or by the application of homatropine (4 grains to the ounce) thoroughly to both eyes for about an hour. The refraction is then tested either with keratotomy or the ophthalmoscope, the first being the most convenient. Without going into the theory of keratotomy, or, as it is sometimes called, retinoscopy, the following outline may suffice : The patient sits in a dark room with a good light above and behind his head, and is told to look straight forwards. The observer seats himself at a distance of one metre in front of the patient, and with a slightly concave perforated mirror before his eye reflects the light on to the patient's cornea. He then tilts the mirror slightly from side to side, and from above downwards. A shadow is seen to move across the patient's eye in the same direction as the mirror if the eye is myopic, in the opposite direction if emmetropic or hypermetropic. Supposing the latter, convex lenses are in turn placed just in front of the patient's eye, and the movements of the mirror repeated until no shadow is observed, when the error of refraction is slightly over-corrected. For example, if neutralization occurs at + 4 D, when the shadow no longer moves across the eye, or has become extremely faint, the amount of hypermetropia will be about + 3 D. The rule is, from the

result found by keratometry in hypermetropia deduct from + .5 D to +1 D ; add to it in myopia - .5 or -1 D (in high myopia keratometry is not so trustworthy as in other cases).

In our example of strabismus the hypermetropia has been found to be + 3 D, and no astigmatism exists, since the spherical lens of + 4 D corrects the shadow in both meridians. The result may now be confirmed by the ophthalmoscope, the observer using the direct method, relaxing his accommodation to the utmost, and rotating the convex glasses in his instrument so long as the details of the disc are clearly defined. The highest lens with which this is possible indicates the amount of hypermetropia. Or if the patient can read, confirm the result by using convex lenses with the type at 6 metres distance, and it will be found that with the + 3 D he reads $\frac{5}{6}$ with the best eye, the vision of the squinting one being not materially improved.

The full, or very nearly the full, correcting-glass should now be ordered for constant use, and if the squint be of only moderate extent, after some little time the eyes are found to remain straight so long as the glasses are worn. After a few years' use of the glasses the strabismus will very likely be permanently cured. If, however, the squint is very marked (over 20°), tenotomy of one internal rectus will probably be required; and if this does not succeed, tenotomy of the opposite internal rectus or advancement of the external muscle may be necessary. But in any case of hypermetropia with convergent squint a thorough trial of fully-correcting glasses should be made, so long as the patient is old enough to wear them. In children under two or three years, if it is not practicable to use them, the internal rectus of the squinting eye may be divided first, and subsequently the error of refraction corrected.

Example 2.—A young adult comes complaining of headache on use of the eyes in near vision, and of the letters 'running into one' when he reads. There is no strabismus. Take the near and distant vision of each eye, noting the far and near point for reading, and then examine for 'manifest hypermetropia.' This is done by putting up a high convex lens (say + 6 D) before the eye, and then gradually diminishing its effect

by placing successive concave glasses (-1 D, -1.5 D, -2 D, etc.) in front of it. The highest lens with which he reads $\frac{6}{6}$ indicates the manifest hypermetropia, and in patients over thirty this is often the total amount, and this glass should be ordered for reading, etc. But in our example, a young adult, the probability is that he is concealing a certain amount of hypermetropia by contraction of the ciliary muscle. This, the 'latent hypermetropia,' should be estimated by keratometry or the ophthalmoscope, after paralyzing the accommodation with homatropine. The great advantage of this drug over atropine is that its effects pass off in a day, whereas atropine leaves the accommodation impaired, as a rule, for a week. And for practical purposes the four-grain solution of homatropine, if applied several times during an hour, will obtain perfect relaxation of the ciliary muscle.

Let us suppose that a total hypermetropia of $+7$ D is found in one eye, of $+5$ D in the other ('anisometropia,' or unequal refraction in the two eyes). The patient with this degree should certainly be ordered to wear glasses for near vision, but will prefer to have not quite the full correction. Deduct $+1$ D, or $+1.5$ D, from the result, and order $+5.5$ D for one eye, $+3.5$ D for the other. More commonly the two eyes are equally long-sighted, and then in low degrees (*e.g.*, $+2$ D or $+2.5$ D) order the full correction, in high degrees deduct one or two dioptries. But in doing this consideration must be made for each individual case; some patients will use the full correcting glass without difficulty, for others it is best to order a weaker lens at first, and subsequently (after some months' use) to increase the strength.

Keratometry is the best method of detecting hypermetropia, and it is very easily learnt; the direct method with the ophthalmoscope is more difficult, but equally good in the hands of practised observers (provided both patient and surgeon are relaxing their accommodation at the time of the observation). In examining by keratometry a case of either high hypermetropia or myopia the shadow will be noticed to move slowly, to be rather ill-defined, and to have a somewhat crescentic border.

As the successive correcting lenses are placed before the patient's eye in the frame, and the movements of the mirror repeated, the shadow moves faster, becomes more sharply defined, and loses its curved outline.

If a hypermetropic eye be examined by the indirect method, and both lens and observer's head and mirror moved steadily away from the patient, the size of the disc's image is seen to decrease; in myopia, if this experiment is tried, the opposite is the case. If the surgeon use his ophthalmoscope mirror alone and reflect the light into the patient's eye, the retinal vessels and disc are distinguished (*e.g.*, at a distance of one or two feet); and if he then move head and mirror from side to side, the image of the vessels will be noticed to move in the same direction as his head. In myopia it moves in the reverse direction.

To recapitulate :

(1) In hypermetropia convergent strabismus is a frequent symptom in childhood; in later life frontal headache and difficulty in near vision (and in some cases of high degree in distant vision also) are the most characteristic features. It may be noted that some congestion of the lid-margins and even blepharitis are occasional complications of long-sight, and may be cured by wearing the proper glasses.

(2) The total amount of hypermetropia is divided into the latent and manifest parts; the latter can be estimated by the highest lens the patient takes for clear distant vision, the former only after the ciliary muscle has been paralyzed for a time (in young subjects).

(3) Keratometry and the direct ophthalmoscopic method are the best ways of determining the degree of long-sight; but in every case, if the patient can read, the result should be confirmed by trial in distant vision of the lenses before ordering the spectacles.

A common mistake of students is to imagine that because the patient does not see well in near vision, the first thing in hypermetropia is to try what glasses he can read small print well with; this would often give the right result, but in many cases would be quite untrustworthy.

2. **Myopia.**—As already stated, defect in distant vision is the commonest symptom, and if the short-sight be more than of very moderate degree, it will be found that the patient holds print nearer than normal to the eye. Myopia is due to elongation of the globe, which may often be detected by the prominence of the eye or the great extent of sclerotic exposed on looking sideways. In high degrees there is nearly always bulging of the sclerotic at the posterior pole—*i.e.*, just outside and around the optic disc. This bulging is accompanied by an atrophy of the choroid over it, and thus with the phthalmoscope a whitish crescent or circle is seen; if the former only, the crescent is observed to the outer side of the disc. The term 'posterior staphyloma' is applied to the bulging. The choroid is generally thinned, and its vessels more obvious than usual, and in some cases patches of choroidal atrophy are present in the yellow-spot region. Myopia tends to increase, partly by the strain of the recti muscles upon the globe; but the increase, as a rule, does not occur after about twenty-five years; any severe illness, and especially congestion of the eyes brought about by excessive strain in near vision, and stooping over the book, etc., favours its progress. In high myopia there is a tendency to several complications, all seriously damaging the sight. These are (1) opacities in the vitreous ('*muscæ volitantes*,' or floating spots of irregular shape, form a common symptom, even though no opacities can be detected by the surgeon); (2) hæmorrhage into the vitreous or retina after slight blows, or coming on spontaneously; (3) detachment of the retina; (4) choroidal atrophy, or 'central choroiditis'; (5) abnormal fluidity of the vitreous; and (6) secondary cataract, especially of the posterior surface or pole of the lens.

Just as convergent strabismus is a frequent complication of hypermetropia, so divergent squint is sometimes met with in myopia, but much less frequently. It is due to weakness of the internal recti, following upon the strain thrown upon them in near vision; its treatment consists in (1) removing the cause by using proper glasses; (2) the addition to these of prisms with their bases directed inwards; (3) division of the external

rectus ; (4) advancement of the internal rectus of the diverging eye. Tenotomy of the external rectus alone rarely gives satisfactory results.

The rate of increase of myopia varies much amongst its subjects ; sometimes a low degree (*e.g.*, - 3 D) coming on about puberty persists throughout life. In these cases we rarely find a marked crescent round the disc, and beyond the defect in distant vision, such an amount of short-sight entails no disadvantage. Indeed, as soon as the presbyopic age (forty-five) is reached, it is an actual advantage, since glasses may not be required for near vision until about fifty-five or sixty years. In the more common cases in which the myopia increases, the eyes are frequently weak and irritable ; such complications as blepharitis or chronic conjunctivitis are not infrequent. The muscular weakness (or 'asthenopia') has already been alluded to, as well as the graver complications.

To give one or two examples of myopia and myopic astigmatism :

Example 1.—A young man complains that he cannot see across the street so well as he used to, and that he is frequently troubled with floating specks before his eyes, particularly when he is in a bright light. His distant vision is taken first ; he reads $\frac{6}{36}$, or $\frac{20}{100}$, with either eye, making out the letters with some difficulty, and 'screwing up' his lids in order to get a clearer view. His near vision is then tested, and he is found to read 2 J from 3" ('punctum proximum,' or p. p.) up to 12" (p. r. = punctum remotum) ; beyond this distance he cannot read it. The rule in myopia now comes in—divide the distance of the far point in inches into 40, and the result indicates roughly in dioptries the amount of myopia present ; exactly the same is true if the distance of the far point be taken in centimetres and divided into 100.

In our case 12 divided into 40, or 30 divided into 100, gives 3.3 D. A - 3.5 D glass is now placed before each eye, and the distant vision is found to be about $\frac{6}{36}$, or $\frac{20}{100}$, and no spherical glass is found to improve. Slight astigmatism is suspected, and the patient examined by keratotomy, when it is found that

a - 3 D corrects the shadow-movement in the horizontal meridian, a - 4 D lens that in the vertical. On adding a - 1 D cylinder to - 3 D spherical he is found to read $\frac{5}{8}$ and 1 J up to about 20". These glasses are ordered thus :

- 3 D spherical,
- 1 D cylinder axis horizontal,

and may be used both in near and distant vision.

NOTE.—It must be remembered that a concave lens lessens the size of an image, and hence when a high one is ordered the patient finds that print, etc., is rendered so small that it is impossible to use the glasses for near vision. And so long as a myopic patient can read moderate-sized print at a reasonable distance (10" to 12") it is unnecessary to wear the glasses, except for obtaining a clear view in the distance. It is generally found that up to - 4 D or - 5 D can be comfortably worn in near vision (and if this is the total myopia they may be ordered for constant use). Above this degree the full correction, or nearly the full, may be offered for use in distant vision, and that glass (usually - 4 D or - 5 D) which will enable the subject to avoid bringing the book nearer than 10" for use in near vision. To avoid the trouble of changing the spectacles sometimes a moderate concave lens is ordered in spectacles for constant use, and another concave lens in eye-glasses for putting up in front of the spectacles when clear distant vision is required.

In our example the eyes are examined with the ophthalmoscope, and no cause found for the 'muscae volitantes,' the fundus being normal apart from the myopia, and no floating particles to be seen in the vitreous (to test for these use the direct method, keeping one's head some six inches away from the patient's whilst having rather a weak light, and making the patient look up and down and from side to side). If this symptom be very troublesome, and if the patient's eyes are irritable in ordinary sunlight, it is a good plan to order the proper glasses in light cobalt or neutral tint. In any case of myopia the patient should be warned against reading in a bad light (*e.g.*, in some railway carriages at night), against stooping over

his work, and against persisting in the latter after the eyes begin to ache; and if out of health tonics, etc., should be ordered. The quality of the print is considered to be an important factor, and may account partly for the great prevalence of short-sight in Germany. The best position for the artificial light in reading, etc., is on the left side, and so placed that it is thrown on to the book or work, and not into the patient's eyes.

Example 2.—A middle-aged patient has worn concave glasses for long, and now complains that they do not help much, and that the eyes and head ache on any attempt to use the former. It is found that $V = \frac{1}{80}$, and that only 4 J can be read up to 4". Some homatropine is applied and dotted opacities in lens and vitreous discovered, there being a large posterior staphyloma and irregular choroidal patches of atrophy about the yellow-spot region. A -10 D or -12 D lens raises the vision to $\frac{6}{36}$, beyond which it cannot be improved.

It is very difficult to order glasses which will help much in such a case; probably with a -6 D or -8 D (by empirical rule deduct -4 D from the total in these cases) the patient will be best able to do his work, and these may be ordered. But he should be warned against anything likely to produce congestion of the eyes, and tinted glasses, or even, in bad cases, protective 'goggles' may be of service.

The following points in myopia may be noted: 1. Distant vision is defective, and improved by concave lenses. 2. In near vision the far point is nearer the eye than normal. 3. By keratotomy the shadow is found to move in the same direction as the mirror if the degree of myopia be over -1 D. 4. By the mirror alone the retinal vessels are seen distinctly at some distance from the eye, and their image moves in the opposite direction to the mirror. 5. By the indirect method the disc looks smaller than normal, and appears to increase in size as both mirror and lens are withdrawn. 6. The disc cannot be clearly seen (unless the observer is himself myopic) by the direct method without a concave lens in the ophthalmoscope.

It has already been said that in testing young adults or

children, to avoid errors, the patient's accommodation must be relaxed, and generally homatropine or atropine is necessary for this purpose. Most people will see more clearly in the distance with a low concave lens in front of their eye, and many more clearly in near vision with a convex glass ; but neither necessarily implies any error of refraction. Hence the rule : take the distant vision first, and exclude the presence of hypermetropia by using convex lenses, and suspect spasm of accommodation when the patient's answers vary from time to time.

The question of testing for **Astigmatism** has already been alluded to, and need not here be much further discussed except to say that where it is suspected owing to the failure of spherical glasses to bring the vision up to or near perfection, and the absence of any cause for defect on examination by direct illumination (a frequent cause for this defect is an old nebula of the cornea), or by the ophthalmoscope, the ciliary muscle should be paralysed by homatropine, and keratotomy employed. If astigmatism be found by this method, the result should be confirmed by testing the patient's distant vision, and unless the cylinder in the usual cases of compound astigmatism is a definite improvement, it should not, as a rule, be ordered. In cases of mixed astigmatism (where one meridian is myopic and the other hypermetropic), if the defect is of low degree, the hypermetropic meridian, as a rule, alone requires correction.

Some puzzling cases are met with in which an error of refraction is suspected from the visual defect and other symptoms, and yet it cannot be found. Nebulæ of the cornea from previous ulceration, and a more or less conical condition of the cornea, account for many of these cases, and if the eye is examined by keratotomy and by direct illumination, neither should be overlooked.

Presbyopia.—An emmetropic patient will, as already stated, want glasses for reading at or soon after the age of forty-five, and starting from +1 D he will require an addition of about +1 D every succeeding five years, although this rule is only roughly true after fifty-five. Unusually rapid increase of presbyopia sometimes is an early sign of glaucoma : unusually early

onset probably implies existing hypermetropia, late onset the presence of myopia. It may be noted that sometimes myopic patients complain of difficulty in near vision at the presbyopic period, and a low concave lens is found to help them, though these cases are infrequent.

In testing a presbyopic patient take the distant vision of each eye first, and see if there is any hypermetropia ; if this is found, add the amount to the glass required according to the rule given, and order the total amount for near vision, first confirming the result with 1 J or 2 J type. If there was originally myopia, its amount in dioptries would have to be deducted from the convex glass in ordering.

Example.—A man aged fifty reads $\frac{6}{12}$ with either eye, and +1 D brings the vision up to $\frac{6}{8}$, +1.5 D not giving so good a result ; without glasses he reads 6 J up to 12" (p. r.) with difficulty. His presbyopia should be +2 D ; to this +1 D (manifest hypermetropia) is added, and it is found that with +3 D he reads 1 J from 8" to 16" ; these are ordered. If +2 D or +4 D of hypermetropia had been found, it might be worth while to order two pairs, one of this strength for ordinary use in distant vision, another with the presbyopic correction added for use in reading, etc. In such a case the upper half of the spectacle lens may be cut to correct the amount of hypermetropia, the lower both the hypermetropia and presbyopia. This form was invented by Benjamin Franklin, and it is called after him. It is unsuited for poor patients on account of the expense.

It should be noted that the presbyopic table is calculated for ordering spectacles to bring the patient's near point in reading up to 9" from the eye. The range of his vision will depend on his age and the amount of accommodative power still possessed.

A fair number of presbyopic patients do not require the glasses for reading or writing so near as 8"—12", but, as in the case of carpenters, musicians, etc., wish to see clearly at a distance of some 18"—24", or even rather further. In these cases the spectacles should be weaker than the table would indicate, and the patient's own choice should be the chief guide.

To recapitulate ; 1. In hypermetropia without strabismus in

young subjects the full correction may be ordered for near vision unless it be of high or moderately high degree (+ 5 D to + 12 D) ; in the latter case a certain amount must be deducted, varying with the patient's accommodative power. It is not necessary to use the glasses for distant vision.

2. In hypermetropia with strabismus convergens, order the full correction (deducting about + 1 D from the result given by keratotomy). The glasses are to be worn constantly.

3. In myopia the glass that gives the best results in distant vision may be ordered, but not for constant use, unless it is - 4 D, or under that amount. If higher than that, deduct - 2 D to - 4 D in ordering for near vision, and no glasses need be worn for this unless the patient is in the habit of bringing the head nearer to the print than 9" or 10" without them. Always aim at under-correcting myopia rather than over-correcting it.

4. In presbyopia order glasses for near vision according to the presbyopic table, making allowance for the patient's special requirements as to working distance, and add or deduct according as he is hypermetropic or myopic.

5. Astigmatism is nearly always complained of before the presbyopic age, and the best correcting-glass is ordered for near and distant vision, except in high compound myopic astigmatism.

XIII.—DEFINITIONS AND EXPLANATORY NOTES.

Blepharo-spasm—spasmodic closure of the lids from contraction of the orbicularis palpebrarum—is met with in some cases of ulcer of the cornea, foreign body either on the cornea or conjunctiva, and is not uncommon in a milder degree with albinos, or in the subjects of myopia or myopic astigmatism.

Buphthalmos (ox-eye) is a peculiar disease, most allied perhaps to glaucoma, which comes on in very early life, affects both eyes, and causes a very great defect of sight. The eye is enlarged in all its diameters, the anterior chamber very deep, the cornea generally hazy, the tension slightly increased. Iridectomy is of little or no avail, but eserine is worth a trial.

Chemosis.—Inflammatory swelling of the conjunctiva, which tends to protrude between the lids and to overlap the cornea. It may consist chiefly of oedema, or may be much firmer and more solid, in which case there is risk of the cornea perishing from obstruction to its nutrition through the obstruction of the bloodvessels. Mild examples are seen with ectropion, occasionally with complete facial paralysis, severe ones in gonorrhœal ophthalmia. Its treatment should be directed to the cause ; if very severe, the chemosed parts may be incised with scissors in several parts.

Cocaine.—To procure anæsthesia of the cornea and conjunctiva, drop in a freshly-prepared solution of the pure salt (2 per cent. in boracic solution or distilled water) two or three times, at intervals of three or four minutes. Slight smarting is felt at first, the amount varying apparently with different individuals. This method is suitable before cataract extraction, iridectomy, etc. Cocaine does not render the iris insensitive, but produces some dilatation of the pupil and loss of accommodation, with slight widening of the palpebral fissure, and contraction of the superficial bloodvessels, due to its stimulating the sympathetic (Jessop). One great use of cocaine is in the removal of foreign bodies from the cornea.

Coloboma of Iris.—An aperture or deficiency in one part of the iris, which may be the result of an iridectomy, or may be congenital. If the latter, it is usually, but not always, symmetrical, and is situated at the lower part of the iris (this being the last part of the iritic circle to close in its development). It may only involve the pupillary margin, and always becomes narrower towards the ciliary margin. Sometimes there is a corresponding coloboma of the choroid, seen by the ophthalmoscope, as a white patch of exposed sclerotic ; but this is much rarer than the cases of congenital cleft in the iris.

Dioptre.—*Dioptric System.*—The unit of measurement in this system is a lens with focal length of 1 metre = 40 inches. Two dioptries = a lens of 20" focal length ; three dioptries = 13" ; four dioptries = 10", and so on. To convert a measurement in dioptries to one in inches simply divide the numeral given into

40. A diopetre is expressed by the capital D with the + or - sign before it, according as the lens is convex or concave. To be consistent with the dioptric system, the distant vision should be reckoned in metres ; thus, $\frac{6}{36}$ implies that the patient only reads at 6 metres' distance the letters a normal eye would read at 36 metres, and so on. Six metres is just about 20 feet, and $\frac{20}{180}$ is very nearly the same as $\frac{6}{36}$ in stating the vision. The old feet measurements, from $\frac{20}{20}$ (perfect vision) up to $\frac{20}{400}$, are still much used, and there is little difficulty in converting terms of the one system into those of the other.

Epicanthus.—A congenital redundancy of skin over the upper part of the nose, which projects on either side in a fold which more or less conceals the inner angles of the palpebral fissure. If very pronounced, a medial piece of the skin may be excised, and the wound sutured, but as a rule no treatment is required.

Field of Vision.—The farther away from the macula that an image is formed on the retina, the less distinct does it become to the patient ; and thus, when looking fixedly forward with one eye (the other being covered), an object moving horizontally or vertically is only distinguished up to a certain distance from the fixation-point. To register accurately the field, a *perimeter* must be used, small squares of white and coloured paper being employed in it. The normal field for white (squares about one centimetre in size being used) is oval in shape, and extends about 65° upwards, inwards, and downwards, about 100° outwards from the fixation-point. The fields for blue, yellow, red, and green are progressively smaller in the order named. It may be noted that the two smallest fields, red and green, are the ones which show most defect in tobacco-amaurosis, and several other retinal and optic-nerve diseases.

Without a perimeter the field may be roughly estimated by making the patient stand with his back to the light, cover one eye, and fix the surgeon's nose with his other one, whilst a mounted square of paper is moved away from the fixation-point in all directions, the patient giving the word when it goes out of sight. In this experiment the surgeon faces the patient at a

distance of about eighteen inches, and makes the patient continue to look at the fixation-point.

Narrowing of the field is observed in cases of glaucoma, retinitis pigmentosa, atrophy of the optic nerve, and some other forms of retinal and choroidal disease.¹

Hypopyon.—The presence of pus, or puro-lymph, in the anterior chamber. A yellowish-white crescent at the lower part of the chamber is seen; it may be the result of iritis (rarely), or of ulceration of the cornea (especially the serpiginous form), or of penetrating wound (see Fig. 2).

Treatment.—Hot boracic or belladonna fomentations. If these fail, let out the pus by means of a needle introduced just in front of the sclero-corneal margin.

Nebula of the Cornea.—The white opacity of the cornea left by previous ulceration, or by interstitial keratitis. Like other scars, it is very slow to disappear, and often a very faint nebula accounts for some considerable defect of vision, especially in the distance. A stimulating ointment (yellow oxide of mercury, four to eight grains in the ounce) seems to hasten the absorption of recent opacities, though little or no improvement can be looked for in the case of old ones.

If an old nebula or leucoma be very conspicuous, the operation of tattooing is sometimes performed. A needle charged with liquid Indian ink is thrust into the leucoma at a number of points, and thus the scar rendered black, and less easily detected.

Proptosis.—Protrusion of the entire globe. It is one of the symptoms of exophthalmic goitre, and is also met with in cases of 'pulsating orbital tumour,' or orbital sarcoma.

Ptosis.—Drooping of the upper lid; may be congenital, or may be due to paralysis of the levator palpebræ. Is a frequent symptom of locomotor ataxia, in which case one or other of the oculo-motor muscles is often paralysed at the same time. This form is nearly always temporary, the paralysis clearing off or much improving, especially under treatment with iodide of potassium. In old people ptosis sometimes comes on with marked laxity of the lid; it is, as a rule, of only slight degree.

In these cases, and for congenital ptosis, an operation (excision of an oval fold of skin from the upper lid) may be required.

Pterygium or Pterygion.—A small triangular growth of conjunctiva invading the surface of the cornea, and generally following slight ulceration. It is a rare condition, and may be treated by dissecting off the corneal part, and then turning in and fixing with a suture its apex.

Staphyloma.—A bulging of some part of the cornea, or sclerotic. If of the latter at the posterior pole of the eye



FIG. 30.—Anterior staphyloma with synechia.

(around and to the outer side of the optic disc), it is called posterior staphyloma, and is met with in high myopia. It is recognised with the ophthalmoscope by the whitish crescent seen at the margin of the disc. If of the cornea, or at the ciliary region, it is called anterior staphyloma, and may be the result of inflammatory changes (cyclitis, ulceration, purulent ophthalmia), or of severe wounds or operations.

Synechia.—Adhesion of the iris to the cornea (anterior synechia), or to the lens (posterior synechia).

Tension of the eye.—Is made out by the surgeon standing in

front of the patient, who looks down, by pressing gently with the two forefingers through the closed lid. Pressure should be made directly downwards, and the two eyes carefully compared. If the sclerotic cannot be indented by moderate pressure, the tension is said to be + 3 ; if the eye is harder than normal but can still be indented, the signs + 1 and + 2 are used ; T - 1 ; - 2 or - 3 meaning different degrees of lowered tension. The latter is met with in eyes lost from old inflammatory changes, in extreme myopia, after wound or rupture of the cornea or sclerotic, etc. Increased tension occurs in acute and chronic glaucoma, in some cases of iritis, and of intra-ocular tumours. Slight variations in eyeball tension may occur rapidly, and sometimes a glaucomatous eye becomes of normal tension with the lapse of time, although its condition has not improved at all as regards vision.

XIV.—EXAMINATION QUESTIONS.

The student is advised to test his knowledge by means of the following questions, a good plan being to answer them very briefly on paper, and then revise the answers with the book :

1. What is meant by Granular Ophthalmia ? What are its usual complications, and how should they be treated ?
2. Define or explain the terms Entropion, Hypermetropia, Blepharitis, Nystagmus, Synechia, Staphyloma.
3. Describe the symptoms of a case of acute Iritis. What are its usual causes, and how would you treat the case ?
4. Describe the normal course of the tears from the Lacrymal Gland to the Nose. How would you treat a case of Lacrymal Obstruction with Abscess ?
5. Give the treatment in detail of a case of Convergent Strabismus in a child.
6. How would you test for and estimate the degree of Hypermetropia ?
7. Name the chief varieties of Cataract, and describe the operation for extraction of a senile one.
8. How would you decide when a case of Senile Cataract is

ready for operation ? Mention the chief risks of the latter, and explain the term Secondary Cataract.

9. Ophthalmia Neonatorum ; mention its complications, and describe its treatment, in full.

10. How would you distinguish between Syphilitic and Rheumatic Iritis ? How does the treatment differ in the two cases ?

11. What are the chief causes of Optic Neuritis, and how do you recognise its presence ?

12. What is meant by Epiphora, and to what may it be due ?

13. What are the ocular symptoms met with in Locomotor Ataxia ?

14. Describe the symptoms, progress, and treatment of Interstitial Keratitis. What other eye-lesions may be due to Inherited Syphilis ?

15. What is meant by Diplopia ? What ocular symptoms are present in a case of complete paralysis of (a) one third nerve ; (b) one sixth nerve ; (c) the cervical sympathetic on one side ?

16. How would you treat a case of punctured wound in the ciliary region ? Describe the symptoms of Sympathetic Ophthalmia.

17. Describe the symptoms, treatment, and results of a case of Corneal Ulcer in a strumous child. What is meant by Pannus, and how would you treat it ?

18. Give the chief symptoms and treatment of Acute Glaucoma, and contrast them with those of Chronic Glaucoma.

19. What are the chief Intra-ocular Tumours ? Describe the chief features of Rodent Ulcer affecting the eyelids, and of Molluscum Contagiosum.

20. To what may Hæmorrhages into the Retina be due ? Mention the chief features of Retinal Detachment.

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Xanthelasma, 20





